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D4.2 Core Curricula

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Project information

The Artificial Intelligence Skills Alliance (ARISA) fast-tracks the upskilling and reskilling of employees, job seekers, business leaders, and policymakers into AI-related professions to open Europe to new business opportunities. It is a four-year transnational project funded under the EU's Erasmus+ programme. For more information, contact info@aiskills.eu | aiskills.eu

Project Partners

List of Piloting Partners

ADECCO	ADECCO FORMAZIONE SRL
UNIPISA	The University of Pisa
UNIR	UNIR – La Universidad en Internet- Universidad Internacional de La Rioja
BCS	BCS Koolitus
UL	University of Ljubljana
BME	BME University: Budapest University of Technology and Economics
WSCS	Warsaw School of Computer Science
HU	HU University of Applied Sciences Utrecht
GK	Global Knowledge

List of abbreviations and acronyms

AI	Artificial Intelligence
ARISA	Artificial Intelligence Skills Alliance
D	Deliverable
EC	European Commission
EQF	European Qualification Framework
ESCO	European Skills, Competences, and Occupations
EU	European Union
LO	Learning Outcome
LU	Learning Unit
LUM	Learning Unit Matrix
PLO	Programme Learning Outcome
T	Task
ULO	Unit Learning Outcome

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1. Executive Summary

1.1. Introduction

The present report (D4.2) explains how the project moved from the Programme Learning Outcomes (PLOs) and Unit Learning Outcomes (ULOs) to the definition of the Educational Profiles and the development of the Specific Curricula. The methodology described in Section 2 outlines the processes for defining educational profiles, which translate market needs into educational terms, and developing curricula structures. The results, presented in Section 3, include detailed educational profiles and their associated Specific Curricula.

1.2. Objectives

The objective of the deliverable D4.2 presented in this report is to develop curricula to enable skilling, reskilling, and upskilling for AI related roles. A singular methodological approach was implemented, since it was broad enough to be adapted to the diverse roles the project addresses, namely AI professionals and AI managers.

The difference between these two categories of roles is that AI professionals require technical skills, for example, in the fields of data science, machine learning, and data engineering, as well as soft skills and knowledge of ethics and security to design and implement AI solutions (AlAfnan et al., 2024). AI managers need basic AI knowledge in areas like ethics, law, and AI fundamentals to make informed decisions and rely on AI advisors for deeper expertise (Giraud et al., 2023).

1.3. Methodological approach

To achieve the results of this report, we adopted a qualitative approach, supported by the development of tools tailored for this process. Specifically, we placed great importance on collaboration with partners by integrating their knowledge and contributions through the organization and management of recurring meetings, both group and one-to-one, as well as through sharing documents with them for feedback.

The methodology for defining the Curricula is structured into two primary processes: the "Definition of Educational Profiles," which involves developing templates, determining the number and titles of profiles, and defining each profile based on specific AI roles and EQF levels, and the "Definition of Curricula Structure," which aims to identify the structure for each profile through the development of guidelines, completion of a Learning Unit Matrix, and the design of both core and specific curricula, guided by continuous interaction with piloting partners.

Initially, educational profiles are established through the creation of a structured template, determination of the number and titles of profiles, and definition of these profiles by aligning Learning Outcomes (LOs) with appropriate assessments for the various AI roles. Subsequently, the curricula structure is developed by creating comprehensive guidelines and templates, completing the Learning Unit Matrix (LUM) to map LOs to Learning Units (LUs), and then designing the curricula, ensuring a coherent and adaptable framework for educational development.

1.4. Results

The main results of this Deliverable are the Curricula, which include both core and specific sections tailored for each developed educational profile. Each curriculum is linked to a detailed educational profile that outlines the

Program Learning Outcomes (PLOs), Unit Learning Outcomes (ULOs), and corresponding assessment methods. The intermediate results of the process are these educational profiles, which provide the foundational structure upon which the specific curricula are built.

Task 4.2 delivered firstly a set of Educational Profiles for selected AI roles, which have been chosen by the pilot partners. The educational profiles have been designed considering the PLOs and the ULOs defined in Collection of Learning Outcomes (D4.1). Task 4.2 ultimately produces the set of Specific Curricula as its main outcome, informed by the Educational Profile previously identified and the contribution of piloting partners.

The intermediate outcomes are eight Educational Profiles for the AI Professionals Roles. For AI Managers roles, a table was created to clarify the relationship between AI Managers roles and their PLOs, as these roles focus on reskilling and upskilling rather than complete educational profiles.

Following this, the main outcome is represented by 15 Curricula based on the Educational Profiles: ten for AI Professionals and five for AI Managers, containing information about the curricula goals, scope, learning outcomes, learning units, delivery methods, and materials.

1.5. Conclusions

In this deliverable a set of Curricula for AI roles has been developed, that will then be used to develop training courses in various types of organizations.

The curricula developed are aligned with the piloting partners' choices: each partner selected their educational profile of interest from among AI Professionals and AI Managers, indicating the desired EQF level for that profile. Requesting partners to specify their choices was essential to meet the diverse needs of their respective European organizations. The curricula are designed at a high level to ensure usability by educators external to the project.

1.6. Use of this document

The main use of this document is to provide insights for the further progress of the Development of training programmes. It can further be used by government, industry, and education and training representatives to get insights into the key factors and enablers of effective skilling and reskilling programs, and to understand how to promote and build trust in AI. It also offers valuable insights into how to become or keep up to date with AI developments.

2. Introduction

This document presents an in-depth analysis of the development of the Core Curricula under Task 4.2 of the ARISA project, which aimed to translate Programme Learning Outcomes (PLOs) and Unit Learning Outcomes (ULOs) into structured educational profiles and specific curricula tailored to the AI-related roles identified in the Needs Analysis Report (D2.2).

The main goals of Task 4.2 were:

- To define and describe the educational profiles needed for AI roles.
- To develop both Core and Specific Curricula aligned with these educational profiles.

Educational profile are structured frameworks that translate market needs into educational terms. These profiles include general descriptions, defined learning outcomes, and corresponding assessments, providing a solid foundation for curriculum development. Indeed, the definition of educational profiles ensures comparability of curricula designed based on these profiles (ESSA, 2023).

The objective of this document is to detail the methodology, analysis, and outcomes of defining educational profiles and developing curricula, providing a comprehensive understanding of their implementation and impact.

Based on the PLOs and ULOs produced in Collection of Learning Outcomes (D4.1), the consortium designed educational profiles and curricula. According to CEDEFOP, 2014, a curriculum is defined as a systematic arrangement of educational content, structured to achieve specific learning outcomes. In this document, the Core Curricula refer to the foundational elements that characterize the overall curriculum framework, derived from the Learning Unit Matrix (LUM). In contrast, the Specific Curricula provide detailed, role-specific information, tailored to meet the distinct needs of various AI-related roles. This process ensures that the curricula are directly relevant to the competencies and skills required in the professional AI landscape, with the educational profiles serving as a guiding framework to ensure each curriculum is purposeful and targeted towards achieving specific learning outcomes.

Following this introduction, the document is organized into several key sections. The first section outlines the methodology used for defining educational profiles and developing curricula. The second section presents an analysis of the implementation phase. The third section delves into the results, highlighting the detailed educational profiles and their associated Specific Curricula. Finally, the concluding section offers a summary of findings, lessons learned, and recommendations for future iterations of educational profiles and curricula within the ARISA project.

3. Methodology

There are two processes used to define the curricula.

In this section both processes are presented: the first, “Definition of educational profiles”, describes the approach used to define the educational profiles. The second, “Definition of curricula structure”, shows the method implemented to develop the Specific Curricula for each educational profile previously identified.

For these tasks, we opted for a qualitative approach for several strategic reasons. Firstly, the partnership possesses strong expertise in the defined profiles and skills targeted for this project. This made It possible to rely less on external sources, streamlining our process and ensuring a more focused analysis. Additionally, employing a qualitative method facilitates continuity between previous and subsequent project phases, aligning closely with the approaches used in T4.1, as described in Collection of Learning Outcomes (D4.1). This approach synergizes well with best practices and lessons learned from past Skills Blueprint Projects, enhancing our ability to adapt proven strategies and refine our methodologies effectively.

3.1. Definition of educational profiles

The definition of educational profiles is structured in a series of sub-activities articulated as follows:

1. Development of the educational profile template (Section 2.1.1.)
2. Definition of number and titles of the educational profiles (Section 2.1.2)
3. Definition of the educational profiles (Section 2.1.3.)

During these sub-activities, we relied on the PLOs and ULOs from Collection of Learning Outcomes (D4.1), along with the piloting partners’ preferences for the educational profiles they intended to pilot. Specifically, partners selected the educational profiles they wanted to design and pilot, which were then developed. Each educational profile was characterized by a specific AI Role and EQF level. Development was guided by a table from Collection of Learning Outcomes (D4.1), which indicated the relevant EQF level(s) for each skill corresponding to the AI roles. Based on the chosen AI Role and EQF level for each educational profile, we incorporated only the PLOs and ULOs that matched or were below the specified EQF level for that AI role.

3.1.1. Development of the educational profile template

The aim of this sub-task was to create the structure for the educational profiles, which includes predefined tables with fillable spaces, as well as preset titles and bullet points. These predefined tables are designed to host the details of the educational profiles: the first table shows the Program Learning Outcome (PLO) and its related Unit Learning Outcomes (ULOs), while the second table details the assessment method for each ULO. Additionally, in the introductory section, the definition of the corresponding AI Role from ESCO and the definition of the AI role at that specific EQF level are provided (European Commission – Education and Culture, 2008).

This form was designed to be adaptable to the specific AI Roles at the specific EQF levels on which the curricula would be based. This was essential to establish a standardized definition of the educational profiles, which would serve as the foundation for partners in the subsequent curricula development.

3.1.2. Definition of number and titles of the educational profiles

The aim of this sub task was to define the number and the titles (i.e. name of the educational profile) of the educational profiles. The definition of the number was based on the preferences of the partners for the educational profiles.

The definition of the title reflected the AI Role for which that educational profile was developed, for this reason, it was set up to match the title of the AI Role specifying its EQF level. According to this logic, the piloting partners chose the role profile they would develop and pilot at a given EQF level. To achieve this, a matrix was provided to the partners, (Section 3.2: "EQF-Level and AI Role Selection Matrix") with the EQF levels as rows and the AI Roles as columns. Each partner could indicate their choice by entering the name of their organization at the intersection of the desired row and column. The task leaders covered eventual profiles which were not selected by the partners to assure the proper coverage of the final output in terms of profiles and EQF levels.

Based on the matrix, task leaders defined the educational profiles selected, following the process showed in the next section.

3.1.3. Definition of the educational profiles

The aim of this sub task was to define the educational profiles. Each of them was defined considering all the LOs at its specific EQF level and specifying an appropriate assessment method for each LO. Following John Biggs' constructive alignment logic (Biggs, 1996), the assessment methods were carefully aligned with the respective LOs to ensure that teaching activities and assessments accurately reflected and supported the desired learning outcomes. This process was carried out for both the AI professionals' roles (i.e. Data Analyst, Data Scientist, Machine Learning Engineer, NLP Engineer, Computer Vision Engineer), and the AI Managers roles. Each educational profile is structured in two sections. The first one provides a general description of the role both in general and instantiated in the specific EQF level. The second one encompasses tables describing the PLOs and ULOs, each one followed by a table containing the related assessing methods.

3.2. Definition of curricula structure

The goal of this second process is to identify the curricula structure for each educational profile.

The sub-activities to reach this goal are:

1. Development of guidelines and templates (Section 2.2.1.)
2. Completion of the Learning Unit Matrix (Section 2.2.2.)
3. Design of the Core curricula (Section 2.2.3.)
4. Development of the specific curricula (Section 2.2.4.)

During these sub-activities, we relied on the Educational Profiles and on the results of the continuous interaction with the piloting partners. The task leader assisted the partners in the production of the Learning Unit Matrix (LUM), which represents one of the main steps towards designing the core curricula. After providing the partners with all the necessary tools, that is, the templates described and included in Section 2.2.1, a further phase of support was carried out for the actual design of the Specific Curricula themselves.

3.2.1. Development of guidelines and templates

The aim of this sub task was to create the structure for partners to design the curricula. Doing this was important to ensure the coherence of the output of the subsequent subtasks. In particular, the LUM template and the Curricula template were created, accompanied by all the necessary guidelines for their completion.

The LUM, of which an extract is shown in Annex 2, serves as a crucial tool for visualizing the relationship between learning outcomes and learning units (LUs). A LU is a modular part of a curriculum, designed to be independent and self-contained, offering coherent content aligned with clear learning outcomes and concluding with a form of assessment. LUs can vary in size and are tailored to fit the specific context, target group, and delivery method. Given the many-to-many relationship between LOs and LUs, the LUM provides a detailed overview that clearly shows how each LO is covered by various LUs and vice versa. By mapping LOs to specific LUs, the LUM helps create a transparent and well-organized curriculum. This clarity allows to understand the expected goals and the pathways to achieving them.

Each LUM is specifically drafted for a particular educational profile. The template has been constructed as follows:

- Each row of the matrix refers to a ULO grouped within its own PLO;
- Each column refers to a specific Learning Unit (LU), which will be inserted into the template by the piloting partners.

For each ULO, the 'Entry Requirement' column is also defined, filled with 'yes' or 'no' depending on whether entry requirements are necessary for that ULO.

Here is an example of an extract from a LUM template that was shared with piloting partners:

Machine Learning Engineer (EQF 7)				Learning unit	*[Please provide the Title of the Learning Unit. Add a column for each Learning Unit under the Learning Section.]*	.....	*[Write a Learning Unit. Add a column for each Learning Unit under the section.]*	...	
ULO ID	**PLOs**	**ULOs**	**Entry Requirements**						
1.1	1 - Deep Learning (EQF 7)	Critically evaluates the theoretical underpinnings of deep learning			*[Tick the box with an X if the Learning Unit covers the ULO]*	...			
1.2		Designs innovative deep learning models			...	...			
1.3		Develops advanced deep learning models using current frameworks and tools							
1.4		Analyses complex datasets using deep learning models							
1.5		Reflects on the ethical, legal, and social implications of deploying deep learning models							
1.6		Collaborates effectively in interdisciplinary teams to design, develop, and deploy deep learning solutions							
1.7		Communicates complex deep learning concepts, methodologies, and outcomes							
1.8		Applies innovative problem-solving skills							
1.9		Manages the lifecycle of deep learning projects							
2.1	2 - AI Technologies (EQF 7)	Assesses the capabilities and limitations of different AI technologies							
2.2		Integrates AI technologies to create comprehensive systems that improve decision-making							
2.3		Implements AI solutions using best practices in software engineering and data management							
2.4		Critiques the impact of AI technologies on society							
2.5		Fosters multidisciplinary collaboration in developing AI technologies							
2.6		Innovates with AI technologies to solve novel or unstructured problems							
2.7		Leads strategic planning and execution of AI projects							

Figure 1: Overview of the Learning Unit Matrix (LUM) template

The Curricula Template, shown in Annex 3, is also specific to each educational profile and is structured as follows:

- The first chapter provides general information, such as the name, the EQF level, the goals, the scope, the list of entry requirements for which 'yes' was indicated in the LUM, and the PLOs of that specific educational profile;
- The second chapter describes the curriculum structure, focusing on the relationships and connections between the learning units;
- Finally, the third and fourth chapters describe the learning units in detail.

The purpose of this curriculum template is to provide a clear overview of the final output of T4.3 and to give clear indications on who will complete which part (task leader or partners) and in which order, in fact, in it we find two sections:

- Sections in Yellow: they have been completed by the task leader to design the Core Curriculum (Section 2.2.3.)
- Sections in Green: they have been filled in by Piloting Partners to develop Specific Curricula (Section 2.2.4.).

3.2.2. Completion of the Learning Unit Matrix

The aim of this sub task was to complete the LUM, combining each LU with the PLOs and ULOs it covers.

The task leader supported the piloting partners in the development of the LUM for the educational profile chosen in the previous sub task (Section 2.1.2.). The LUM is a necessary input for the Core Curriculum Design (done by the task leader) and the Specific Curricula Development (done by the piloting partners).

This process was carried out for both the AI professionals' roles (i.e., Data Analyst, Data Scientist, Machine Learning Engineer, NLP Engineer, and Computer Vision Engineer), and the AI Managers roles. The partners were assisted through one-to-on meeting in completing the LUMs. They were tasked to:

- Define the learning units, which filled the various columns;
- Place an 'X' on the matrix at the intersections between the defined LU and the ULOs covered by that LU;
- Define whether they deemed it necessary for that ULO to have an 'Entry requirement'.

In this way, the LUMs were completed and made available as input for the curriculum design.

3.2.3. Design of the Core curricula

The aim of this sub task was to support piloting partners in the development of the curricula.

In particular, in accordance with what is described in Section 2.2.1, the curriculum template has been completed for the Yellow Sections taking information from the LUM completed by the partners and inserting them into the designated sections within the template.

The main information provided is as follows: the name of the Curriculum, the EQF level, the associated PLOs, and an overview of the learning units, indicating the respective EQF level for each. Subsequently, each learning unit has been further detailed by defining the PLOs and ULOs associated with it, as indicated in the LUM.

3.2.4. Development of the specific curricula

The aim of this sub task was to finally develop the specific curricula, based on the Core Curricula previously drafted by UNIPISA (Section 2.2.3.). In accordance with what is described in Section 2.2.1, in this task the curriculum template has been completed for the Green Sections by Piloting Partners. Additional information is added to instantiate the draft curriculum defined in the LUMs.

In particular, the additional detailed information are as follows:

- The Goals of the curriculum, the Scope, the Target Group, and the Entry Requirements, if needed, in the paragraph “General information”

- A description of the structure with the objective to explain the whole rationale and structure of the curriculum, focusing on aspects such as modularity and the connection between learning units.
- In the "Overview of Learning Units" section, for each Learning Unit, the hours/ECTS (European Commission, 2015) and assessments are defined.
- In the detailed description of each Learning Unit, the following are included: a more detailed description of the learning unit itself, the best-fitting delivery method, and the training materials needed for the learning unit, which will be developed in Task 4.3.

4. Results

In this section we present the results output from task 4.3 of the ARISA Project, that are the educational profiles (Section 3.1) and the associated core curricula (Section 3.2).

4.1. Educational Profiles

Here we present the intermediate output of T4.2, created as described in Section 2.1. This output is represented by eight educational profiles related to AI Professionals Roles and by Basic information on AI Managers.

For the AI Managers, a table was created to clarify the relationship between their roles and the PLOs specific to these positions. Complete educational profiles were not developed, as the learning programs for these roles are focused solely on reskilling and upskilling, which involves building upon an existing base of skills.

For the AI professionals, the developed educational profiles are as follows: Data Analyst EQF 4/5, Data Analyst EQF 6, Data Scientist EQF 6, Data Scientist EQF 7, Machine Learning Engineer EQF 6, Machine Learning Engineer EQF 7, NLP engineer EQF 6 and NLP engineer EQF 7.

Each educational profile is structured as follows:

- Definition of the corresponding AI Role from ESCO
- Definition of the AI role at that specific EQF level
- Series of tables, with 2 tables for each PLO:
    - The first one shows the PLO and its related ULOs.
    - The second one shows the assessment method for each ULO.

The educational profiles for the AI Professionals and the basic information used in place of complete educational profiles for the AI Managers roles can be found in Annex 1.

4.2. Core Curricula

Here we present the final output of T4.2, created as described in Section 2.2. This output is represented by 10 curricula related to AI Professionals roles and 5 curricula related to AI Managers roles.

The specific AI Professionals roles and AI Managers roles selected at a specific EQF level are those chosen by the partners through the "EQF-Level and AI Role Selection Matrix" provided below.

EQF-Level and AI Role Selection Matrix		Educational Profiles							
		Data Analyst	Data Scientist	Machine learning engineer	NLP engineer	Computer vision engineer	Policy makers	Decision makers	AI advisor/ consultant
EQF levels	EQF 4/5	X							
	EQF 6	X X	X	X	X		X	X	X
	EQF 7		X	X X	X			X	X
	EQF 8								

Table 1: EQF-Level and AI Role Selection Matrix

In table 2 we present an overview of the curricula developed for the AI professionals. This table Indicates with an "X" when the PLO of the corresponding row Is covered by the curriculum at the AI role and EQF level of the corresponding column.

	Data Analyst		Data Scientist		Machine learning engineer		NLP engineer	
PLOs	**EQF 4/5**	**EQF 6**	**EQF 6**	**EQF 7**	**EQF 6**	**EQF 7**	**EQF 6**	**EQF 7**
Deep Learning		X	X	X	X	X	X	X
AI Technologies	X	X	X	X	X	X	X	X
MLOps		X		X	X	X		X
HPC and Cloud services						X		X
Machine Learning	X	X	X	X	X	X	X	X
Explainable AI	X	X	X	X	X	X		X
Big Data & Data Analytics	X	X	X	X		X		
Human-Centred AI		X	X	X		X	X	X
AI Ethics	X	X	X	X	X	X	X	X
AI Futures and Innovation		X		X			X	X
Business Intelligence	X	X	X	X				
AI Awareness	X	X	X	X	X	X	X	X
AI for Robotics								
Cyber and Data Security		X	X	X	X	X	X	
NLP							X	X
Generative AI		X	X	X	X	X	X	X
Change Management			X	X		X	X	X
Soft Skills	X	X	X	X	X	X	X	X

Table 2: Overview of AI Professionals curricula

The Core Curricula Developed for AI Manager are as follows:

- Policy makers at EQF 6
- Decision-makers at EQF 6 and at EQF 7
- AI advisor/ consultant at EQF 6 and at EQF 7

In table 3 we present an overview of the curricula developed for the AI Managers. Like table 2, this table Indicates with an "X" when the PLO of the corresponding row Is covered by the curriculum at the AI role and EQF level of the corresponding column.

	Policy makers/ Decision makers	Decisionmakers		AI advisor/ consultant	
PLOs	**EQF 6**	**EQF 6/7**	**EQF 7**	**EQF 6**	**EQF 6/7**
AI fundamentals	X	X			X
AI and policy					
Organisational decision-making on AI		X	X		
AI Strategy					X
AI implementation					X
AI Ethics advanced					X
Impact of AI					X

Table 3: Overview of AI Managers curricula

The Core Curricula for the AI Professionals and for the AI Managers can be found in Annex 4.

5. Conclusions

This report details the development and structuring of core curricula for AI-related roles within the ARISA project, providing a practical guide for AI education and training. The methodologies and outcomes presented serve as a resource for stakeholders in government, industry, and education, offering strategies to address skill gaps and effectively train a workforce proficient in AI technologies.

By defining educational profiles that translate market needs into educational terms, the report aligns with the European Qualification Framework (EQF), ensuring that learning outcomes are clearly connected to appropriate assessment methods. This alignment supports the creation of flexible, adaptable curricula that can be applied across different educational contexts. The educational profiles provide a standardized framework for both core and specific curricula, facilitating transparency and comparability between institutions and enabling the mobility of students and learners across educational and national boundaries. This ensures that the curricula not only meet current industry standards but are also adaptable to evolving educational and professional requirements. The curricula developed for various AI roles, including Data Analyst, Data Scientist, Machine Learning Engineer, and NLP Engineer, as well as roles for AI managers, are tailored to equip learners with the necessary competencies for these positions.

The outcomes of this project contribute to the broader European AI Skills Strategy by providing a clear framework for skilling, reskilling, and upskilling in the AI domain. This supports the development of a workforce capable of responsibly and innovatively advancing AI technologies. Additionally, the report enhances the dialogue on trust, ethics, and inclusivity in AI by promoting an educational approach that emphasizes these values, helping to cultivate an ethically aware AI workforce.

In summary, this deliverable provides a comprehensive foundation for the design and implementation of AI curricula that are relevant, dynamic, and aligned with both market needs and European educational standards. It serves as a practical tool for educators and policymakers to develop AI training programs that are both effective and adaptable, ensuring that learners are well-prepared for the demands of AI professions.

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Annex 1: Educational Profiles

EDUCATIONAL PROFILE

Data Analyst

EQF 4/5

This educational profile belongs to the field of Software Engineering and is covered by relevant references in ESCO

Data Analyst EQF 4/5

Role Description:

"Data analysts import, inspect, clean, transform, validate, model, or interpret collections of data with regard to the business goals of the company. They ensure that the data sources and repositories provide consistent and reliable data. Data analysts use different algorithms and IT tools as demanded by the situation and the current data. They might prepare reports in the form of visualisations such as graphs, charts, and dashboards."

(Source: https://esco.ec.europa.eu/en/classification/occupation?uri=http://data.europa.eu/esco/occupation/d3edb8f8-3a06-47a0-8fb9-9b212c006aa2*)*

Role Description at specific EQF 4/5:

Data analysts at EQF 5 apply specialized knowledge and practical skills in AI technologies and big data analytics to import, inspect, clean, and transform data aligning with business goals. They develop creative solutions to ensure data consistency and reliability, creating visual reports like graphs and dashboards. Responsible for managing data projects, they also focus on continuous personal and team development within dynamic environments.

Programme Learning Outcomes (PLO)

1. PLO AI Technologies - EQF 5
The learner has demonstrated the ability to integrate and innovate using various AI technologies to address real-world challenges, managing multidisciplinary teams in contexts that require adaptability and continuous learning.
Unit learning outcomes
1. Applies a range of AI technologies such as machine learning, natural language processing, and computer vision, understanding their specific applications and limitations in the field of AI. 2. Designs and optimizes AI models to solve specific problems, demonstrating a comprehensive understanding of the underlying algorithms and data requirements. 3. Leads projects and teams in the development and deployment of AI solutions, fostering an environment of innovation and ethical responsibility. 4. Evaluates the effectiveness and impact of AI technologies in various sectors such as healthcare, finance, and transportation, using advanced analytical skills. 5. Synthesizes knowledge from different AI subfields to develop integrated solutions that are robust, scalable, and sustainable in changing environments. 6. Communicates technical and non-technical aspects of AI technologies effectively to a variety of stakeholders, ensuring clarity and inclusivity in decision-making processes. 7. Assesses and addresses ethical, legal, and social implications of AI technologies, promoting responsible and sustainable use.

1. Assessment

Unit learning outcome	Assessment method
1.1	Exam
1.2	Practical assignment
1.3	360° assessment[1]
1.4	Report
1.5	Report
1.6	360° assessment
1.7	360° assessment

[1] A 360-degree assessment in education is a holistic feedback system that integrates self-assessment, peer assessment, and teacher assessment to enhance student learning. (Tee & Ahmed, 2014)

2. PLO Machine Learning - EQF 5
The learner has demonstrated the ability to effectively design, implement, and refine machine learning algorithms, managing complex projects within interdisciplinary teams in dynamic and diverse settings.
Unit learning outcomes
1. Applies comprehensive and specialized knowledge in machine learning techniques such as supervised, unsupervised, and reinforcement learning, identifying the appropriate methods for specific real-world applications. 2. Designs and evaluates machine learning models to optimize performance, utilizing a deep understanding of mathematical and statistical foundations to address abstract problems creatively. 3. Manages and leads machine learning projects, ensuring effective team collaboration, project alignment with strategic objectives, and adaptation to unforeseen changes in technology or project scope. 4. Implements advanced data pre-processing, feature engineering, and algorithm tuning techniques to enhance model accuracy and efficiency in various operational contexts. 5. Assesses the ethical implications of machine learning projects, developing guidelines and practices that ensure fairness, transparency, and accountability in algorithmic decision-making. 6. Communicates complex machine learning concepts and results to stakeholders with varying levels of technical expertise, facilitating informed decision-making and fostering a culture of data-driven innovation. 7. Stays abreast of emerging trends and technologies in machine learning, continuously integrating new knowledge and techniques into professional practice to maintain technical proficiency and competitive advantage.

2. Assessment

Unit learning outcome	Assessment method
2.1	Exam
2.2	Practical assignment
2.3	360° assessment
2.4	Practical assignment
2.5	Report
2.6	360° assessment
2.7	360° assessment

3. PLO Explainable AI - EQF 5
The learner has demonstrated the ability to develop and implement AI systems that are not only effective but also transparent and understandable, ensuring that these systems are accessible and interpretable to diverse stakeholders in various sectors.
Unit learning outcomes
1. Understands and explains the theoretical foundations of explainable AI, including methods for model transparency and interpretability, to ensure stakeholders can comprehend AI decision-making processes. 2. Implements techniques for developing explainable AI models, such as LIME, SHAP, or decision trees, to enhance transparency in machine learning algorithms across different applications. 3. Assesses the impact of AI systems on stakeholders, particularly focusing on how explainability affects trust and reliance in sectors like healthcare, finance, and public services. 4. Evaluates the trade-offs between model complexity and interpretability, optimizing algorithms to balance performance with clarity and ease of understanding. 5. Develops guidelines and best practices for creating explainable AI solutions, promoting ethical standards and regulatory compliance in AI deployments. 6. Communicates effectively the principles and benefits of explainable AI to non-technical audiences, ensuring clarity and reducing barriers to acceptance and utilization of AI technologies. 7. Leads interdisciplinary teams in projects that integrate explainable AI, fostering an environment where ethical considerations are prioritized in the development and deployment of AI technologies.

3. Assessment

Unit learning outcome	Assessment method
3.1	Exam
3.2	Practical assignment
3.3	Exam
3.4	Practical assignment
3.5	Report
3.6	360° assessment
3.7	360° assessment

4. PLO Big Data & Data Analytics - EQF 5
The learner has demonstrated the ability to masterfully manage, analyse, and interpret large datasets using advanced data analytics techniques, driving decision-making processes and strategic initiatives in various industries.
Unit learning outcomes
1. Utilizes comprehensive, specialized knowledge of big data technologies and data analytics processes to extract, transform, and load large datasets efficiently. 2. Analyses complex data using statistical models and machine learning techniques to uncover trends, predict outcomes, and provide actionable insights. 3. Develops scalable data pipelines and architectures that ensure data integrity and accessibility, adapting to changing technological landscapes and business requirements. 4. Evaluates the effectiveness of data analytics strategies and tools in real-world applications, continuously seeking improvements and innovations in data handling and analysis. 5. Implements data governance and compliance measures, ensuring that data handling practices meet ethical standards and legal requirements. 6. Communicates findings from data analytics clearly to stakeholders across various levels of an organization, ensuring that insights are accessible and actionable for decision-making. 7. Leads and manages teams in data-driven projects, promoting a culture of data literacy and fostering collaboration and innovation across functional areas.

4. Assessment

Unit learning outcome	Assessment method
4.1	Exam
4.2	Exam
4.3	Practical assignment
4.4	Report
4.5	Practical assignment
4.6	360° assessment
4.7	360° assessment

5. PLO AI Ethics - EQF 5
The learner has demonstrated the ability to critically assess, develop, and implement AI technologies in accordance with ethical principles, ensuring that AI systems are developed and used responsibly across various sectors.
Unit learning outcomes
1. Analyses and understands the foundational ethical theories and principles that guide the responsible development and deployment of AI technologies, such as fairness, accountability, transparency, and privacy. 2. Evaluates AI systems for potential ethical issues and biases, applying ethical frameworks and tools to ensure these systems do not perpetuate inequality or harm. 3. Develops guidelines and best practices for ethical AI, leading the creation of policies and procedures that safeguard user rights and promote ethical standards within organizations. 4. Implements strategies for ethical auditing and compliance in AI projects, ensuring that all stages of AI development adhere to established ethical norms and regulations. 5. Communicates effectively the importance of ethics in AI to diverse audiences, including developers, policymakers, and end-users, fostering an organizational culture that prioritizes ethical considerations in technology. 6. Leads multidisciplinary teams in ethical decision-making processes, promoting critical thinking and ethical reasoning in the design and deployment of AI systems. 7. Stays abreast of emerging ethical issues and debates in AI, continuously updating knowledge and practices to address new challenges as technology evolves.

5. Assessment

Unit learning outcome	Assessment method
5.1	Exam
5.2	Report
5.3	Practical assignment
5.4	Practical assignment
5.5	360° assessment
5.6	360° assessment
5.7	360° assessment

6. Business Intelligence - EQF 5
The learner has demonstrated the ability to effectively harness business intelligence tools and techniques to analyse data, inform strategic decision-making, and improve organizational performance across various business contexts.
Unit learning outcomes
1. Utilizes specialized knowledge in business intelligence systems, including data warehousing, data mining, and visualization tools, to extract and analyse business data efficiently. 2. Develops and implements analytical models and reports that transform raw data into actionable insights, driving business strategy and operational improvements. 3. Evaluates the effectiveness of business intelligence strategies and tools in achieving organizational goals, identifying areas for enhancement and innovation. 4. Manages business intelligence projects, coordinating between technical teams and business stakeholders to ensure that business needs are met through effective data analysis. 5. Communicates complex data insights in a clear and understandable manner to stakeholders at all levels of the organization, enhancing data-driven decision-making processes. 6. Leads the adoption of new business intelligence technologies and practices within the organization, fostering a culture of continuous learning and adaptation to technological advancements. 7. Assesses ethical considerations in data handling and analytics, ensuring that business intelligence practices comply with legal standards and respect privacy and data protection laws.

6. Assessment

Unit learning outcome	Assessment method
6.1	Exam
6.2	Practical assignment
6.3	Report
6.4	360° assessment
6.5	360° assessment
6.6	360° assessment
6.7	Self-reflection Report

7. PLO AI Awareness - EQF 5
The learner has demonstrated the ability to understand and articulate the fundamental concepts of artificial intelligence, its potential impacts, and the challenges it presents in various societal and business contexts.
Unit learning outcomes
1. Identifies and explains the key technologies and methodologies that underpin AI, such as machine learning, neural networks, and natural language processing, and their applications across different industries. 2. Analyses the potential impacts of AI on society, including economic, ethical, and social implications, promoting an informed perspective on how AI can be used responsibly. 3. Discusses the challenges and risks associated with AI deployment, such as privacy concerns, job displacement, and decision-making biases, fostering a critical understanding of AI limitations. 4. Evaluates real-world case studies where AI has been successfully implemented, understanding both the benefits and the complexities involved in integrating AI into existing systems. 5. Communicates effectively about AI technologies and their implications to diverse audiences, ensuring clarity and addressing common misconceptions and fears. 6. Participates in debates and discussions about the future of AI, contributing informed viewpoints that consider both technological advancements and societal needs. 7. Advocates for ethical AI practices, emphasizing the importance of transparency, fairness, and accountability in AI development and deployment.

7. Assessment

Unit learning outcome	Assessment method
7.1	Exam
7.2	Self-reflection report
7.3	Self-reflection report
7.4	Report
7.5	360° assessment
7.6	360° assessment
7.7	360° assessment

8. PLO Soft Skills - EQF 5
The learner has demonstrated the ability to master a suite of essential soft skills, including communication, teamwork, problem-solving, presentation, innovation, critical thinking, conflict management, and change management, effectively applying these skills to enhance personal effectiveness and organizational performance in various professional settings.
Unit learning outcomes
1. Communicates effectively across a variety of platforms, ensuring clear, persuasive, and impactful exchanges with diverse audiences to facilitate organizational and personal objectives. 2. Collaborates within teams, fostering a cooperative environment that leverages diverse strengths and perspectives to achieve common goals and optimize team performance. 3. Solves problems creatively and efficiently, applying structured and innovative approaches to overcome challenges and implement practical solutions in dynamic environments. 4. Designs and delivers compelling presentations, utilizing advanced tools and techniques to convey information clearly and engage audiences effectively. 5. Cultivates an innovative mindset, encouraging creative thinking and continuous improvement both individually and within teams. 6. Applies critical thinking to analyse and synthesize information, making informed decisions based on comprehensive evaluation and logical reasoning. 7. Manages conflicts by implementing effective resolution strategies, promoting a harmonious work environment, and enhancing interpersonal relationships.

8. Assessment

Unit learning outcome	Assessment method
8.1	360° assessment
8.2	Practical assignment
8.3	Practical assignment
8.4	Practical assignment
8.5	Self-reflection report
8.6	Report
8.7	360° assessment

EDUCATIONAL PROFILE

Data Analyst

EQF 6

This educational profile belongs to the field of Software Engineering and is covered by relevant references in ESCO

Data Analyst EQF 6

Role Description:

"Data analysts import, inspect, clean, transform, validate, model, or interpret collections of data with regard to the business goals of the company. They ensure that the data sources and repositories provide consistent and reliable data. Data analysts use different algorithms and IT tools as demanded by the situation and the current data. They might prepare reports in the form of visualisations such as graphs, charts, and dashboards."

(Source: https://esco.ec.europa.eu/en/classification/occupation?uri=http://data.europa.eu/esco/occupation/d3edb8f8-3a06-47a0-8fb9-9b212c006aa2*)*

Role Description at specific EQF 6:

Data analysts at EQF 6 apply advanced skills in AI technologies, machine learning, and big data to manage and interpret complex data sets, ensuring alignment with business goals. They lead projects, innovate data-driven solutions, and are responsible for data integrity and security, making key decisions in dynamic business environments.

Programme Learning Outcomes (PLO)

1. PLO Deep Learning - EQF 6
The learner has demonstrated the ability to design and implement deep learning models and architectures, encompassing their development, implementation, and application across various domains, while integrating computational and organizational considerations and evaluating their societal and technological impacts.
Unit learning outcomes
1. Analyzes the fundamental principles of neural networks, focusing on their structure and function, to understand the underlying mechanics of deep learning technologies in a professional context. 2. Identifies suitable applications for deep and shallow neural architectures by evaluating their types and functionalities, ensuring the selection aligns with specific project requirements and industry standards. 3. Designs deep learning models by selecting appropriate architectures and frameworks, demonstrating innovation in model architecture to meet the unique needs of diverse applications. 4. Implements deep learning models using relevant frameworks and libraries, showcasing proficiency in parameter tuning, performance optimization, and addressing computational challenges to enhance model efficiency and effectiveness. Evaluates the performance of deep learning models using standard metrics, interpreting results to make informed decisions about model improvements, adjustments, and the selection of models for specific tasks in real-world applications. 5. Applies deep learning techniques to solve problems in various domains such as image recognition, natural language processing, and predictive analytics, demonstrating the ability to adapt models to new challenges and datasets within a given context. 6. Discusses the ethical implications of deploying deep learning models, including issues related to fairness, privacy, transparency, and accountability, proposing strategies to mitigate risks and promote ethical AI development in diverse societal applications. 7. Critiques the current trends and advancements in deep learning, assessing their potential impact on future technologies, industry practices, and societal norms, with a focus on sustainable and responsible innovation. 8. Collaborates effectively in teams to design, implement, and evaluate deep learning projects, demonstrating the ability to communicate complex concepts to stakeholders with varying levels of technical expertise, facilitating informed decision-making and promoting interdisciplinary understanding. 9. Engages with the AI community by participating in discussions, debates, and collaborative projects, contributing to the advancement of ethical practices and innovative technologies in deep learning.

1. Assessment

Unit learning outcome	Assessment method
1.1	Exam

1.2	Report
1.3	Practical assignment
1.4	Practical assignment
1.5	Practical assignment
1.6	Self-reflection report
1.7	Self-reflection report
1.8	360° assessment
1.9	360° assessment

2. PLO AI Technologies - EQF 6

The learner has demonstrated the ability to know and effectively utilize AI frameworks and libraries for the development and deployment of AI models and technologies, applying these tools across various domains to solve complex problems while considering ethical implications and industry standards.

Unit learning outcomes

1. Selects appropriate AI frameworks and libraries for specific project needs, demonstrating an understanding of their strengths, limitations, and optimal use cases in the development of AI models.
2. Develops AI models using chosen frameworks and libraries, showcasing the ability to integrate various AI technologies to create efficient, scalable, and effective solutions for real-world applications.
3. Analyses the performance and efficiency of AI models and technologies, employing appropriate metrics and tests to ensure they meet project specifications and performance goals.
4. Adapts existing AI models to new contexts and problems, demonstrating innovation and flexibility in applying AI technologies to a diverse range of challenges and domains.
5. Communicates technical details and project outcomes related to AI technologies effectively to both technical and non-technical audiences, ensuring clarity and facilitating informed decision-making.
6. Discusses the ethical implications of deploying AI technologies, including issues related to fairness, privacy, transparency, and accountability, proposing strategies to mitigate risks and promote ethical AI development in diverse societal applications.
7. Critiques the current trends and advancements in AI, assessing their potential impact on future technologies, industry practices, and societal norms, with a focus on sustainable and responsible innovation.
8. Collaborates with multidisciplinary teams on AI projects, leveraging collective expertise to enhance the development, implementation, and evaluation of AI technologies, fostering an environment of knowledge sharing and innovation.
9. Demonstrates an ongoing commitment to advancing skills and knowledge in the field of AI by staying updated on emerging AI frameworks, libraries, and technologies.

2. Assessment

Unit learning outcome	Assessment method
2.1	Exam
2.2	Practical assignment
2.3	Exam
2.4	Practical assignment
2.5	360° assessment
2.6	Self-reflection report
2.7	Self-reflection report
2.8	360° assessment
2.9	360° assessment

3. PLO ML Ops - EQF 6

The learner has demonstrated the ability to proficiently implement AI and machine learning projects, utilizing ML Ops principles to streamline development, ensure high-quality outputs, and manage projects efficiently. This includes deploying scalable AI solutions, managing the lifecycle of machine learning models, and applying quality control measures to maintain accuracy and reliability in AI applications.

Unit learning outcomes

1. Implements AI projects by applying foundational ML Ops principles, ensuring efficient transition from development to production while maintaining high standards of scalability, performance, and reliability.
2. Utilizes project management techniques specific to ML Ops to plan, execute, and monitor AI projects, ensuring alignment with objectives, timelines, and stakeholder expectations.
3. Integrates continuous integration and continuous delivery (CI/CD) pipelines for machine learning projects, automating the testing, deployment, and monitoring of AI models to enhance productivity and reduce time to market.
4. Applies AI quality control measures throughout the machine learning project lifecycle, employing techniques for data validation, model testing, and performance monitoring to ensure the accuracy and reliability of AI applications.
5. Adapts machine learning models to evolving data and requirements, leveraging ML Ops tools and practices for model versioning, updating, and retraining to maintain high performance in dynamic environments.
6. Communicates effectively with stakeholders involved in AI projects, including technical teams, management, and external partners, ensuring clear understanding of project goals, progress, and outcomes.
7. Evaluates the ethical and social implications of deploying AI solutions, implementing strategies to address potential biases, privacy concerns, and ethical issues in machine learning applications.
8. Stays informed about emerging technologies, practices, and standards to lead and innovate in the implementation and management of AI projects.

3. Assessment

Unit learning outcome	Assessment method
3.1	Practical assignment
3.2	Practical assignment
3.3	Practical assignment
3.4	Practical assignment
3.5	Report
3.6	360° assessment
3.7	Self-reflection report
3.8	Self-reflection report

4. PLO Machine Learning - EQF 6

The learner has demonstrated the ability to design, implement, and evaluate machine learning models and algorithms to address (complex) problems across various domains.

Unit learning outcomes

1. Applies fundamental machine learning concepts and algorithms to address predictive analytics, classification, and clustering tasks, employing appropriate tools and techniques for model development within diverse real-world contexts. Knowledge of the techniques for hyperparameter tuning and optimization to enhance model accuracy and efficiency.
2. Evaluates machine learning models using established metrics and validation techniques, critically interpreting results to ensure the models' reliability, accuracy, and applicability to specific problem domains.
3. Designs data pre-processing and feature engineering strategies to enhance machine learning model performance, demonstrating an understanding of the influence of data quality and feature selection on model outcomes.
4. Assesses the ethical implications of machine learning projects, identifying potential biases, fairness issues, and privacy concerns, and developing strategies to address these challenges in the design and deployment of models.
5. Communicates machine learning findings effectively to both technical and non-technical stakeholders, ensuring clarity and facilitating informed decision-making.
6. Collaborates with interdisciplinary teams on machine learning projects, leveraging collective expertise to overcome complex challenges and innovate while upholding ethical standards and achieving practical solutions.
7. Engages in professional development and community activities related to machine learning, including attending workshops, contributing to forums, and participating in collaborative research, to stay informed about industry trends and ethical discussions.

4. Assessment

Unit learning outcome	Assessment method
4.1	Practical assignment
4.2	Report
4.3	Practical assignment
4.4	Self-reflection report
4.5	360° assessment
4.6	360° assessment
4.7	360° assessment

5. PLO Explainable AI - EQF 6

The learner has demonstrated the ability to design, implement and evaluate AI models that are both transparent and interpretable, ensuring that stakeholders can understand, trust, and effectively manage AI solutions. Also, the learner has demonstrated the ability to assess the explainability level of an AI system. This includes applying principles and techniques of explainable AI to enhance the accountability, fairness, and ethical use of AI technologies across various domains.

Unit learning outcomes

1. Develops AI models using explainable AI techniques to ensure transparency and interpretability, enhancing the ability of users to understand how AI decisions are made.
2. Analyses existing AI models to assess and measure their explainability, employing methods and metrics to evaluate the transparency and interpretability of model decisions and outputs.
3. Implements strategies to improve the explainability of existing AI models, incorporating techniques such as feature importance scoring, model simplification, and visualization tools to make AI decision-making processes more accessible to non-expert users.
4. Evaluates the impact of explainable AI on model performance, balancing the trade-offs between transparency, accuracy, and complexity to meet both technical and ethical standards.
5. Conveys the principles and benefits of explainable AI to stakeholders, including developers, end-users, and decision-makers, ensuring that the rationale behind AI decisions is clear and comprehensible.
6. Collaborates with interdisciplinary teams to integrate explainable AI practices into the development lifecycle, fostering a culture of transparency and accountability in AI applications.
7. Navigates ethical and legal considerations associated with AI explainability, addressing concerns such as bias, fairness, and privacy to ensure responsible AI deployment.
8. Stays up to date with emerging techniques, tools, and best practices to lead advancements in creating transparent and understandable AI systems.

5. Assessment

Unit learning outcome	Assessment method
5.1	Practical assignment
5.2	Exam
5.3	Practical assignment
5.4	Report
5.5	Report
5.6	360° assessment
5.7	Self-reflection report
5.8	Self-reflection report

6. PLO Big Data & Data Analytics - EQF 6

The learner has demonstrated the ability to effectively harness big data technologies and data analytics methodologies to extract insights and inform decision-making. This includes the application of data science principles to analyse datasets that express large velocity, volume, value, variety, and veracity. Also, the learner has shown the ability to implement data visualization techniques to communicate findings clearly.

Unit learning outcomes

1. Utilizes big data technologies to efficiently process and analyse large volumes of data, applying scalable solutions to handle data-intensive applications across various domains.
2. Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets, employing statistical analysis, machine learning techniques, and predictive modelling to support evidence-based decision-making.
3. Develops data science solutions to tackle specific analytical challenges, integrating data pre-processing, analysis, and model evaluation to ensure the accuracy and relevance of analytical outcomes.
4. Creates effective data visualizations that clearly communicate analytical findings to both technical and non-technical audiences, using visualization tools and principles to represent complex data in an accessible and impactful manner.
5. Describes the results and implications of data analysis projects to stakeholders, providing insights and recommendations that inform strategic decision-making and operational improvements.
6. Collaborates with multidisciplinary teams on big data and data analytics projects, leveraging collective expertise to address complex data challenges and achieve comprehensive analytical solutions.
7. Engages in continuous learning and professional development related to big data, data analytics, and data science, staying abreast of emerging technologies, methodologies, and industry best practices to maintain and enhance analytical capabilities.

6. Assessment

Unit learning outcome	Assessment method
6.1	Practical assignment
6.2	Practical assignment
6.3	Report
6.4	Practical assignment
6.5	Self-reflection report
6.6	360° assessment
6.7	360° assessment

7. PLO Human-Centered AI - EQF 6

The learner has demonstrated the ability to integrate human-centered design principles in AI development, ensuring sustainable, ethical, and effective AI solutions. This includes formulating and implementing AI governance policies, managing AI-related risks, devising strategic AI plans, and enhancing human-computer interaction to create AI systems that are aligned with human values and societal goals.

Unit learning outcomes

1. Incorporates human-centered design principles in the development of AI systems, focusing on user needs and ethical considerations to create solutions that enhance human well-being and productivity.
2. Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies and implementing strategies to mitigate these risks, ensuring the sustainability and reliability of AI systems.
3. Enhances human-computer interaction through the design of intuitive and accessible AI interfaces, improving user experience and engagement with AI systems across diverse application areas.
4. Evaluates the sustainability of AI solutions, considering their environmental, social, and economic impacts to promote responsible and sustainable AI development and use.
5. Communicates effectively with stakeholders about the benefits, challenges, and ethical implications of AI technologies, ensuring informed decision-making and fostering a culture of transparency and trust in AI.
6. Stays informed about emerging trends and best practices in human-centered AI, governance policies, risk management, and sustainability, contributing to the advancement of ethical and effective AI solutions.

7. Assessment

Unit learning outcome	Assessment method
7.1	Exam
7.2	Report
7.3	Practical assignment

7.4	Report
7.5	360° assessment
7.6	Self-reflection report

8. PLO AI Ethics - EQF 6
The learner has demonstrated the ability to critically assess the ethical implications of AI technologies, develop and implement strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.
Unit learning outcomes
1. Identifies ethical considerations and challenges in AI development and deployment, such as bias, fairness, transparency, and accountability, emphasizing their importance for respecting human rights and societal norms. 2. Develops ethical guidelines and frameworks for AI projects, integrating ethical considerations into the AI lifecycle from design through deployment, to promote ethical AI practices within organizations and society. 3. Implements strategies to mitigate ethical risks in AI applications, employing methods for detecting and correcting biases, ensuring privacy, and maintaining transparency and accountability in AI systems. 4. Advocates for responsible AI by communicating the significance of ethical considerations in AI to diverse audiences, including technologists, policymakers, and the public, to foster an ethical AI culture. 5. Assesses AI projects for ethical implications, utilizing ethical frameworks and principles to evaluate AI's impact on individuals and communities and to ensure alignment with ethical standards and societal values. 6. Collaborates with interdisciplinary teams to address ethical challenges in AI, facilitating discussions and actions that balance technical possibilities with ethical considerations to achieve consensus on responsible AI development and use. 7. Engages in professional and community forums on AI ethics, contributing to the discourse on responsible AI practices and staying informed about emerging ethical issues and solutions in the field. 8. Knowledge of industry-specific laws (national and international) and any kind of regulations that affect AI development to ensure its compliance. 9. Reflects on personal ethical beliefs and practices in relation to AI technologies, committing to ethical professional conduct and continuous learning about ethical challenges and best practices in AI.

8. Assessment

Unit learning outcome	Assessment method
8.1	Report
8.2	Practical assignment

8.3	Practical assignment
8.4	360° assessment
8.5	Self-reflection report
8.6	360° assessment
8.7	360° assessment
8.8	Exam
8.9	Self-reflection report

9. PLO AI Futures and Innovation - EQF 6

The learner has demonstrated the ability to critically analyse future AI developments, leveraging research skills to innovate and contribute to the advancement of AI technologies. This encompasses a deep understanding of current trends, the capability to forecast technological evolutions, and the application of this knowledge to drive forward-thinking AI solutions that address emerging challenges and opportunities for companies.

Unit learning outcomes

1. Analyses current AI developments and trends, applying critical thinking to evaluate the potential impact, benefits, and challenges of emerging AI technologies in various industrial sectors.
2. Forecasts future trends in AI technology, using research methodologies and future literacy skills to anticipate changes, identify opportunities for innovation, and prepare for potential societal and ethical implications.
3. Conducts research to explore new possibilities in AI, demonstrating proficiency in designing and implementing studies that contribute to the knowledge base and development of AI technologies.
4. Innovates in the field of AI by applying insights from research and trend analysis to develop novel AI solutions or improve existing technologies, focusing on addressing unmet needs and capitalizing on future opportunities.
5. Communicates insights and predictions about future AI developments to a variety of audiences, including academic, industry, and public stakeholders, effectively bridging the gap between current research and practical applications.
6. Collaborates with experts from various fields to explore interdisciplinary approaches to AI innovation, fostering a culture of creativity and shared knowledge that supports the advancement of AI technologies.
7. Evaluates the ethical, social, and economic implications of future AI innovations, incorporating ethical considerations into the forecasting and development process to ensure responsible and beneficial outcomes.
8. Knowledge of the regulations and ethical use of data and data practices to ensure data privacy and compliance.
9. Engages in continuous learning and professional development to stay at the forefront of AI research and innovation, actively participating in forums, conferences, and professional networks to exchange ideas and keep abreast of cutting-edge developments.

9. Assessment

Unit learning outcome	Assessment method
9.1	Exam
9.2	Report
9.3	Report
9.4	Practical assignment
9.5	360° assessment
9.6	360° assessment
9.7	Self-reflection report
9.8	Exam
9.9	360° assessment

10. PLO Business Intelligence - EQF 6

The learner has demonstrated the ability to effectively utilize business intelligence tools and methodologies to analyse data, extract actionable insights, and support strategic business decisions.

Unit learning outcomes

1. Utilizes business intelligence tools and software to collect, process, and analyse large datasets, ensuring data accuracy and relevance for business analysis.
2. Interprets complex data sets to identify trends, patterns, and insights that inform business strategies and operations, applying analytical techniques and critical thinking.
3. Designs and implements data visualization techniques to effectively communicate business insights to stakeholders, using dashboards, reports, and presentations to facilitate data-driven decision-making.
4. Evaluates the effectiveness of business intelligence strategies and tools in meeting business objectives, identifying areas for improvement and optimization to enhance business performance.
5. Integrates data warehousing and data management practices to ensure the integrity, security, and accessibility of business data, supporting effective and efficient business intelligence processes.
6. Explains findings and strategic recommendations based on business intelligence analysis to stakeholders, including management and cross-functional teams, ensuring clarity and actionable insights.
7. Collaborates with team members and departments to gather data requirements, share insights, and implement business intelligence solutions that support organizational goals and initiatives.

10. Assessment

Unit learning outcome	Assessment method
10.1	Practical assignment
10.2	Report
10.3	Practical assignment
10.4	Report
10.5	Practical assignment

10.6	360° assessment
10.7	360° assessment

11. PLO AI Awareness - EQF 6

The learner has demonstrated the ability to understand the fundamentals of artificial intelligence, its applications across various markets, and its transformative impact on business processes. This encompasses an appreciation of AI technologies, their potential for innovation, and the strategic considerations necessary for integrating AI into business operations.

Unit learning outcomes

1. Understands the basic concepts and technologies underlying artificial intelligence, including machine learning, natural language processing, and robotics, recognizing their roles in driving innovation.
2. Identifies key AI applications in the programming application market, assessing the competitive landscape and potential for disruptive innovation across industries.
3. Analyses the implications of AI on business processes, evaluating how AI technologies can optimize operations, enhance customer experiences, and create new business models.
4. Assesses the strategic considerations for integrating AI into business operations, including technical feasibility, cost-benefit analysis, and alignment with business goals.
5. Recognizes the ethical, legal, and societal challenges associated with AI deployment, advocating for responsible AI use that respects privacy, fairness, and transparency.
6. Communicates effectively about AI technologies and their business applications to a range of audiences, fostering AI literacy and supporting informed decision-making within organizations.
7. Collaborates with technical and non-technical teams to explore AI opportunities, facilitating cross-functional understanding and strategic alignment on AI initiatives.
8. Knowledge of current trends in AI technology to evaluate how these might influence industry innovation and competitive strategies.
9. Engages in continuous learning to keep pace with rapid advancements in AI technology and its evolving impact on the business landscape, maintaining an informed perspective on future opportunities and challenges

11. Assessment

Unit learning outcome	Assessment method
11.1	Exam
11.2	Report
11.3	Report
11.4	Self-reflection report
11.5	Self-reflection report
11.6	360° assessment
11.7	360° assessment

11.8	Exam
11.9	360° assessment

12. PLO Cyber and Data Security - EQF 6
The learner has demonstrated the ability to identify cybersecurity threats and vulnerabilities, implement and manage robust security measures, and develop comprehensive strategies to protect digital assets and ensure data privacy across various operational environments, while understanding the ethical, legal, and societal implications.
Unit learning outcomes
1. Identifies a variety of cybersecurity threats and vulnerabilities, understanding their mechanisms and the potential impact they pose on information systems, to enhance awareness and preparedness in a dynamic digital landscape. 2. Implements key cybersecurity measures such as firewalls, encryption, and intrusion detection systems, showcasing the ability to safeguard information assets against unauthorized access and cyber threats in compliance with relevant regulations. 3. Designs security architectures for information systems that incorporate risk management principles and security-by-design approaches, aiming to minimize vulnerabilities and ensure the integrity, confidentiality, and availability of data across diverse applications. 4. Manages cybersecurity incidents by effectively deploying incident response strategies and techniques to promptly address and mitigate the impact of security breaches, ensuring a rapid return to normal operations and compliance with legal and reporting obligations. 5. Evaluates the ethical, legal, and societal implications of cybersecurity practices, considering issues such as data protection laws, privacy rights, and ethical hacking, to promote responsible and lawful security measures that respect individual and societal values. 6. Conveys complex cyber and data security concepts, policies, and protocols clearly to a broad audience, including technical and non-technical stakeholders, enhancing the organizational culture of security, and fostering best practices in cybersecurity awareness and training. 7. Collaborates within teams to develop and implement comprehensive cybersecurity solutions, leveraging interdisciplinary knowledge and perspectives to address complex security challenges with innovative, ethical, and effective strategies. 8. Reflects on personal and professional growth in the field of cyber and data security, engaging in continuous learning to stay abreast of evolving threats, technologies, and regulatory landscapes, contributing to the advancement of cybersecurity knowledge and practices.

12. Assessment

Unit learning outcome	Assessment method
12.1	Report

12.2	Practical assignment
12.3	Practical assignment
12.4	360° assessment
12.5	Self-reflection report
12.6	360° assessment
12.7	360° assessment
12.8	Self-reflection report

13. PLO Generative AI - EQF 6

The learner has demonstrated the ability to design, implement, and evaluate generative AI systems, utilizing advanced techniques including prompt engineering for Large Language Models. This includes the capacity to identify AI-generated content, create innovative applications using generative AI models, and apply best practices in prompt engineering to achieve desired outcomes in various industrial domains.

Unit learning outcomes

1. Designs generative AI models to create novel content, including text, images, and audio, demonstrating an understanding of the underlying technologies and their application in generating high-quality, creative outputs.
2. Identifies AI-generated content, employing analytical methods and tools to distinguish between human and machine-generated outputs, addressing concerns related to authenticity, copyright, and ethics.
3. Develops prompt engineering skills, crafting effective prompts to guide generative AI models in producing specific and relevant outputs, optimizing the interaction between users and AI systems for enhanced creativity and efficiency.
4. Implements Large Language Models (LLMs) in generative AI projects, leveraging their capabilities for text generation, language understanding, and complex problem-solving, tailoring model parameters and prompts to specific use cases.
5. Evaluates the performance of generative AI systems, using criteria such as originality and relevance to assess system outputs and guide improvements.
6. Assesses the ethical implications of generative AI systems, considering the impact on stakeholders and societal norms to ensure responsible use and development of AI technologies.
7. Integrates generative AI into diverse applications, from content creation and augmentation to problem-solving and innovation, demonstrating the ability to apply generative AI technologies across various fields and industries.
8. Conveys the principles and potential of generative AI to a broad audience, including technical and non-technical stakeholders, facilitating understanding and ethical use of generative technologies.
9. Engages in continuous learning and professional development in the field of generative AI, staying informed about advancements in AI models, prompt engineering techniques, and emerging ethical standards, to lead in the development of responsible and innovative AI-driven solutions.

13. Assessment

Unit learning outcome	Assessment method
13.1	Practical assignment
13.2	Report
13.3	Practical assignment
13.4	Practical assignment
13.5	Self-reflection report
13.6	Self-reflection report
13.7	360° assessment
13.8	360° assessment
13.9	360° assessment

14. PLO Soft Skills - EQF 6
The learner has demonstrated the ability to effectively apply a wide range of soft skills in diverse professional and personal contexts. This includes mastering communication, collaboration, problem-solving, and adaptability, as well as the ability to manage change and conflict, think critically, and innovate.
Unit learning outcomes
1. Collaborates within teams, contributing positively to group efforts, sharing responsibility, and supporting colleagues to achieve collective goals. 2. Solves problems creatively and efficiently, applying logical and innovative thinking to overcome challenges and optimize outcomes. 3. Delivers impactful presentations, effectively using verbal and visual communication to engage audiences and clearly convey information. 4. Cultivates an innovative mindset, embracing and fostering creativity, questioning conventional approaches, and generating novel solutions. 5. Communicates effectively across a variety of platforms and media, adapting messages for different audiences and purposes to enhance understanding and engagement. 6. Thinks critically, analysing situations, evaluating diverse perspectives, and synthesizing information to make informed decisions. 7. Manages conflicts constructively, employing negotiation and mediation skills to resolve disputes and maintain harmonious relationships.

14. Assessment

Unit learning outcome	Assessment method
14.1	360° assessment
14.2	Practical assignment
14.3	360° assessment
14.4	Self-reflection report
14.5	360° assessment
14.6	Self-reflection report
14.7	360° assessment

EDUCATIONAL PROFILE

Data Scientist

EQF 6

This educational profile belongs to the field of Software Engineering and is covered by relevant references in ESCO

Data Scientist EQF 6

Role Description:

"Data scientists find and interpret rich data sources, manage large amounts of data, merge data sources, ensure consistency of datasets, and create visualisations to aid in understanding data. They build mathematical models using data, present and communicate data insights and findings to specialists and scientists in their team and if required, to a non-expert audience, and recommend ways to apply the data."

(Source: https://esco.ec.europa.eu/en/classification/occupation?uri=http://data.europa.eu/esco/occupation/258e46f9-0075-4a2e-adae-1ff0477e0f30)

Role Description at specific EQF 6:

Data scientists at EQF 6 apply advanced AI and big data analytics to manage and interpret large datasets, building mathematical models and creating visualizations for insightful communication. They lead projects to ensure data consistency and security while integrating ethical AI practices. Their role involves adapting to evolving business needs and managing change effectively.

Programme Learning Outcomes (PLO)

1. PLO Deep Learning - EQF 6
The learner has demonstrated the ability to design and implement deep learning models and architectures, encompassing their development, implementation, and application across various domains, while integrating computational and organizational considerations and evaluating their societal and technological impacts.
Unit learning outcomes
1. Analyzes the fundamental principles of neural networks, focusing on their structure and function, to understand the underlying mechanics of deep learning technologies in a professional context. 2. Identifies suitable applications for deep and shallow neural architectures by evaluating their types and functionalities, ensuring the selection aligns with specific project requirements and industry standards. 3. Designs deep learning models by selecting appropriate architectures and frameworks, demonstrating innovation in model architecture to meet the unique needs of diverse applications. 4. Implements deep learning models using relevant frameworks and libraries, showcasing proficiency in parameter tuning, performance optimization, and addressing computational challenges to enhance model efficiency and effectiveness.Evaluates the performance of deep learning models using standard metrics, interpreting results to make informed decisions about model improvements, adjustments, and the selection of models for specific tasks in real-world applications. 5. Applies deep learning techniques to solve problems in various domains such as image recognition, natural language processing, and predictive analytics, demonstrating the ability to adapt models to new challenges and datasets within a given context. 6. Discusses the ethical implications of deploying deep learning models, including issues related to fairness, privacy, transparency, and accountability, proposing strategies to mitigate risks and promote ethical AI development in diverse societal applications. 7. Critiques the current trends and advancements in deep learning, assessing their potential impact on future technologies, industry practices, and societal norms, with a focus on sustainable and responsible innovation. 8. Collaborates effectively in teams to design, implement, and evaluate deep learning projects, demonstrating the ability to communicate complex concepts to stakeholders with varying levels of technical expertise, facilitating informed decision-making and promoting interdisciplinary understanding. 9. Engages with the AI community by participating in discussions, debates, and collaborative projects, contributing to the advancement of ethical practices and innovative technologies in deep learning.

1. Assessment

Unit learning outcome	Assessment method
1.1	Exam
1.2	Report
1.3	Practical assignment
1.4	Practical assignment

1.5	Practical assignment
1.6	Self-reflection report
1.7	Self-reflection report
1.8	360° assessment
1.9	360° assessment

2. PLO AI Technologies - EQF 6
The learner has demonstrated the ability to know and effectively utilize AI frameworks and libraries for the development and deployment of AI models and technologies, applying these tools across various domains to solve complex problems while considering ethical implications and industry standards.
Unit learning outcomes
1. Selects appropriate AI frameworks and libraries for specific project needs, demonstrating an understanding of their strengths, limitations, and optimal use cases in the development of AI models. 2. Develops AI models using chosen frameworks and libraries, showcasing the ability to integrate various AI technologies to create efficient, scalable, and effective solutions for real-world applications. 3. Analyses the performance and efficiency of AI models and technologies, employing appropriate metrics and tests to ensure they meet project specifications and performance goals. 4. Adapts existing AI models to new contexts and problems, demonstrating innovation and flexibility in applying AI technologies to a diverse range of challenges and domains. 5. Communicates technical details and project outcomes related to AI technologies effectively to both technical and non-technical audiences, ensuring clarity and facilitating informed decision-making. Discusses the ethical implications of deploying AI technologies, including issues related to fairness, privacy, transparency, and accountability, proposing strategies to mitigate risks and promote ethical AI development in diverse societal applications. 7. Critiques the current trends and advancements in AI, assessing their potential impact on future technologies, industry practices, and societal norms, with a focus on sustainable and responsible innovation. 8. Collaborates with multidisciplinary teams on AI projects, leveraging collective expertise to enhance the development, implementation, and evaluation of AI technologies, fostering an environment of knowledge sharing and innovation. 9. Demonstrates an ongoing commitment to advancing skills and knowledge in the field of AI by staying updated on emerging AI frameworks, libraries, and technologies.

2. Assessment

Unit learning outcome	Assessment method
2.1	Exam
2.2	Practical assignment
2.3	Exam
2.4	Practical assignment
2.5	360° assessment
2.6	Self-reflection report
2.7	Self-reflection report
2.8	360° assessment
2.9	360° assessment

3. PLO Machine Learning - EQF 6
The learner has demonstrated the ability to design, implement, and evaluate machine learning models and algorithms to address (complex) problems across various domains.
Unit learning outcomes
1. Applies fundamental machine learning concepts and algorithms to address predictive analytics, classification, and clustering tasks, employing appropriate tools and techniques for model development within diverse real-world contexts. Knowledge of the techniques for hyperparameter tuning and optimization to enhance model accuracy and efficiency. 2. Evaluates machine learning models using established metrics and validation techniques, critically interpreting results to ensure the models' reliability, accuracy, and applicability to specific problem domains. 3. Designs data pre-processing and feature engineering strategies to enhance machine learning model performance, demonstrating an understanding of the influence of data quality and feature selection on model outcomes. 4. Assesses the ethical implications of machine learning projects, identifying potential biases, fairness issues, and privacy concerns, and developing strategies to address these challenges in the design and deployment of models. 5. Communicates machine learning findings effectively to both technical and non-technical stakeholders, ensuring clarity and facilitating informed decision-making. 6. Collaborates with interdisciplinary teams on machine learning projects, leveraging collective expertise to overcome complex challenges and innovate while upholding ethical standards and achieving practical solutions. 7. Engages in professional development and community activities related to machine learning, including attending workshops, contributing to forums, and participating in collaborative research, to stay informed about industry trends and ethical discussions.

3. Assessment

Unit learning outcome	Assessment method
3.1	Practical assignment
3.2	Report
3.3	Practical assignment
3.4	Self-reflection report
3.5	360° assessment
3.6	360° assessment
3.7	360° assessment

4. PLO Explainable AI - EQF 6
The learner has demonstrated the ability to design, implement and evaluate AI models that are both transparent and interpretable, ensuring that stakeholders can understand, trust, and effectively manage AI solutions. Also, the learner has demonstrated the ability to assess the explainability level of an AI system. This includes applying principles and techniques of explainable AI to enhance the accountability, fairness, and ethical use of AI technologies across various domains.
Unit learning outcomes
1. Develops AI models using explainable AI techniques to ensure transparency and interpretability, enhancing the ability of users to understand how AI decisions are made. 2. Analyses existing AI models to assess and measure their explainability, employing methods and metrics to evaluate the transparency and interpretability of model decisions and outputs. 3. Implements strategies to improve the explainability of existing AI models, incorporating techniques such as feature importance scoring, model simplification, and visualization tools to make AI decision-making processes more accessible to non-expert users. 4. Evaluates the impact of explainable AI on model performance, balancing the trade-offs between transparency, accuracy, and complexity to meet both technical and ethical standards. 5. Conveys the principles and benefits of explainable AI to stakeholders, including developers, end-users, and decision-makers, ensuring that the rationale behind AI decisions is clear and comprehensible. 6. Collaborates with interdisciplinary teams to integrate explainable AI practices into the development lifecycle, fostering a culture of transparency and accountability in AI applications. 7. Navigates ethical and legal considerations associated with AI explainability, addressing concerns such as bias, fairness, and privacy to ensure responsible AI deployment. 8. Stays up to date with emerging techniques, tools, and best practices to lead advancements in creating transparent and understandable AI systems.

4. Assessment

Unit learning outcome	Assessment method
4.1	Practical assignment
4.2	Exam
4.3	Practical assignment
4.4	Report
4.5	Report
4.6	360° assessment
4.7	Self-reflection report
4.8	Self-reflection report

5. PLO Big Data & Data Analytics - EQF 6
The learner has demonstrated the ability to effectively harness big data technologies and data analytics methodologies to extract insights and inform decision-making. This includes the application of data science principles to analyse datasets that express large velocity, volume, value, variety, and veracity. Also, the learner has shown the ability to implement data visualization techniques to communicate findings clearly.
Unit learning outcomes
1. Utilizes big data technologies to efficiently process and analyse large volumes of data, applying scalable solutions to handle data-intensive applications across various domains. 2. Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets, employing statistical analysis, machine learning techniques, and predictive modelling to support evidence-based decision-making. 3. Develops data science solutions to tackle specific analytical challenges, integrating data pre-processing, analysis, and model evaluation to ensure the accuracy and relevance of analytical outcomes. 4. Creates effective data visualizations that clearly communicate analytical findings to both technical and non-technical audiences, using visualization tools and principles to represent complex data in an accessible and impactful manner. 5. Describes the results and implications of data analysis projects to stakeholders, providing insights and recommendations that inform strategic decision-making and operational improvements. 6. Collaborates with multidisciplinary teams on big data and data analytics projects, leveraging collective expertise to address complex data challenges and achieve comprehensive analytical solutions. 7. Engages in continuous learning and professional development related to big data, data analytics, and data science, staying abreast of emerging technologies, methodologies, and industry best practices to maintain and enhance analytical capabilities.

5. Assessment

Unit learning outcome	Assessment method
5.1	Practical assignment
5.2	Practical assignment
5.3	Report
5.4	Practical assignment
5.5	Self-reflection report
5.6	360° assessment
5.7	360° assessment

6. PLO Human-Centered AI - EQF 6
The learner has demonstrated the ability to integrate human-centered design principles in AI development, ensuring sustainable, ethical, and effective AI solutions. This includes formulating and implementing AI governance policies, managing AI-related risks, devising strategic AI plans, and enhancing human-computer interaction to create AI systems that are aligned with human values and societal goals.
Unit learning outcomes
1. Incorporates human-centered design principles in the development of AI systems, focusing on user needs and ethical considerations to create solutions that enhance human well-being and productivity. 2. Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies and implementing strategies to mitigate these risks, ensuring the sustainability and reliability of AI systems. 3. Enhances human-computer interaction through the design of intuitive and accessible AI interfaces, improving user experience and engagement with AI systems across diverse application areas. 4. Evaluates the sustainability of AI solutions, considering their environmental, social, and economic impacts to promote responsible and sustainable AI development and use. 5. Communicates effectively with stakeholders about the benefits, challenges, and ethical implications of AI technologies, ensuring informed decision-making and fostering a culture of transparency and trust in AI. 6. Stays informed about emerging trends and best practices in human-centered AI, governance policies, risk management, and sustainability, contributing to the advancement of ethical and effective AI solutions.

6. Assessment

Unit learning outcome	Assessment method
6.1	Exam
6.2	Report
6.3	Practical assignment
6.4	Report
6.5	360° assessment
6.6	Self-reflection report

7. PLO AI Ethics - EQF 6
The learner has demonstrated the ability to critically assess the ethical implications of AI technologies, develop and implement strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.
Unit learning outcomes
1. Identifies ethical considerations and challenges in AI development and deployment, such as bias, fairness, transparency, and accountability, emphasizing their importance for respecting human rights and societal norms. 2. Develops ethical guidelines and frameworks for AI projects, integrating ethical considerations into the AI lifecycle from design through deployment, to promote ethical AI practices within organizations and society. 3. Implements strategies to mitigate ethical risks in AI applications, employing methods for detecting and correcting biases, ensuring privacy, and maintaining transparency and accountability in AI systems. 4. Advocates for responsible AI by communicating the significance of ethical considerations in AI to diverse audiences, including technologists, policymakers, and the public, to foster an ethical AI culture. 5. Assesses AI projects for ethical implications, utilizing ethical frameworks and principles to evaluate AI's impact on individuals and communities and to ensure alignment with ethical standards and societal values. 6. Collaborates with interdisciplinary teams to address ethical challenges in AI, facilitating discussions and actions that balance technical possibilities with ethical considerations to achieve consensus on responsible AI development and use. 7. Engages in professional and community forums on AI ethics, contributing to the discourse on responsible AI practices and staying informed about emerging ethical issues and solutions in the field. 8. Knowledge of industry-specific laws (national and international) and any kind of regulations that affect AI development to ensure its compliance. 9. Reflects on personal ethical beliefs and practices in relation to AI technologies, committing to ethical professional conduct and continuous learning about ethical challenges and best practices in AI.

7. Assessment

Unit learning outcome	Assessment method
7.1	Report
7.2	Practical assignment
7.3	Practical assignment
7.4	360° assessment
7.5	Self-reflection report
7.6	360° assessment
7.7	360° assessment
7.8	Exam
7.9	Self-reflection report

8. PLO AI Futures and Innovation - EQF 6
The learner has demonstrated the ability to critically analyse future AI developments, leveraging research skills to innovate and contribute to the advancement of AI technologies. This encompasses a deep understanding of current trends, the capability to forecast technological evolutions, and the application of this knowledge to drive forward-thinking AI solutions that address emerging challenges and opportunities for companies.
Unit learning outcomes
1. Analyses current AI developments and trends, applying critical thinking to evaluate the potential impact, benefits, and challenges of emerging AI technologies in various industrial sectors. 2. Forecasts future trends in AI technology, using research methodologies and future literacy skills to anticipate changes, identify opportunities for innovation, and prepare for potential societal and ethical implications. 3. Conducts research to explore new possibilities in AI, demonstrating proficiency in designing and implementing studies that contribute to the knowledge base and development of AI technologies. 4. Innovates in the field of AI by applying insights from research and trend analysis to develop novel AI solutions or improve existing technologies, focusing on addressing unmet needs and capitalizing on future opportunities. 5. Communicates insights and predictions about future AI developments to a variety of audiences, including academic, industry, and public stakeholders, effectively bridging the gap between current research and practical applications. 6. Collaborates with experts from various fields to explore interdisciplinary approaches to AI innovation, fostering a culture of creativity and shared knowledge that supports the advancement of AI technologies. 7. Evaluates the ethical, social, and economic implications of future AI innovations, incorporating ethical considerations into the forecasting and development process to ensure responsible and beneficial outcomes. 8. Knowledge of the regulations and ethical use of data and data practices to ensure data privacy and compliance. 9. Engages in continuous learning and professional development to stay at the forefront of AI research and innovation, actively participating in forums, conferences, and professional networks to exchange ideas and keep abreast of cutting-edge developments.

8. Assessment

Unit learning outcome	Assessment method
8.1	Exam
8.2	Report
8.3	Report
8.4	Practical assignment

8.5	360° assessment
8.6	360° assessment
8.7	Self-reflection report
8.8	Exam
8.9	360° assessment

9. PLO Business Intelligence - EQF 6
The learner has demonstrated the ability to effectively utilize business intelligence tools and methodologies to analyse data, extract actionable insights, and support strategic business decisions.
Unit learning outcomes
1. Utilizes business intelligence tools and software to collect, process, and analyse large datasets, ensuring data accuracy and relevance for business analysis. 2. Interprets complex data sets to identify trends, patterns, and insights that inform business strategies and operations, applying analytical techniques and critical thinking. 3. Designs and implements data visualization techniques to effectively communicate business insights to stakeholders, using dashboards, reports, and presentations to facilitate data-driven decision-making. 4. Evaluates the effectiveness of business intelligence strategies and tools in meeting business objectives, identifying areas for improvement and optimization to enhance business performance. 5. Integrates data warehousing and data management practices to ensure the integrity, security, and accessibility of business data, supporting effective and efficient business intelligence processes. 6. Explains findings and strategic recommendations based on business intelligence analysis to stakeholders, including management and cross-functional teams, ensuring clarity and actionable insights. 7. Collaborates with team members and departments to gather data requirements, share insights, and implement business intelligence solutions that support organizational goals and initiatives.

9. Assessment

Unit learning outcome	Assessment method
9.1	Practical assignment
9.2	Report
9.3	Practical assignment
9.4	Report
9.5	Practical assignment
9.6	360° assessment
9.7	360° assessment

10. PLO AI Awareness - EQF 6
The learner has demonstrated the ability to understand the fundamentals of artificial intelligence, its applications across various markets, and its transformative impact on business processes. This encompasses an appreciation of AI technologies, their potential for innovation, and the strategic considerations necessary for integrating AI into business operations.
Unit learning outcomes
1. Understands the basic concepts and technologies underlying artificial intelligence, including machine learning, natural language processing, and robotics, recognizing their roles in driving innovation. 2. Identifies key AI applications in the programming application market, assessing the competitive landscape and potential for disruptive innovation across industries. 3. Analyses the implications of AI on business processes, evaluating how AI technologies can optimize operations, enhance customer experiences, and create new business models. 4. Assesses the strategic considerations for integrating AI into business operations, including technical feasibility, cost-benefit analysis, and alignment with business goals. 5. Recognizes the ethical, legal, and societal challenges associated with AI deployment, advocating for responsible AI use that respects privacy, fairness, and transparency. 6. Communicates effectively about AI technologies and their business applications to a range of audiences, fostering AI literacy and supporting informed decision-making within organizations. 7. Collaborates with technical and non-technical teams to explore AI opportunities, facilitating cross-functional understanding and strategic alignment on AI initiatives. 8. Knowledge of current trends in AI technology to evaluate how these might influence industry innovation and competitive strategies. 9. Engages in continuous learning to keep pace with rapid advancements in AI technology and its evolving impact on the business landscape, maintaining an informed perspective on future opportunities and challenges

10. Assessment

Unit learning outcome	Assessment method
10.1	Exam
10.2	Report
10.3	Report
10.4	Self-reflection report
10.5	Self-reflection report
10.6	360° assessment
10.7	360° assessment
10.8	Exam
10.9	360° assessment

11. PLO Cyber and Data Security - EQF 6
The learner has demonstrated the ability to identify cybersecurity threats and vulnerabilities, implement and manage robust security measures, and develop comprehensive strategies to protect digital assets and ensure data privacy across various operational environments, while understanding the ethical, legal, and societal implications.
Unit learning outcomes
1. Identifies a variety of cybersecurity threats and vulnerabilities, understanding their mechanisms and the potential impact they pose on information systems, to enhance awareness and preparedness in a dynamic digital landscape. 2. Implements key cybersecurity measures such as firewalls, encryption, and intrusion detection systems, showcasing the ability to safeguard information assets against unauthorized access and cyber threats in compliance with relevant regulations. 3. Designs security architectures for information systems that incorporate risk management principles and security-by-design approaches, aiming to minimize vulnerabilities and ensure the integrity, confidentiality, and availability of data across diverse applications. 4. Manages cybersecurity incidents by effectively deploying incident response strategies and techniques to promptly address and mitigate the impact of security breaches, ensuring a rapid return to normal operations and compliance with legal and reporting obligations. 5. Evaluates the ethical, legal, and societal implications of cybersecurity practices, considering issues such as data protection laws, privacy rights, and ethical hacking, to promote responsible and lawful security measures that respect individual and societal values. 6. Conveys complex cyber and data security concepts, policies, and protocols clearly to a broad audience, including technical and non-technical stakeholders, enhancing the organizational culture of security, and fostering best practices in cybersecurity awareness and training. 7. Collaborates within teams to develop and implement comprehensive cybersecurity solutions, leveraging interdisciplinary knowledge and perspectives to address complex security challenges with innovative, ethical, and effective strategies. 8. Reflects on personal and professional growth in the field of cyber and data security, engaging in continuous learning to stay abreast of evolving threats, technologies, and regulatory landscapes, contributing to the advancement of cybersecurity knowledge and practices.

11. Assessment

Unit learning outcome	Assessment method
11.1	Report
11.2	Practical assignment
11.3	Practical assignment
11.4	360° assessment
11.5	Self-reflection report
11.6	360° assessment
11.7	360° assessment
11.8	Self-reflection report

12. PLO Generative AI - EQF 6
The learner has demonstrated the ability to design, implement, and evaluate generative AI systems, utilizing advanced techniques including prompt engineering for Large Language Models. This includes the capacity to identify AI-generated content, create innovative applications using generative AI models, and apply best practices in prompt engineering to achieve desired outcomes in various industrial domains.
Unit learning outcomes
1. Designs generative AI models to create novel content, including text, images, and audio, demonstrating an understanding of the underlying technologies and their application in generating high-quality, creative outputs. 2. Identifies AI-generated content, employing analytical methods and tools to distinguish between human and machine-generated outputs, addressing concerns related to authenticity, copyright, and ethics. 3. Develops prompt engineering skills, crafting effective prompts to guide generative AI models in producing specific and relevant outputs, optimizing the interaction between users and AI systems for enhanced creativity and efficiency. 4. Implements Large Language Models (LLMs) in generative AI projects, leveraging their capabilities for text generation, language understanding, and complex problem-solving, tailoring model parameters and prompts to specific use cases. 5. Evaluates the performance of generative AI systems, using criteria such as originality and relevance to assess system outputs and guide improvements. 6. Assesses the ethical implications of generative AI systems, considering the impact on stakeholders and societal norms to ensure responsible use and development of AI technologies. 7. Integrates generative AI into diverse applications, from content creation and augmentation to problem-solving and innovation, demonstrating the ability to apply generative AI technologies across various fields and industries. 8. Conveys the principles and potential of generative AI to a broad audience, including technical and non-technical stakeholders, facilitating understanding and ethical use of generative technologies. 9. Engages in continuous learning and professional development in the field of generative AI, staying informed about advancements in AI models, prompt engineering techniques, and emerging ethical standards, to lead in the development of responsible and innovative AI-driven solutions.

12. Assessment

Unit learning outcome	Assessment method
12.1	Practical assignment
12.2	Report
12.3	Practical assignment
12.4	Practical assignment
12.5	Self-reflection report
12.6	Self-reflection report
12.7	360° assessment
12.8	360° assessment

13. PLO Change Management- EQF 6
The learner has demonstrated the ability to effectively lead and manage change processes within organizations, employing strategies to facilitate smooth transitions, overcome resistance, and ensure stakeholder engagement. This includes understanding the dynamics of organizational change, communicating effectively to align team and organizational goals, and applying change management models to support and sustain organizational transformation.
Unit learning outcomes
1. Understands the principles and theories of change management, including the factors driving change, the stages of change processes, and the impact of change on organizations and individuals. 2. Assesses organizational readiness for change, evaluating factors such as culture, resources, and stakeholder attitudes to plan effective change initiatives. 3. Designs change management strategies, developing plans that outline objectives, actions, timelines, and resources needed to achieve successful change. 4. Communicates change effectively, using clear, persuasive messaging to convey the reasons for change, the benefits of the change process, and the expected outcomes to various stakeholders. 5. Engages stakeholders throughout the change process, employing techniques to build support, address concerns, and foster participation in change initiatives. 6. Implements change management plans, coordinating actions, monitoring progress, and adjusting as necessary to ensure the success of change initiatives. 7. Manages resistance to change, identifying sources of opposition and employing strategies to address resistance constructively and supportively. 8. Evaluates the effectiveness of change management efforts, analysing outcomes to determine the impact of change initiatives and identifying lessons learned for future change efforts. 9. Cultivates resilience and adaptability in teams, fostering an organizational culture that embraces change as an opportunity for growth and development.

12.9	360° assessment

13. Assessment

Unit learning outcome	Assessment method
13.1	Exam
13.2	Report
13.3	Practical assignment
13.4	360° assessment
13.5	360° assessment
13.6	Practical assignment
13.7	360° assessment
13.8	Self-reflection report
13.9	Self-reflection report

14. PLO Soft Skills - EQF 6
The learner has demonstrated the ability to effectively apply a wide range of soft skills in diverse professional and personal contexts. This includes mastering communication, collaboration, problem-solving, and adaptability, as well as the ability to manage change and conflict, think critically, and innovate.
Unit learning outcomes
1. Collaborates within teams, contributing positively to group efforts, sharing responsibility, and supporting colleagues to achieve collective goals. 2. Solves problems creatively and efficiently, applying logical and innovative thinking to overcome challenges and optimize outcomes. 3. Delivers impactful presentations, effectively using verbal and visual communication to engage audiences and clearly convey information. 4. Cultivates an innovative mindset, embracing and fostering creativity, questioning conventional approaches, and generating novel solutions. 5. Communicates effectively across a variety of platforms and media, adapting messages for different audiences and purposes to enhance understanding and engagement. 6. Thinks critically, analysing situations, evaluating diverse perspectives, and synthesizing information to make informed decisions. 7. Manages conflicts constructively, employing negotiation and mediation skills to resolve disputes and maintain harmonious relationships.

14. Assessment

Unit learning outcome	Assessment method
14.1	360° assessment
14.2	Practical assignment
14.3	360° assessment
14.4	Self-reflection report
14.5	360° assessment
14.6	Self-reflection report
14.7	360° assessment

EDUCATIONAL PROFILE

Data scientists

EQF 7

This educational profile belongs to the field of Software Engineering and is covered by relevant references in ESCO

Data Scientist EQF 7

Role Description:

Data scientists find and interpret rich data sources, manage large amounts of data, merge data sources, ensure consistency of datasets, and create visualisations to aid in understanding data. They build mathematical models using data, present and communicate data insights and findings to specialists and scientists in their team and if required, to a non-expert audience, and recommend ways to apply the data.

(Source: https://esco.ec.europa.eu/en/classification/occupation?uri=http://data.europa.eu/esco/occupation/258e46f9-0075-4a2e-adae-1ff0477e0f30)

Role Description at specific EQF 6:

Data scientists at EQF 7 command highly specialized knowledge, using AI and machine learning to interpret and merge vast data sources effectively. They build advanced models and create impactful visualizations to communicate insights. Responsible for leading data-driven projects, they ensure secure and ethical use of AI, incorporating change management and innovation strategies to drive business intelligence and future AI applications.

Programme Learning Outcomes (PLO)

1. PLO Deep Learning - EQF 7
The learner has demonstrated the ability to critically analyse and synthesize deep learning concepts and methodologies, as well as to develop and implement advanced deep learning models in complex, interdisciplinary contexts. This includes taking responsibility for managing the development process of these models and contributing to the advancement of knowledge and practice within the field of deep learning.
Unit learning outcomes
1. Critically evaluates the theoretical underpinnings of deep learning, including neural network architectures, optimization algorithms, and loss functions, to understand their applicability and limitations in various domains. 2. Designs innovative deep learning models by integrating knowledge from computational theory, data science, and domain-specific requirements to address complex problems, ensuring the models are efficient, scalable, and ethical. 3. Develops advanced deep learning models using current frameworks and tools, demonstrating the ability to manage datasets, pre-process data, and optimize model performance in unpredictable and multifaceted environments. 4. Analyses complex datasets using deep learning models to extract meaningful patterns and insights, applying critical thinking to assess the validity and reliability of the findings in a specific context. 5. Reflects on the ethical, legal, and social implications of deploying deep learning models, including considerations of bias, fairness, transparency, and accountability, leading discussions on ethical AI development practices. 6. Collaborates effectively in interdisciplinary teams to design, develop, and deploy deep learning solutions, demonstrating leadership in guiding strategic approaches to problem-solving and innovation. 7. Communicates complex deep learning concepts, methodologies, and outcomes clearly and effectively to both technical and non-technical stakeholders, adapting the communication style as necessary to ensure understanding and ethical use of AI technology. 8. Applies innovative problem-solving skills to extend the frontiers of knowledge in deep learning, contributing to the development of new methodologies, applications, or approaches that integrate knowledge from different fields. 9. Manages the lifecycle of deep learning projects, from conceptualization through development and evaluation, demonstrating the ability to adapt to new challenges and requirements in complex and unpredictable environments.

1. Assessment

Unit learning outcome	Assessment method
1.1	Self-reflection report
1.2	Practical assignment
1.3	Practical assignment
1.4	Exam

1.5	Self-reflection report
1.6	360° assessment
1.7	360° assessment
1.8	Practical assignment
1.9	360° assessment

2. PLO AI Technologies - EQF 7

The learner has demonstrated the ability to critically evaluate and apply various AI technologies across different domains, managing complex projects that innovate and integrate AI solutions, thereby enhancing professional practice and contributing to the field.

Unit learning outcomes

1. Assesses the capabilities and limitations of different AI technologies, including machine learning, neural networks, and natural language processing, within diverse operational environments.
2. Integrates AI technologies to create comprehensive systems that improve decision-making and operational efficiency in business, healthcare, or other domains.
3. Implements AI solutions using best practices in software engineering and data management, ensuring scalability, security, and compliance with regulatory standards.
4. Critiques the impact of AI technologies on society, addressing ethical considerations like privacy, bias, and job displacement, and proposes mitigation strategies.
5. Fosters multidisciplinary collaboration in developing AI technologies, demonstrating leadership and effective communication in team settings.
6. Innovates with AI technologies to solve novel or unstructured problems, contributing to new knowledge and methods in the field.
7. Leads strategic planning and execution of AI projects, ensuring alignment with organizational goals and adapting to new technological advancements and market trends.
8. Disseminates findings and developments in AI technologies through scholarly articles, conferences, or workshops, enhancing the knowledge base and application of AI in various fields.

2. Assessment

Unit learning outcome	Assessment method
2.1	Report
2.2	Practical assignment
2.3	Practical assignment
2.4	Self-reflection report
2.5	360° assessment
2.6	Practical assignment
2.7	360° assessment

2.8	360° assessment

3. PLO ML Ops - EQF 7
The learner has demonstrated the ability to design, implement, and manage ML Ops systems that efficiently operationalize machine learning models within production environments, ensuring scalable, reproducible, and ethical AI solutions.
Unit learning outcomes
1. Designs robust ML Ops architectures that integrate machine learning models with production systems to streamline deployment, monitoring, and maintenance processes. 2. Implements continuous integration, continuous delivery (CI/CD) pipelines for machine learning applications, demonstrating proficiency in automating model training, testing, and deployment. 3. Optimizes machine learning pipelines for performance and efficiency, applying best practices in data handling, model versioning, and experiment tracking. 4. Evaluates the effectiveness and efficiency of ML Ops systems, using metrics to monitor model performance and resource utilization in real-world scenarios. 5. Collaborates with data scientists, developers, and IT professionals to ensure ML Ops strategies align with organizational goals and technical requirements. 6. Adapts ML Ops practices to emerging technologies and methodologies, maintaining agility in dynamic and complex environments. 7. leads cross-functional teams in the development and implementation of ML Ops initiatives, taking responsibility for project outcomes and strategic alignment. 8. Communicates the strategic value and operational impact of ML Ops to stakeholders, including technical teams, management, and external partners, ensuring transparency and alignment with business objectives.

3. Assessment

Unit learning outcome	Assessment method
3.1	Practical assignment
3.2	Practical assignment
3.3	Practical assignment
3.4	Report
3.5	360° assessment
3.6	Practical assignment
3.7	360° assessment
3.8	360° assessment

4. PLO Machine Learning - EQF 7
The learner has demonstrated the ability to independently develop, evaluate, and refine machine learning models, using advanced techniques to address and solve complex, real-world problems across various sectors. This includes leading projects that integrate machine learning into existing systems, enhancing their efficiency and effectiveness.
Unit learning outcomes
1. Independently develops robust machine learning models using advanced algorithms and techniques, tailored to solve specific problems in areas such as finance, healthcare, or technology. 2. Critically evaluates the performance of machine learning models using sophisticated validation techniques to ensure accuracy, reliability, and generalizability of the results. 3. Optimizes machine learning algorithms and systems for improved performance, focusing on aspects such as computational efficiency, model accuracy, and data handling. 4. Integrates machine learning models into existing business processes and systems, demonstrating the ability to enhance operational capabilities and address strategic business goals. 5. Leads multidisciplinary teams in the design and implementation of machine learning projects, taking responsibility for decision-making, strategic direction, and project outcomes. 6. Applies innovative approaches to extend the capabilities of machine learning, exploring new algorithms, data sources, and modelling techniques to advance the field. 7. Effectively communicates complex machine learning concepts and results to stakeholders, including technical and non-technical audiences, ensuring transparency, and facilitating informed decision-making. 8. Assesses the ethical implications of machine learning applications, ensuring that models adhere to ethical standards and contribute positively to societal goals.

4. Assessment

Unit learning outcome	Assessment method
4.1	Practical assignment
4.2	Self-reflection report
4.3	Practical assignment
4.4	Practical assignment
4.5	360° assessment
4.6	Practical assignment
4.7	360° assessment

4.8	Self-reflection report

5. PLO Explainable AI - EQF 7
The learner has demonstrated the ability to design, implement, and evaluate artificial intelligence (AI) systems that are not only effective but also transparent and understandable by humans, ensuring these systems can be audited and trusted by users and stakeholders. This capability includes leading the integration of explainable AI components into broader AI projects to enhance accountability and foster trust in AI applications.
Unit learning outcomes
1. Designs AI systems with a focus on explainability, ensuring that all outputs of AI models can be interpreted by end-users and stakeholders. 2. Implements techniques such as feature importance scores, model-agnostic methods, and visualization of AI decision paths to make complex AI models more understandable. 3. Evaluates the effectiveness of explainable AI models by comparing their performance and transparency with traditional AI models, ensuring that explainability does not compromise system performance. 4. Researches and applies the latest advancements in explainable AI to remain at the forefront of the field, incorporating innovative methods that enhance transparency without sacrificing functionality. 5. Communicates the importance and benefits of explainable AI to a variety of audiences, including technical teams, business stakeholders, and regulatory bodies, highlighting how transparency leads to better trust and adoption. 6. Critically assesses AI models for biases and ethical implications, ensuring that explanations accurately reflect the decision-making process and do not mislead users. 7. Leads cross-functional teams in projects that require the integration of explainable AI, coordinating efforts between data scientists, developers, and business analysts to meet project goals and compliance requirements. 8. Advocates for ethical AI practices, using explainability as a cornerstone for ethical discussions and decision-making in AI development and deployment.

5. Assessment

Unit learning outcome	Assessment method
5.1	Practical assignment
5.2	Practical assignment
5.3	Report
5.4	Report

5.5	360° assessment
5.6	Self-reflection report
5.7	360° assessment
5.8	360° assessment

6. PLO Big Data & Data Analytics - EQF 7
The learner has demonstrated the ability to effectively design, implement, and lead advanced data analytics projects that leverage big data technologies to extract meaningful insights from large, diverse datasets. This includes managing projects that integrate big data solutions into business or research environments, enhancing decision-making processes and strategic development.
Unit learning outcomes
1. Designs and implements robust big data infrastructures that can efficiently process and store massive volumes of data, using advanced technologies like Hadoop, Spark, and NoSQL databases. 2. Develops and applies sophisticated data analytics algorithms and models to big data sets to uncover patterns, trends, and insights that support strategic decision-making. 3. Manages the entire lifecycle of data analytics projects, from data collection and cleaning to analysis and reporting, ensuring alignment with organizational goals and compliance with data privacy laws. 4. Evaluates the performance of big data systems and analytics approaches, using metrics to ensure scalability, efficiency, and accuracy in real-world applications. 5. Innovates with machine learning and artificial intelligence techniques to enhance the capabilities of data analytics, pushing the boundaries of what can be achieved with big data. 6. Leads multidisciplinary teams in data-driven projects, fostering collaboration among data scientists, IT specialists, and business stakeholders to ensure project success. 7. Communicates complex data insights to non-technical audiences, translating analytical findings into actionable business strategies and clear, understandable presentations. 8. Advocates for responsible data usage, ensuring that big data projects adhere to ethical standards and contribute positively to societal challenges.

6. Assessment

Unit learning outcome	Assessment method
6.1	Practical assignment
6.2	Practical assignment
6.3	360° assessment
6.4	Report
6.5	Practical assignment
6.6	360° assessment
6.7	360° assessment

6.8	360° assessment

7. PLO Human-Centered AI - EQF 7
The learner has demonstrated the ability to design and lead the development of AI systems that are user-friendly, ethical, and transparent, integrating human-centered design principles into AI development to enhance user trust and engagement.
Unit learning outcomes
1. Designs AI solutions that incorporate human-centered design principles, ensuring that the end user's needs and experiences are at the forefront of AI development. 2. Implements interactive AI systems that facilitate effective human-AI collaboration, enhancing user satisfaction and system usability. 3. Evaluates AI systems from a human-centered perspective, assessing usability, accessibility, and the ethical implications of AI technologies to ensure they align with human values. 4. Innovates by applying the latest research in psychology, cognitive science, and user experience design to AI development, creating more intuitive and empathetic AI systems. 5. Leads interdisciplinary teams that include UX designers, psychologists, and AI developers, fostering a collaborative environment where diverse perspectives enhance the human-centered approach to AI. 6. Communicates the benefits and limitations of human-centered AI systems to stakeholders, including technical teams, business leaders, and end-users, ensuring clear understanding and appropriate expectations. 7. Advocates for ethical standards in AI development, emphasizing the importance of transparency, fairness, and accountability in systems that impact human users. 8. Critically assesses societal impacts of AI, considering how AI systems can be designed to contribute positively to societal needs and mitigate potential harms.

7. Assessment

Unit learning outcome	Assessment method
7.1	Practical assignment
7.2	Practical assignment
7.3	Report
7.4	Practical assignment
7.5	360° assessment
7.6	360° assessment
7.7	360° assessment
7.8	Self-reflection report

8. PLO AI Ethics - EQF 7
The learner has demonstrated the ability to critically analyse and navigate the ethical challenges associated with AI technologies, developing, and implementing strategies to ensure AI systems are designed and used in a responsible and ethical manner.
Unit learning outcomes
1. Analyse the ethical implications of AI systems, identifying potential risks and benefits to individuals and society, and proposing balanced solutions to mitigate ethical concerns. 2. Develop ethical guidelines for AI projects, ensuring that all phases of AI development, from design to deployment, adhere to these principles to protect user privacy and promote fairness. 3. Evaluate AI systems for ethical compliance, using established frameworks and tools to assess the transparency, accountability, and fairness of AI technologies. 4. Lead discussions and workshops on AI ethics, educating and engaging stakeholders from various backgrounds to foster a broader understanding and commitment to ethical AI practices. 5. Innovate in the creation of tools and methods for ethical AI, contributing to the development of new ways to address ethical issues in AI research and practical applications. 6. Advocate for policies and regulations that encourage ethical AI practices, influencing public and private sector approaches to AI development and governance. 7. Collaborate with ethicists, technologists, and business leaders to integrate ethical considerations into the corporate and public-sector use of AI. 8. Research and apply interdisciplinary knowledge from philosophy, law, social science, and technology to enrich the understanding and application of AI ethics.

8. Assessment

Unit learning outcome	Assessment method
8.1	Self-reflection report
8.2	Practical assignment
8.3	Report
8.4	360° assessment
8.5	Practical assignment
8.6	360° assessment
8.7	360° assessment
8.8	360° assessment

9. PLO AI Futures and Innovation - EQF 7
The learner has demonstrated the ability to critically assess and creatively engage with emerging AI technologies, predicting future trends and spearheading innovative projects that explore new possibilities and applications of AI in various fields.
Unit learning outcomes
1. Assess the emerging trends in AI technology, evaluating potential future developments and their implications for various industries and societal norms. 2. Develop innovative AI applications, utilizing cutting-edge AI technologies and methodologies to create novel solutions that address unmet needs or open new markets. 3. Lead multidisciplinary teams in experimental AI projects, fostering a collaborative environment that encourages creative problem-solving and rapid prototyping of new ideas. 4. Evaluate the impact of new AI technologies on existing business models and strategies, providing insights that help organizations adapt to technological changes. 5. Advocate for a proactive approach to AI innovation, emphasizing the importance of ethical considerations, sustainability, and long-term societal impacts in the development of new AI technologies. 6. Communicate the potential and risks of future AI innovations to a range of stakeholders, including investors, policymakers, and the public, to foster informed decision-making. 7. Integrate diverse knowledge from fields such as cognitive science, engineering, and digital ethics to enrich AI innovation processes, ensuring that new developments are well-rounded and grounded in interdisciplinary insights. 8. Pioneer research and development in AI, pushing the boundaries of what is technically possible while also considering the practical and ethical challenges associated with advanced AI technologies.

9. Assessment

Unit learning outcome	Assessment method
9.1	Report
9.2	Practical assignment
9.3	360° assessment
9.4	Report
9.5	360° assessment
9.6	360° assessment
9.7	360° assessment
9.8	360° assessment

10. PLO Business Intelligence - EQF 7
The learner has demonstrated the ability to critically analyse large datasets, develop and implement strategic business intelligence (BI) systems, and lead projects that transform data into actionable insights, thereby driving business optimization and innovation.
Unit learning outcomes
1. Develop comprehensive BI strategies that align with organizational goals, utilizing advanced analytics to inform strategic decisions and improve business processes. 2. Implement BI tools and technologies effectively to collect, store, and analyse data, ensuring the delivery of reliable and timely insights. 3. Lead BI projects, managing cross-functional teams to ensure that BI implementations meet time and budget constraints while achieving intended outcomes. 4. Evaluate the effectiveness of BI systems, using performance metrics to assess and optimize the impact of BI on organizational efficiency and competitiveness. 5. Innovate with emerging BI technologies and methodologies, identifying and integrating new tools that enhance the analytical capabilities of the organization. 6. Communicate complex data insights to stakeholders at all levels of the organization, translating data findings into clear, strategic actions that can be easily understood and implemented. 7. Advocate for data-driven culture within the organization, encouraging the use of BI tools across departments to foster informed decision-making. 8. Ensure ethical considerations in data handling and analysis, maintaining compliance with data protection regulations and ensuring integrity in reporting and analytics.

10. Assessment

Unit learning outcome	Assessment method
10.1	Practical assignment
10.2	Practical assignment
10.3	360° assessment
10.4	Report
10.5	Practical assignment
10.6	360° assessment
10.7	360° assessment
10.8	360° assessment

11. PLO AI Awareness - EQF 7
The learner has demonstrated the ability to comprehensively understand and communicate the foundational principles of AI, its current and potential applications, and the ethical, legal, and societal challenges associated with its deployment.
Unit learning outcomes
1. Understand the fundamental concepts of AI, including machine learning, deep learning, neural networks, and their underlying algorithms, to build a solid foundation of AI knowledge. 2. Assess the impact of AI technologies on various sectors such as healthcare, finance, manufacturing, and education, analysing both the opportunities and challenges they present. 3. Communicate effectively about AI to diverse audiences, explaining complex AI concepts in accessible language and contextualizing its benefits and risks. 4. Analyse ethical implications of AI deployments, considering issues such as bias, privacy, and accountability, and proposing strategies to address these concerns. 5. Explore AI's potential for innovation, identifying areas where AI can drive advancements and improve outcomes, while also considering the disruption it may cause. 6. Lead discussions and training sessions on AI literacy within the organization to foster an informed and engaged workforce prepared to adapt to AI-driven changes. 7. Advocate for responsible AI use, promoting policies and practices that ensure AI technologies are implemented in a fair, ethical, and transparent manner. 8. Stay informed about the latest developments in AI, maintaining an ongoing awareness of emerging technologies, research findings, and regulatory changes to remain current in the field.

11. Assessment

Unit learning outcome	Assessment method
11.1	Exam
11.2	Report
11.3	360° assessment
11.4	Self-reflection report
11.5	Report
11.6	360° assessment
11.7	360° assessment
11.8	Self-reflection report

12. PLO Cyber and Data Security - EQF 7
The learner has demonstrated the ability to design, implement, and lead comprehensive cybersecurity strategies that protect information assets against emerging threats and vulnerabilities, while ensuring compliance with international data protection regulations.
Unit learning outcomes
1. Analyse and mitigate security risks associated with organizational data assets, utilizing advanced risk assessment tools and techniques to identify vulnerabilities and threats. 2. Design and implement robust security frameworks that incorporate best practices in cybersecurity, including the use of encryption, intrusion detection systems, and secure software development life cycles. 3. Develop policies and procedures that enforce data security standards and regulatory compliance, including GDPR and other international data protection laws. 4. Lead cybersecurity incident response teams, coordinating efforts to quickly address and mitigate the impact of security breaches. 5. Evaluate the effectiveness of security measures by regularly conducting security audits and penetration testing to ensure systems are resilient against attacks. 6. Train and mentor staff on cybersecurity best practices, raising awareness and fostering a security-minded culture within the organization. 7. Stay abreast of the latest developments in cybersecurity technology and threat landscapes, continuously updating and adapting security strategies to address new challenges. 8. Advocate for ethical considerations in data handling and security practices, ensuring that the privacy and rights of individuals are protected in the face of increasing digital surveillance and data collection.

12. Assessment

Unit learning outcome	Assessment method
12.1	Report
12.2	Practical assignment
12.3	Practical assignment
12.4	360° assessment
12.5	Report
12.6	360° assessment
12.7	360° assessment
12.8	360° assessment

13. PLO Generative AI - EQF 7
The learner has demonstrated the ability to design, implement, and evaluate generative AI models, leveraging their capabilities to innovate and drive forward creative solutions in various sectors such as media, healthcare, and technology.
Unit learning outcomes
1. Design and implement advanced generative AI models, such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Transformer models, to generate novel images, texts, and data structures. 2. Evaluate the effectiveness and safety of generative AI models, ensuring they produce high-quality, innovative outputs while addressing potential risks like misinformation or unethical use. 3. Optimize generative models for efficiency and scalability, ensuring they can be deployed effectively in diverse environments, including cloud platforms and edge devices. 4. Knowledge in fine tuning and customizing generative models and use of transfer learning while implementing strategies to identify and mitigate biases in generative AI outputs. 5. Apply generative AI in novel applications, exploring uses in fields such as synthetic data generation for training other AI models, creative arts, and product design. 6. Lead projects and teams in the development of generative AI applications, managing cross-disciplinary groups to foster innovation and ensure project alignment with strategic goals. 7. Communicate the capabilities and limitations of generative AI, educating stakeholders on both the potential and the challenges of generative models, ensuring informed decision-making. 8. Stay abreast of technological advancements in the field of generative AI, incorporating the latest research and tools into ongoing projects to maintain cutting-edge knowledge and application. 9. Advocate for responsible use of generative AI technologies, ensuring that ethical considerations are integrated into the development and deployment processes to mitigate harm and bias.

13. Assessment

Unit learning outcome	Assessment method
13.1	Practical assignment
13.2	Report
13.3	Practical assignment
13.4	Exam
13.5	Practical assignment
13.6	360° assessment
13.7	360° assessment
13.8	Self-reflection report
13.9	360° assessment

14. PLO Change Management - EQF 6
The learner has demonstrated the ability to effectively lead and manage change processes within organizations, employing strategies to facilitate smooth transitions, overcome resistance, and ensure stakeholder engagement. This includes understanding the dynamics of organizational change, communicating effectively to align team and organizational goals, and applying change management models to support and sustain organizational transformation.
Unit learning outcomes
1. Understands the principles and theories of change management, including the factors driving change, the stages of change processes, and the impact of change on organizations and individuals. 2. Assesses organizational readiness for change, evaluating factors such as culture, resources, and stakeholder attitudes to plan effective change initiatives. 3. Designs change management strategies, developing plans that outline objectives, actions, timelines, and resources needed to achieve successful change. 4. Communicates change effectively, using clear, persuasive messaging to convey the reasons for change, the benefits of the change process, and the expected outcomes to various stakeholders. 5. Engages stakeholders throughout the change process, employing techniques to build support, address concerns, and foster participation in change initiatives. 6. Implements change management plans, coordinating actions, monitoring progress, and adjusting as necessary to ensure the success of change initiatives. 7. Manages resistance to change, identifying sources of opposition and employing strategies to address resistance constructively and supportively. 8. Evaluates the effectiveness of change management efforts, analysing outcomes to determine the impact of change initiatives and identifying lessons learned for future change efforts. 9. Cultivates resilience and adaptability in teams, fostering an organizational culture that embraces change as an opportunity for growth and development.

14. Assessment

Unit learning outcome	Assessment method
14.1	Exam
14.2	Self-reflection report
14.3	Practical assignment
14.4	360° assessment
14.5	360° assessment
14.6	Practical assignment
14.7	360° assessment
14.8	Report
14.9	360° assessment

15. PLO Soft Skills - EQF 7
The learner has demonstrated the ability to integrate and apply a broad range of advanced soft skills to lead teams, manage change, solve complex problems, and communicate effectively, enhancing organizational performance and driving innovation.
Unit learning outcomes
1. Masters advanced communication techniques, tailoring messaging and employing diverse media to effectively reach and engage varied audiences in different contexts. 2. Leads and enhances team performance through effective collaboration, motivational strategies, and conflict resolution, fostering a cooperative and productive workplace environment. 3. Develops and implements creative problem-solving strategies, using innovative and critical thinking to address complex challenges and achieve strategic goals. 4. Delivers compelling presentations, utilizing state-of-the-art presentation tools and persuasive communication techniques to influence and drive decisions. 5. Cultivates an innovative mindset, encouraging creativity and continuous improvement in personal and organizational practices. 6. Applies critical thinking to evaluate information, make informed decisions, and develop well-reasoned arguments to support organizational objectives. 7. Resolves conflicts effectively, using advanced negotiation and mediation skills to handle disputes and maintain positive relationships among stakeholders.

15. Assessment

Unit learning outcome	Assessment method
15.1	360° assessment
15.2	360° assessment
15.3	Practical assignment
15.4	360° assessment
15.5	Self-reflection report
15.6	Self-reflection report
15.7	360° assessment

EDUCATIONAL PROFILE

Machine learning engineer

EQF 6

This educational profile belongs to the field of Software Engineering and is covered by relevant references in ESCO

Machine learning engineer EQF 6

(ICT Intelligent systems designer) Role Description:

Machine learning engineer apply methods of artificial intelligence in engineering, robotics and computer science to design programs which simulate intelligence including thinking models, cognitive and knowledge-based systems, problem solving, and decision making. They also integrate structured knowledge into computer systems (ontologies, knowledge bases) in order to solve complex problems normally requiring a high level of human expertise or artificial intelligence methods.

(Source: https://esco.ec.europa.eu/en/classification/occupation?uri=http://data.europa.eu/esco/occupation/35553663-deab-4d9a-bf22-15c1625d28e8)

(ICT Intelligent systems designer) Role Description at specific EQF 6:

Machine learning engineers at EQF 6 design and develop AI-driven programs in fields like engineering and robotics, incorporating advanced techniques in deep learning and AI ethics. They create and integrate complex knowledge systems to tackle problems requiring high-level expertise, ensuring secure and effective AI implementations and managing change.

Programme Learning Outcomes (PLO)

1. PLO Deep Learning - EQF 6
The learner has demonstrated the ability to design and implement deep learning models and architectures, encompassing their development, implementation, and application across various domains, while integrating computational and organizational considerations and evaluating their societal and technological impacts.

Unit learning outcomes
1. Analyzes the fundamental principles of neural networks, focusing on their structure and function, to understand the underlying mechanics of deep learning technologies in a professional context. 2. Identifies suitable applications for deep and shallow neural architectures by evaluating their types and functionalities, ensuring the selection aligns with specific project requirements and industry standards. 3. Designs deep learning models by selecting appropriate architectures and frameworks, demonstrating innovation in model architecture to meet the unique needs of diverse applications. 4. Implements deep learning models using relevant frameworks and libraries, showcasing proficiency in parameter tuning, performance optimization, and addressing computational challenges to enhance model efficiency and effectiveness. 5. Evaluates the performance of deep learning models using standard metrics, interpreting results to make informed decisions about model improvements, adjustments, and the selection of models for specific tasks in real-world applications. 6. Applies deep learning techniques to solve problems in various domains such as image recognition, natural language processing, and predictive analytics, demonstrating the ability to adapt models to new challenges and datasets within a given context. 7. Discusses the ethical implications of deploying deep learning models, including issues related to fairness, privacy, transparency, and accountability, proposing strategies to mitigate risks and promote ethical AI development in diverse societal applications. 8. Critiques the current trends and advancements in deep learning, assessing their potential impact on future technologies, industry practices, and societal norms, with a focus on sustainable and responsible innovation. 9. Collaborates effectively in teams to design, implement, and evaluate deep learning projects, demonstrating the ability to communicate complex concepts to stakeholders with varying levels of technical expertise, facilitating informed decision-making and promoting interdisciplinary understanding. 10. Engages with the AI community by participating in discussions, debates, and collaborative projects, contributing to the advancement of ethical practices and innovative technologies in deep learning.

1. Assessment

Unit learning outcome	Assessment method
1.1	Exam
1.2	Report
1.3	Practical assignment

1.4	Practical assignment
1.5	Practical assignment
1.6	Self-reflection report
1.7	Self-reflection report
1.8	360° assessment
1.9	360° assessment

2. PLO AI Technologies - EQF 6

The learner has demonstrated the ability to know and effectively utilize AI frameworks and libraries for the development and deployment of AI models and technologies, applying these tools across various domains to solve complex problems while considering ethical implications and industry standards.

Unit learning outcomes

1. Selects appropriate AI frameworks and libraries for specific project needs, demonstrating an understanding of their strengths, limitations, and optimal use cases in the development of AI models.
2. Develops AI models using chosen frameworks and libraries, showcasing the ability to integrate various AI technologies to create efficient, scalable, and effective solutions for real-world applications.
3. Analyses the performance and efficiency of AI models and technologies, employing appropriate metrics and tests to ensure they meet project specifications and performance goals.
4. Adapts existing AI models to new contexts and problems, demonstrating innovation and flexibility in applying AI technologies to a diverse range of challenges and domains.
5. Communicates technical details and project outcomes related to AI technologies effectively to both technical and non-technical audiences, ensuring clarity and facilitating informed decision-making.
6. Discusses the ethical implications of deploying AI technologies, including issues related to fairness, privacy, transparency, and accountability, proposing strategies to mitigate risks and promote ethical AI development in diverse societal applications.
7. Critiques the current trends and advancements in AI, assessing their potential impact on future technologies, industry practices, and societal norms, with a focus on sustainable and responsible innovation.
8. Collaborates with multidisciplinary teams on AI projects, leveraging collective expertise to enhance the development, implementation, and evaluation of AI technologies, fostering an environment of knowledge sharing and innovation.
9. Demonstrates an ongoing commitment to advancing skills and knowledge in the field of AI by staying updated on emerging AI frameworks, libraries, and technologies.

2. Assessment

Unit learning outcome	Assessment method
2.1	Exam
2.2	Practical assignment
2.3	Exam
2.4	Practical assignment
2.5	360° assessment
2.6	Self-reflection report
2.7	Self-reflection report
2.8	360° assessment
2.9	360° assessment

3. PLO ML Ops - EQF 6

The learner has demonstrated the ability to proficiently implement AI and machine learning projects, utilizing ML Ops principles to streamline development, ensure high-quality outputs, and manage projects efficiently. This includes deploying scalable AI solutions, managing the lifecycle of machine learning models, and applying quality control measures to maintain accuracy and reliability in AI applications.

Unit learning outcomes

1. Implements AI projects by applying foundational ML Ops principles, ensuring efficient transition from development to production while maintaining high standards of scalability, performance, and reliability.
2. Utilizes project management techniques specific to ML Ops to plan, execute, and monitor AI projects, ensuring alignment with objectives, timelines, and stakeholder expectations.
3. Integrates continuous integration and continuous delivery (CI/CD) pipelines for machine learning projects, automating the testing, deployment, and monitoring of AI models to enhance productivity and reduce time to market.
4. Applies AI quality control measures throughout the machine learning project lifecycle, employing techniques for data validation, model testing, and performance monitoring to ensure the accuracy and reliability of AI applications.
5. Adapts machine learning models to evolving data and requirements, leveraging ML Ops tools and practices for model versioning, updating, and retraining to maintain high performance in dynamic environments.
6. Communicates effectively with stakeholders involved in AI projects, including technical teams, management, and external partners, ensuring clear understanding of project goals, progress, and outcomes.
7. Evaluates the ethical and social implications of deploying AI solutions, implementing strategies to address potential biases, privacy concerns, and ethical issues in machine learning applications.
8. Stays informed about emerging technologies, practices, and standards to lead and innovate in the implementation and management of AI projects.

3. Assessment

Unit learning outcome	Assessment method
3.1	Practical assignment
3.2	Practical assignment
3.3	Practical assignment
3.4	Practical assignment
3.5	Report
3.6	360° assessment
3.7	Self-reflection report
3.8	Self-reflection report

4. PLO Machine Learning - EQF 6

The learner has demonstrated the ability to design, implement, and evaluate machine learning models and algorithms to address (complex) problems across various domains.

Unit learning outcomes

1. Applies fundamental machine learning concepts and algorithms to address predictive analytics, classification, and clustering tasks, employing appropriate tools and techniques for model development within diverse real-world contexts.
2. Evaluates machine learning models using established metrics and validation techniques, critically interpreting results to ensure the models' reliability, accuracy, and applicability to specific problem domains.
3. Designs data pre-processing and feature engineering strategies to enhance machine learning model performance, demonstrating an understanding of the influence of data quality and feature selection on model outcomes.
4. Assesses the ethical implications of machine learning projects, identifying potential biases, fairness issues, and privacy concerns, and developing strategies to address these challenges in the design and deployment of models.
5. Communicates machine learning findings effectively to both technical and non-technical stakeholders, ensuring clarity and facilitating informed decision-making.
6. Collaborates with interdisciplinary teams on machine learning projects, leveraging collective expertise to overcome complex challenges and innovate while upholding ethical standards and achieving practical solutions.
7. Engages in professional development and community activities related to machine learning, including attending workshops, contributing to forums, and participating in collaborative research, to stay informed about industry trends and ethical discussions.

4. Assessment

Unit learning outcome	Assessment method
4.1	Practical assignment
4.2	Report
4.3	Practical assignment
4.4	Self-reflection report
4.5	360° assessment
4.6	360° assessment
4.7	360° assessment

5. PLO Explainable AI - EQF 6

The learner has demonstrated the ability to design, implement and evaluate AI models that are both transparent and interpretable, ensuring that stakeholders can understand, trust, and effectively manage AI solutions. Also, the learner has demonstrated the ability to assess the explainability level of an AI system. This includes applying principles and techniques of explainable AI to enhance the accountability, fairness, and ethical use of AI technologies across various domains.

Unit learning outcomes

1. Develops AI models using explainable AI techniques to ensure transparency and interpretability, enhancing the ability of users to understand how AI decisions are made.
2. Analyses existing AI models to assess and measure their explainability, employing methods and metrics to evaluate the transparency and interpretability of model decisions and outputs.
3. Implements strategies to improve the explainability of existing AI models, incorporating techniques such as feature importance scoring, model simplification, and visualization tools to make AI decision-making processes more accessible to non-expert users.
4. Evaluates the impact of explainable AI on model performance, balancing the trade-offs between transparency, accuracy, and complexity to meet both technical and ethical standards.
5. Conveys the principles and benefits of explainable AI to stakeholders, including developers, end-users, and decision-makers, ensuring that the rationale behind AI decisions is clear and comprehensible.
6. Collaborates with interdisciplinary teams to integrate explainable AI practices into the development lifecycle, fostering a culture of transparency and accountability in AI applications.
7. Navigates ethical and legal considerations associated with AI explainability, addressing concerns such as bias, fairness, and privacy to ensure responsible AI deployment.
8. Stays up to date with emerging techniques, tools, and best practices to lead advancements in creating transparent and understandable AI systems.

5. Assessment

Unit learning outcome	Assessment method
5.1	Practical assignment
5.2	Exam
5.3	Practical assignment
5.4	Report
5.5	Report
5.6	360° assessment
5.7	Self-reflection report
5.8	Self-reflection report

6. PLO AI Ethics - EQF 6
The learner has demonstrated the ability to critically assess the ethical implications of AI technologies, develop and implement strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.
Unit learning outcomes
1. Identifies ethical considerations and challenges in AI development and deployment, such as bias, fairness, transparency, and accountability, emphasizing their importance for respecting human rights and societal norms. 2. Develops ethical guidelines and frameworks for AI projects, integrating ethical considerations into the AI lifecycle from design through deployment, to promote ethical AI practices within organizations and society. 3. Implements strategies to mitigate ethical risks in AI applications, employing methods for detecting and correcting biases, ensuring privacy, and maintaining transparency and accountability in AI systems. 4. Advocates for responsible AI by communicating the significance of ethical considerations in AI to diverse audiences, including technologists, policymakers, and the public, to foster an ethical AI culture. 5. Assesses AI projects for ethical implications, utilizing ethical frameworks and principles to evaluate AI's impact on individuals and communities and to ensure alignment with ethical standards and societal values. 6. Collaborates with interdisciplinary teams to address ethical challenges in AI, facilitating discussions and actions that balance technical possibilities with ethical considerations to achieve consensus on responsible AI development and use. 7. Engages in professional and community forums on AI ethics, contributing to the discourse on responsible AI practices and staying informed about emerging ethical issues and solutions in the field. 8. Knowledge of industry-specific laws (national and international) and any kind of regulations that affect AI development to ensure its compliance. 9. Reflects on personal ethical beliefs and practices in relation to AI technologies, committing to ethical professional conduct and continuous learning about ethical challenges and best practices in AI.

6. Assessment

Unit learning outcome	Assessment method
6.1	Report
6.2	Practical assignment
6.3	Practical assignment
6.4	360° assessment
6.5	Self-reflection report
6.6	360° assessment
6.7	360° assessment
6.8	Exam

6.9	Self-reflection report

7. PLO AI Awareness - EQF 6
The learner has demonstrated the ability to understand the fundamentals of artificial intelligence, its applications across various markets, and its transformative impact on business processes. This encompasses an appreciation of AI technologies, their potential for innovation, and the strategic considerations necessary for integrating AI into business operations.
Unit learning outcomes
1. Understands the basic concepts and technologies underlying artificial intelligence, including machine learning, natural language processing, and robotics, recognizing their roles in driving innovation. 2. Identifies key AI applications in the programming application market, assessing the competitive landscape and potential for disruptive innovation across industries. 3. Analyses the implications of AI on business processes, evaluating how AI technologies can optimize operations, enhance customer experiences, and create new business models. 4. Assesses the strategic considerations for integrating AI into business operations, including technical feasibility, cost-benefit analysis, and alignment with business goals. 5. Recognizes the ethical, legal, and societal challenges associated with AI deployment, advocating for responsible AI use that respects privacy, fairness, and transparency. 6. Communicates effectively about AI technologies and their business applications to a range of audiences, fostering AI literacy and supporting informed decision-making within organizations. 7. Collaborates with technical and non-technical teams to explore AI opportunities, facilitating cross-functional understanding and strategic alignment on AI initiatives. 8. Knowledge of current trends in AI technology to evaluate how these might influence industry innovation and competitive strategies. 9. Engages in continuous learning to keep pace with rapid advancements in AI technology and its evolving impact on the business landscape, maintaining an informed perspective on future opportunities and challenges

7. Assessment

Unit learning outcome	Assessment method
7.1	Exam
7.2	Report
7.3	Report
7.4	Self-reflection report
7.5	Self-reflection report
7.6	360° assessment
7.7	360° assessment
7.8	Exam

7.9	360° assessment

8. PLO Cyber and Data Security - EQF 5
The learner has demonstrated the ability to design, implement, and evaluate security measures and protocols to protect data integrity and confidentiality across various digital platforms and systems, effectively managing risks in diverse and unpredictable cybersecurity environments.
Unit learning outcomes
1. Analyses the landscape of cyber threats and vulnerabilities, employing comprehensive and specialized knowledge to identify and assess risks in different technological environments. 2. Implements advanced security measures, such as encryption, firewalls, and intrusion detection systems, to safeguard information assets against unauthorized access and breaches. 3. Develops and tests robust cybersecurity policies and procedures that comply with legal and ethical standards, ensuring data protection and network security across organizational platforms. 4. Manages incident response and recovery operations, demonstrating the ability to effectively handle security breaches and minimize their impact on business operations and data privacy. 5. Evaluates the effectiveness of security protocols through regular audits and updates, adapting strategies to combat evolving cyber threats and ensure continuous protection. 6. Communicates complex cybersecurity concepts and practices to non-specialists, fostering a culture of security awareness and compliance throughout the organization. 7. Leads cybersecurity teams and projects, coordinating efforts to enhance data security, and fostering innovation in response to emerging security challenges and technological advancements.

8. Assessment

Unit learning outcome	Assessment method
8.1	Report
8.2	Practical assignment
8.3	Practical assignment
8.4	360° assessment
8.5	Self-reflection report
8.6	360° assessment
8.7	360° assessment

9. PLO Generative AI - EQF 6
The learner has demonstrated the ability to design, implement, and evaluate generative AI systems, utilizing advanced techniques including prompt engineering for Large Language Models. This includes the capacity to identify AI-generated content, create innovative applications using generative AI models, and apply best practices in prompt engineering to achieve desired outcomes in various industrial domains.
Unit learning outcomes
1. Designs generative AI models to create novel content, including text, images, and audio, demonstrating an understanding of the underlying technologies and their application in generating high-quality, creative outputs. 2. Identifies AI-generated content, employing analytical methods and tools to distinguish between human and machine-generated outputs, addressing concerns related to authenticity, copyright, and ethics. 3. Develops prompt engineering skills, crafting effective prompts to guide generative AI models in producing specific and relevant outputs, optimizing the interaction between users and AI systems for enhanced creativity and efficiency. 4. Implements Large Language Models (LLMs) in generative AI projects, leveraging their capabilities for text generation, language understanding, and complex problem-solving, tailoring model parameters and prompts to specific use cases. 5. Evaluates the performance of generative AI systems, using criteria such as originality and relevance to assess system outputs and guide improvements. 6. Assesses the ethical implications of generative AI systems, considering the impact on stakeholders and societal norms to ensure responsible use and development of AI technologies. 7. Integrates generative AI into diverse applications, from content creation and augmentation to problem-solving and innovation, demonstrating the ability to apply generative AI technologies across various fields and industries. 8. Conveys the principles and potential of generative AI to a broad audience, including technical and non-technical stakeholders, facilitating understanding and ethical use of generative technologies. 9. Engages in continuous learning and professional development in the field of generative AI, staying informed about advancements in AI models, prompt engineering techniques, and emerging ethical standards, to lead in the development of responsible and innovative AI-driven solutions.

9. Assessment

Unit learning outcome	Assessment method
9.1	Practical assignment
9.2	Report
9.3	Practical assignment
9.4	Practical assignment
9.5	Self-reflection report
9.6	Self-reflection report
9.7	360° assessment
9.8	360° assessment
9.9	360° assessment

10. PLO Change Management - EQF 6
The learner has demonstrated the ability to effectively lead and manage change processes within organizations, employing strategies to facilitate smooth transitions, overcome resistance, and ensure stakeholder engagement. This includes understanding the dynamics of organizational change, communicating effectively to align team and organizational goals, and applying change management models to support and sustain organizational transformation.
Unit learning outcomes
1. Understands the principles and theories of change management, including the factors driving change, the stages of change processes, and the impact of change on organizations and individuals. 2. Assesses organizational readiness for change, evaluating factors such as culture, resources, and stakeholder attitudes to plan effective change initiatives. 3. Designs change management strategies, developing plans that outline objectives, actions, timelines, and resources needed to achieve successful change. 4. Communicates change effectively, using clear, persuasive messaging to convey the reasons for change, the benefits of the change process, and the expected outcomes to various stakeholders. 5. Engages stakeholders throughout the change process, employing techniques to build support, address concerns, and foster participation in change initiatives. 6. Implements change management plans, coordinating actions, monitoring progress, and adjusting as necessary to ensure the success of change initiatives. 7. Manages resistance to change, identifying sources of opposition and employing strategies to address resistance constructively and supportively. 8. Evaluates the effectiveness of change management efforts, analysing outcomes to determine the impact of change initiatives and identifying lessons learned for future change efforts. 9. Cultivates resilience and adaptability in teams, fostering an organizational culture that embraces change as an opportunity for growth and development.

10. Assessment

Unit learning outcome	Assessment method
10.1	Exam
10.2	Self-reflection report
10.3	Practical assignment
10.4	360° assessment
10.5	360° assessment
10.6	Practical assignment
10.7	360° assessment
10.8	Report
10.9	360° assessment

11. PLO Soft Skills - EQF 6
The learner has demonstrated the ability to effectively apply a wide range of soft skills in diverse professional and personal contexts. This includes mastering communication, collaboration, problem-solving, and adaptability, as well as the ability to manage change and conflict, think critically, and innovate.
Unit learning outcomes
1. Collaborates within teams, contributing positively to group efforts, sharing responsibility, and supporting colleagues to achieve collective goals. 2. Solves problems creatively and efficiently, applying logical and innovative thinking to overcome challenges and optimize outcomes. 3. Delivers impactful presentations, effectively using verbal and visual communication to engage audiences and clearly convey information. 4. Cultivates an innovative mindset, embracing and fostering creativity, questioning conventional approaches, and generating novel solutions. 5. Communicates effectively across a variety of platforms and media, adapting messages for different audiences and purposes to enhance understanding and engagement. 6. Thinks critically, analysing situations, evaluating diverse perspectives, and synthesizing information to make informed decisions. 7. Manages conflicts constructively, employing negotiation and mediation skills to resolve disputes and maintain harmonious relationships.

11. Assessment

Unit learning outcome	Assessment method
11.1	360° assessment
11.2	Practical assignment
11.3	360° assessment
11.4	Self-reflection report
11.5	360° assessment
11.6	Self-reflection report
11.7	360° assessment

EDUCATIONAL PROFILE

Machine learning engineer

EQF 7

This educational profile belongs to the field of Software Engineering and is covered by relevant references in ESCO

Machine learning engineer EQF 7

(ICT Intelligent systems designer) Role Description:

Machine learning engineer apply methods of artificial intelligence in engineering, robotics and computer science to design programs which simulate intelligence including thinking models, cognitive and knowledge-based systems, problem solving, and decision making. They also integrate structured knowledge into computer systems (ontologies, knowledge bases) in order to solve complex problems normally requiring a high level of human expertise or artificial intelligence methods.

(Source: https://esco.ec.europa.eu/en/classification/occupation?uri=http://data.europa.eu/esco/occupation/35553663-deab-4d9a-bf22-15c1625d28e8)

(ICT Intelligent systems designer) Role Description at specific EQF 6:

Machine learning engineers at EQF 7 wield highly specialized knowledge to pioneer AI applications in fields like engineering and robotics. They innovate by developing advanced methods in deep learning and machine learning, integrating these solutions across disciplines. They lead strategic, complex projects, setting new industry standards and driving technological advancements.

Programme Learning Outcomes (PLO)

1. PLO Deep Learning - EQF 7
The learner has demonstrated the ability to critically analyse and synthesize deep learning concepts and methodologies, as well as to develop and implement advanced deep learning models in complex, interdisciplinary contexts. This includes taking responsibility for managing the development process of these models and contributing to the advancement of knowledge and practice within the field of deep learning.
Unit learning outcomes
1. Critically evaluates the theoretical underpinnings of deep learning, including neural network architectures, optimization algorithms, and loss functions, to understand their applicability and limitations in various domains. 2. Designs innovative deep learning models by integrating knowledge from computational theory, data science, and domain-specific requirements to address complex problems, ensuring the models are efficient, scalable, and ethical. 3. Develops advanced deep learning models using current frameworks and tools, demonstrating the ability to manage datasets, pre-process data, and optimize model performance in unpredictable and multifaceted environments. 4. Analyses complex datasets using deep learning models to extract meaningful patterns and insights, applying critical thinking to assess the validity and reliability of the findings in a specific context. 5. Reflects on the ethical, legal, and social implications of deploying deep learning models, including considerations of bias, fairness, transparency, and accountability, leading discussions on ethical AI development practices. 6. Collaborates effectively in interdisciplinary teams to design, develop, and deploy deep learning solutions, demonstrating leadership in guiding strategic approaches to problem-solving and innovation. 7. Communicates complex deep learning concepts, methodologies, and outcomes clearly and effectively to both technical and non-technical stakeholders, adapting the communication style as necessary to ensure understanding and ethical use of AI technology. 8. Applies innovative problem-solving skills to extend the frontiers of knowledge in deep learning, contributing to the development of new methodologies, applications, or approaches that integrate knowledge from different fields. 9. Manages the lifecycle of deep learning projects, from conceptualization through development and evaluation, demonstrating the ability to adapt to new challenges and requirements in complex and unpredictable environments.

1. Assessment

Unit learning outcome	Assessment method
1.1	Self-reflection report
1.2	Practical assignment
1.3	Practical assignment
1.4	Exam
1.5	Self-reflection report

1.6	360° assessment
1.7	360° assessment
1.8	Practical assignment
1.9	360° assessment

2. PLO AI Technologies - EQF 7
The learner has demonstrated the ability to critically evaluate and apply various AI technologies across different domains, managing complex projects that innovate and integrate AI solutions, thereby enhancing professional practice and contributing to the field.
Unit learning outcomes
1. Assesses the capabilities and limitations of different AI technologies, including machine learning, neural networks, and natural language processing, within diverse operational environments. 2. Integrates AI technologies to create comprehensive systems that improve decision-making and operational efficiency in business, healthcare, or other domains. 3. Implements AI solutions using best practices in software engineering and data management, ensuring scalability, security, and compliance with regulatory standards. 4. Critiques the impact of AI technologies on society, addressing ethical considerations like privacy, bias, and job displacement, and proposes mitigation strategies. 5. Fosters multidisciplinary collaboration in developing AI technologies, demonstrating leadership and effective communication in team settings. 6. Innovates with AI technologies to solve novel or unstructured problems, contributing to new knowledge and methods in the field. 7. Leads strategic planning and execution of AI projects, ensuring alignment with organizational goals and adapting to new technological advancements and market trends. 8. Disseminates findings and developments in AI technologies through scholarly articles, conferences, or workshops, enhancing the knowledge base and application of AI in various fields.

2. Assessment

Unit learning outcome	Assessment method
2.1	Report
2.2	Practical assignment
2.3	Practical assignment
2.4	Self-reflection report
2.5	360° assessment
2.6	Practical assignment
2.7	360° assessment
2.8	360° assessment

3. PLO ML Ops - EQF 7
The learner has demonstrated the ability to design, implement, and manage ML Ops systems that efficiently operationalize machine learning models within production environments, ensuring scalable, reproducible, and ethical AI solutions.
Unit learning outcomes
1. Designs robust ML Ops architectures that integrate machine learning models with production systems to streamline deployment, monitoring, and maintenance processes. 2. Implements continuous integration, continuous delivery (CI/CD) pipelines for machine learning applications, demonstrating proficiency in automating model training, testing, and deployment. 3. Optimizes machine learning pipelines for performance and efficiency, applying best practices in data handling, model versioning, and experiment tracking. 4. Evaluates the effectiveness and efficiency of ML Ops systems, using metrics to monitor model performance and resource utilization in real-world scenarios. 5. Collaborates with data scientists, developers, and IT professionals to ensure ML Ops strategies align with organizational goals and technical requirements. 6. Adapts ML Ops practices to emerging technologies and methodologies, maintaining agility in dynamic and complex environments. 7. leads cross-functional teams in the development and implementation of ML Ops initiatives, taking responsibility for project outcomes and strategic alignment. 8. Communicates the strategic value and operational impact of ML Ops to stakeholders, including technical teams, management, and external partners, ensuring transparency and alignment with business objectives.

3. Assessment

Unit learning outcome	Assessment method
3.1	Practical assignment
3.2	Practical assignment
3.3	Practical assignment
3.4	Report
3.5	360° assessment
3.6	Practical assignment
3.7	360° assessment
3.8	360° assessment

4. PLO HPC and Cloud services - EQF 7
The learner has demonstrated the ability to architect, deploy, and manage high-performance computing and cloud services solutions that meet advanced computing needs across various industries, ensuring scalability, reliability, and security.
Unit learning outcomes
1. Architects scalable and secure HPC and cloud infrastructures that meet the specific computational and data requirements of diverse applications. 2. Conduct detailed performance monitoring and tuning to enhance the efficiency of HPC and cloud applications. 3. Deploys complex applications on HPC and cloud platforms, utilizing automation tools to ensure efficiency and accuracy in resource allocation and service provisioning. 4. Manages HPC and cloud environments, overseeing operational aspects such as performance tuning, cost optimization, and compliance with security standards. 5. Analyses the performance of HPC and cloud systems, employing advanced monitoring tools and techniques to optimize resource utilization and service delivery. 6. Innovates with emerging technologies in HPC and cloud computing, integrating them into existing systems to enhance capabilities and address new market challenges. 7. Collaborates effectively with IT specialists, software developers, and business managers to ensure that HPC and cloud solutions align with organizational goals and user needs. 8. Evaluates new HPC and cloud technologies and services for potential adoption, assessing their strategic impact on business and technology operations. 9. Communicates technical and strategic aspects of HPC and cloud services to a diverse range of stakeholders, ensuring clarity and supporting strategic decision-making processes.

4. Assessment

Unit learning outcome	Assessment method
4.1	Practical assignment
4.2	Practical assignment
4.3	Practical assignment
4.4	360° assessment
4.5	Exam
4.6	Report
4.7	360° assessment
4.8	Report
4.9	Report

5. PLO Machine Learning - EQF 7
The learner has demonstrated the ability to independently develop, evaluate, and refine machine learning models, using advanced techniques to address and solve complex, real-world problems across various sectors. This includes leading projects that integrate machine learning into existing systems, enhancing their efficiency and effectiveness.
Unit learning outcomes
1. Independently develops robust machine learning models using advanced algorithms and techniques, tailored to solve specific problems in areas such as finance, healthcare, or technology. 2. Critically evaluates the performance of machine learning models using sophisticated validation techniques to ensure accuracy, reliability, and generalizability of the results. 3. Optimizes machine learning algorithms and systems for improved performance, focusing on aspects such as computational efficiency, model accuracy, and data handling. 4. Integrates machine learning models into existing business processes and systems, demonstrating the ability to enhance operational capabilities and address strategic business goals. 5. Leads multidisciplinary teams in the design and implementation of machine learning projects, taking responsibility for decision-making, strategic direction, and project outcomes. 6. Applies innovative approaches to extend the capabilities of machine learning, exploring new algorithms, data sources, and modelling techniques to advance the field. 7. Effectively communicates complex machine learning concepts and results to stakeholders, including technical and non-technical audiences, ensuring transparency, and facilitating informed decision-making. 8. Assesses the ethical implications of machine learning applications, ensuring that models adhere to ethical standards and contribute positively to societal goals.

5. Assessment

Unit learning outcome	Assessment method
5.1	Practical assignment
5.2	Self-reflection report
5.3	Practical assignment
5.4	Practical assignment
5.5	360° assessment
5.6	Practical assignment
5.7	360° assessment
5.8	Self-reflection report

6. PLO Explainable AI - EQF 7
The learner has demonstrated the ability to design, implement, and evaluate artificial intelligence (AI) systems that are not only effective but also transparent and understandable by humans, ensuring these systems can be audited and trusted by users and stakeholders. This capability includes leading the integration of explainable AI components into broader AI projects to enhance accountability and foster trust in AI applications.
Unit learning outcomes
1. Designs AI systems with a focus on explainability, ensuring that all outputs of AI models can be interpreted by end-users and stakeholders. 2. Implements techniques such as feature importance scores, model-agnostic methods, and visualization of AI decision paths to make complex AI models more understandable. 3. Evaluates the effectiveness of explainable AI models by comparing their performance and transparency with traditional AI models, ensuring that explainability does not compromise system performance. 4. Researches and applies the latest advancements in explainable AI to remain at the forefront of the field, incorporating innovative methods that enhance transparency without sacrificing functionality. 5. Communicates the importance and benefits of explainable AI to a variety of audiences, including technical teams, business stakeholders, and regulatory bodies, highlighting how transparency leads to better trust and adoption. 6. Critically assesses AI models for biases and ethical implications, ensuring that explanations accurately reflect the decision-making process and do not mislead users. 7. Leads cross-functional teams in projects that require the integration of explainable AI, coordinating efforts between data scientists, developers, and business analysts to meet project goals and compliance requirements. 8. Advocates for ethical AI practices, using explainability as a cornerstone for ethical discussions and decision-making in AI development and deployment.

6. Assessment

Unit learning outcome	Assessment method
6.1	Practical assignment
6.2	Practical assignment
6.3	Report
6.4	Report
6.5	360° assessment
6.6	Self-reflection report
6.7	360° assessment
6.8	360° assessment

7. PLO Big Data & Data Analytics - EQF 7
The learner has demonstrated the ability to effectively design, implement, and lead advanced data analytics projects that leverage big data technologies to extract meaningful insights from large, diverse datasets. This includes managing projects that integrate big data solutions into business or research environments, enhancing decision-making processes and strategic development.
Unit learning outcomes
1. Designs and implements robust big data infrastructures that can efficiently process and store massive volumes of data, using advanced technologies like Hadoop, Spark, and NoSQL databases. 2. Develops and applies sophisticated data analytics algorithms and models to big data sets to uncover patterns, trends, and insights that support strategic decision-making. 3. Manages the entire lifecycle of data analytics projects, from data collection and cleaning to analysis and reporting, ensuring alignment with organizational goals and compliance with data privacy laws. 4. Evaluates the performance of big data systems and analytics approaches, using metrics to ensure scalability, efficiency, and accuracy in real-world applications. 5. Innovates with machine learning and artificial intelligence techniques to enhance the capabilities of data analytics, pushing the boundaries of what can be achieved with big data. 6. Leads multidisciplinary teams in data-driven projects, fostering collaboration among data scientists, IT specialists, and business stakeholders to ensure project success. 7. Communicates complex data insights to non-technical audiences, translating analytical findings into actionable business strategies and clear, understandable presentations. 8. Advocates for responsible data usage, ensuring that big data projects adhere to ethical standards and contribute positively to societal challenges.

7. Assessment

Unit learning outcome	Assessment method
7.1	Practical assignment
7.2	Practical assignment
7.3	360° assessment
7.4	Report
7.5	Practical assignment
7.6	360° assessment
7.7	360° assessment
7.8	360° assessment

8. PLO Human-Centered AI - EQF 7
The learner has demonstrated the ability to design and lead the development of AI systems that are user-friendly, ethical, and transparent, integrating human-centered design principles into AI development to enhance user trust and engagement.
Unit learning outcomes
1. Designs AI solutions that incorporate human-centered design principles, ensuring that the end user's needs and experiences are at the forefront of AI development. 2. Implements interactive AI systems that facilitate effective human-AI collaboration, enhancing user satisfaction and system usability. 3. Evaluates AI systems from a human-centered perspective, assessing usability, accessibility, and the ethical implications of AI technologies to ensure they align with human values. 4. Innovates by applying the latest research in psychology, cognitive science, and user experience design to AI development, creating more intuitive and empathetic AI systems. 5. Leads interdisciplinary teams that include UX designers, psychologists, and AI developers, fostering a collaborative environment where diverse perspectives enhance the human-centered approach to AI. 6. Communicates the benefits and limitations of human-centered AI systems to stakeholders, including technical teams, business leaders, and end-users, ensuring clear understanding and appropriate expectations. 7. Advocates for ethical standards in AI development, emphasizing the importance of transparency, fairness, and accountability in systems that impact human users. 8. Critically assesses societal impacts of AI, considering how AI systems can be designed to contribute positively to societal needs and mitigate potential harms.

8. Assessment

Unit learning outcome	Assessment method
8.1	Practical assignment
8.2	Practical assignment
8.3	Report
8.4	Practical assignment
8.5	360° assessment
8.6	360° assessment
8.7	360° assessment
8.8	Self-reflection report

9. PLO AI Ethics - EQF 6
The learner has demonstrated the ability to critically assess the ethical implications of AI technologies, develop and implement strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.
Unit learning outcomes
1. Identifies ethical considerations and challenges in AI development and deployment, such as bias, fairness, transparency, and accountability, emphasizing their importance for respecting human rights and societal norms. 2. Develops ethical guidelines and frameworks for AI projects, integrating ethical considerations into the AI lifecycle from design through deployment, to promote ethical AI practices within organizations and society. 3. Implements strategies to mitigate ethical risks in AI applications, employing methods for detecting and correcting biases, ensuring privacy, and maintaining transparency and accountability in AI systems. 4. Advocates for responsible AI by communicating the significance of ethical considerations in AI to diverse audiences, including technologists, policymakers, and the public, to foster an ethical AI culture. 5. Assesses AI projects for ethical implications, utilizing ethical frameworks and principles to evaluate AI's impact on individuals and communities and to ensure alignment with ethical standards and societal values. 6. Collaborates with interdisciplinary teams to address ethical challenges in AI, facilitating discussions and actions that balance technical possibilities with ethical considerations to achieve consensus on responsible AI development and use. 7. Engages in professional and community forums on AI ethics, contributing to the discourse on responsible AI practices and staying informed about emerging ethical issues and solutions in the field. 8. Knowledge of industry-specific laws (national and international) and any kind of regulations that affect AI development to ensure its compliance. 9. Reflects on personal ethical beliefs and practices in relation to AI technologies, committing to ethical professional conduct and continuous learning about ethical challenges and best practices in AI.

9. Assessment

Unit learning outcome	Assessment method
9.1	Report
9.2	Practical assignment
9.3	Practical assignment
9.4	360° assessment
9.5	Self-reflection report
9.6	360° assessment
9.7	360° assessment
9.8	Exam
9.9	Self-reflection report

10. PLO AI Awareness - EQF 6
The learner has demonstrated the ability to understand the fundamentals of artificial intelligence, its applications across various markets, and its transformative impact on business processes. This encompasses an appreciation of AI technologies, their potential for innovation, and the strategic considerations necessary for integrating AI into business operations.
Unit learning outcomes
1. Understands the basic concepts and technologies underlying artificial intelligence, including machine learning, natural language processing, and robotics, recognizing their roles in driving innovation. 2. Identifies key AI applications in the programming application market, assessing the competitive landscape and potential for disruptive innovation across industries. 3. Analyses the implications of AI on business processes, evaluating how AI technologies can optimize operations, enhance customer experiences, and create new business models. 4. Assesses the strategic considerations for integrating AI into business operations, including technical feasibility, cost-benefit analysis, and alignment with business goals. 5. Recognizes the ethical, legal, and societal challenges associated with AI deployment, advocating for responsible AI use that respects privacy, fairness, and transparency. 6. Communicates effectively about AI technologies and their business applications to a range of audiences, fostering AI literacy and supporting informed decision-making within organizations. 7. Collaborates with technical and non-technical teams to explore AI opportunities, facilitating cross-functional understanding and strategic alignment on AI initiatives. 8. Knowledge of current trends in AI technology to evaluate how these might influence industry innovation and competitive strategies. 9. Engages in continuous learning to keep pace with rapid advancements in AI technology and its evolving impact on the business landscape, maintaining an informed perspective on future opportunities and challenges

10. Assessment

Unit learning outcome	Assessment method
10.1	Exam
10.2	Report
10.3	Report
10.4	Self-reflection report
10.5	Self-reflection report
10.6	360° assessment
10.7	360° assessment
10.8	Exam
10.9	360° assessment

11. PLO Cyber and Data Security - EQF 5
The learner has demonstrated the ability to design, implement, and evaluate security measures and protocols to protect data integrity and confidentiality across various digital platforms and systems, effectively managing risks in diverse and unpredictable cybersecurity environments.
Unit learning outcomes
1. Analyses the landscape of cyber threats and vulnerabilities, employing comprehensive and specialized knowledge to identify and assess risks in different technological environments. 2. Implements advanced security measures, such as encryption, firewalls, and intrusion detection systems, to safeguard information assets against unauthorized access and breaches. 3. Develops and tests robust cybersecurity policies and procedures that comply with legal and ethical standards, ensuring data protection and network security across organizational platforms. 4. Manages incident response and recovery operations, demonstrating the ability to effectively handle security breaches and minimize their impact on business operations and data privacy. 5. Evaluates the effectiveness of security protocols through regular audits and updates, adapting strategies to combat evolving cyber threats and ensure continuous protection. 6. Communicates complex cybersecurity concepts and practices to non-specialists, fostering a culture of security awareness and compliance throughout the organization. 7. Leads cybersecurity teams and projects, coordinating efforts to enhance data security, and fostering innovation in response to emerging security challenges and technological advancements.

11. Assessment

Unit learning outcome	Assessment method
11.1	Report
11.2	Practical assignment
11.3	Practical assignment
11.4	360° assessment
11.5	Self-reflection report
11.6	360° assessment
11.7	360° assessment

12. PLO Generative AI - EQF 7
The learner has demonstrated the ability to design, implement, and evaluate generative AI models, leveraging their capabilities to innovate and drive forward creative solutions in various sectors such as media, healthcare, and technology.
Unit learning outcomes
1. Design and implement advanced generative AI models, such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Transformer models, to generate novel images, texts, and data structures. 2. Evaluate the effectiveness and safety of generative AI models, ensuring they produce high-quality, innovative outputs while addressing potential risks like misinformation or unethical use. 3. Optimize generative models for efficiency and scalability, ensuring they can be deployed effectively in diverse environments, including cloud platforms and edge devices. 4. Knowledge in fine tuning and customizing generative models and use of transfer learning while implementing strategies to identify and mitigate biases in generative AI outputs. 5. Apply generative AI in novel applications, exploring uses in fields such as synthetic data generation for training other AI models, creative arts, and product design. 6. Lead projects and teams in the development of generative AI applications, managing cross-disciplinary groups to foster innovation and ensure project alignment with strategic goals. 7. Communicate the capabilities and limitations of generative AI, educating stakeholders on both the potential and the challenges of generative models, ensuring informed decision-making. 8. Stay abreast of technological advancements in the field of generative AI, incorporating the latest research and tools into ongoing projects to maintain cutting-edge knowledge and application. 9. Advocate for responsible use of generative AI technologies, ensuring that ethical considerations are integrated into the development and deployment processes to mitigate harm and bias.

12. Assessment

Unit learning outcome	Assessment method
12.1	Practical assignment
12.2	Report
12.3	Practical assignment
12.4	Exam
12.5	Practical assignment
12.6	360° assessment
12.7	360° assessment
12.8	Self-reflection report
12.9	360° assessment

13. PLO Change Management - EQF 6
The learner has demonstrated the ability to effectively lead and manage change processes within organizations, employing strategies to facilitate smooth transitions, overcome resistance, and ensure stakeholder engagement. This includes understanding the dynamics of organizational change, communicating effectively to align team and organizational goals, and applying change management models to support and sustain organizational transformation.
Unit learning outcomes
1. Understands the principles and theories of change management, including the factors driving change, the stages of change processes, and the impact of change on organizations and individuals. 2. Assesses organizational readiness for change, evaluating factors such as culture, resources, and stakeholder attitudes to plan effective change initiatives. 3. Designs change management strategies, developing plans that outline objectives, actions, timelines, and resources needed to achieve successful change. 4. Communicates change effectively, using clear, persuasive messaging to convey the reasons for change, the benefits of the change process, and the expected outcomes to various stakeholders. 5. Engages stakeholders throughout the change process, employing techniques to build support, address concerns, and foster participation in change initiatives. 6. Implements change management plans, coordinating actions, monitoring progress, and adjusting as necessary to ensure the success of change initiatives. 7. Manages resistance to change, identifying sources of opposition and employing strategies to address resistance constructively and supportively. 8. Evaluates the effectiveness of change management efforts, analysing outcomes to determine the impact of change initiatives and identifying lessons learned for future change efforts. 9. Cultivates resilience and adaptability in teams, fostering an organizational culture that embraces change as an opportunity for growth and development.

13. Assessment

Unit learning outcome	Assessment method
13.1	Exam
13.2	Self-reflection report
13.3	Practical assignment
13.4	360° assessment
13.5	360° assessment
13.6	Practical assignment
13.7	360° assessment
13.8	Report
13.9	360° assessment

14. PLO Soft Skills - EQF 6
The learner has demonstrated the ability to effectively apply a wide range of soft skills in diverse professional and personal contexts. This includes mastering communication, collaboration, problem-solving, and adaptability, as well as the ability to manage change and conflict, think critically, and innovate.
Unit learning outcomes
1. Collaborates within teams, contributing positively to group efforts, sharing responsibility, and supporting colleagues to achieve collective goals. 2. Solves problems creatively and efficiently, applying logical and innovative thinking to overcome challenges and optimize outcomes. 3. Delivers impactful presentations, effectively using verbal and visual communication to engage audiences and clearly convey information. 4. Cultivates an innovative mindset, embracing and fostering creativity, questioning conventional approaches, and generating novel solutions. 5. Communicates effectively across a variety of platforms and media, adapting messages for different audiences and purposes to enhance understanding and engagement. 6. Thinks critically, analysing situations, evaluating diverse perspectives, and synthesizing information to make informed decisions. 7. Manages conflicts constructively, employing negotiation and mediation skills to resolve disputes and maintain harmonious relationships.

14. Assessment

Unit learning outcome	Assessment method
14.1	360° assessment
14.2	Practical assignment
14.3	360° assessment
14.4	Self-reflection report
14.5	360° assessment
14.6	Self-reflection report
14.7	360° assessment

EDUCATIONAL PROFILE

NLP engineer

EQF 6

This educational profile belongs to the field of Software Engineering

NLP engineer EQF 6

NLP engineer (language engineer) Role Description at specific EQF 6:

NLP Engineers at EQF 6 leverage advanced AI and machine learning to optimize natural language processing systems, using deep learning and explainable AI for data analysis and generation. They manage complex projects and ensure scalable deployments with ML Ops and cloud technologies. Skilled in AI ethics and security, they lead with a focus on innovation and ethical practices in the evolving AI field.

Programme Learning Outcomes (PLO)

1. PLO Deep Learning - EQF 6
The learner has demonstrated the ability to design and implement deep learning models and architectures, encompassing their development, implementation, and application across various domains, while integrating computational and organizational considerations and evaluating their societal and technological impacts.
Unit learning outcomes
1. Analyzes the fundamental principles of neural networks, focusing on their structure and function, to understand the underlying mechanics of deep learning technologies in a professional context. 2. Identifies suitable applications for deep and shallow neural architectures by evaluating their types and functionalities, ensuring the selection aligns with specific project requirements and industry standards. 3. Designs deep learning models by selecting appropriate architectures and frameworks, demonstrating innovation in model architecture to meet the unique needs of diverse applications. 4. Implements deep learning models using relevant frameworks and libraries, showcasing proficiency in parameter tuning, performance optimization, and addressing computational challenges to enhance model efficiency and effectiveness. 5. Evaluates the performance of deep learning models using standard metrics, interpreting results to make informed decisions about model improvements, adjustments, and the selection of models for specific tasks in real-world applications. 6. Applies deep learning techniques to solve problems in various domains such as image recognition, natural language processing, and predictive analytics, demonstrating the ability to adapt models to new challenges and datasets within a given context. 7. Discusses the ethical implications of deploying deep learning models, including issues related to fairness, privacy, transparency, and accountability, proposing strategies to mitigate risks and promote ethical AI development in diverse societal applications. 8. Critiques the current trends and advancements in deep learning, assessing their potential impact on future technologies, industry practices, and societal norms, with a focus on sustainable and responsible innovation. 9. Collaborates effectively in teams to design, implement, and evaluate deep learning projects, demonstrating the ability to communicate complex concepts to stakeholders with varying levels of technical expertise, facilitating informed decision-making and promoting interdisciplinary understanding. 10. Engages with the AI community by participating in discussions, debates, and collaborative projects, contributing to the advancement of ethical practices and innovative technologies in deep learning.

1. Assessment

Unit learning outcome	Assessment method
1.1	Exam
1.2	Report
1.3	Practical assignment
1.4	Practical assignment

1.5	Practical assignment
1.6	Self-reflection report
1.7	Self-reflection report
1.8	360° assessment
1.9	360° assessment

2. PLO AI Technologies - EQF 6

The learner has demonstrated the ability to know and effectively utilize AI frameworks and libraries for the development and deployment of AI models and technologies, applying these tools across various domains to solve complex problems while considering ethical implications and industry standards.

Unit learning outcomes

1. Selects appropriate AI frameworks and libraries for specific project needs, demonstrating an understanding of their strengths, limitations, and optimal use cases in the development of AI models.
2. Develops AI models using chosen frameworks and libraries, showcasing the ability to integrate various AI technologies to create efficient, scalable, and effective solutions for real-world applications.
3. Analyses the performance and efficiency of AI models and technologies, employing appropriate metrics and tests to ensure they meet project specifications and performance goals.
4. Adapts existing AI models to new contexts and problems, demonstrating innovation and flexibility in applying AI technologies to a diverse range of challenges and domains.
5. Communicates technical details and project outcomes related to AI technologies effectively to both technical and non-technical audiences, ensuring clarity and facilitating informed decision-making.
6. Discusses the ethical implications of deploying AI technologies, including issues related to fairness, privacy, transparency, and accountability, proposing strategies to mitigate risks and promote ethical AI development in diverse societal applications.
7. Critiques the current trends and advancements in AI, assessing their potential impact on future technologies, industry practices, and societal norms, with a focus on sustainable and responsible innovation.
8. Collaborates with multidisciplinary teams on AI projects, leveraging collective expertise to enhance the development, implementation, and evaluation of AI technologies, fostering an environment of knowledge sharing and innovation.
9. Demonstrates an ongoing commitment to advancing skills and knowledge in the field of AI by staying updated on emerging AI frameworks, libraries, and technologies.

2. Assessment

Unit learning outcome	Assessment method
2.1	Exam
2.2	Practical assignment
2.3	Exam
2.4	Practical assignment
2.5	360° assessment
2.6	Self-reflection report
2.7	Self-reflection report
2.8	360° assessment
2.9	360° assessment

3. PLO Machine Learning - EQF 6

The learner has demonstrated the ability to design, implement, and evaluate machine learning models and algorithms to address (complex) problems across various domains.

Unit learning outcomes

1. Applies fundamental machine learning concepts and algorithms to address predictive analytics, classification, and clustering tasks, employing appropriate tools and techniques for model development within diverse real-world contexts. Knowledge of the techniques for hyperparameter tuning and optimization to enhance model accuracy and efficiency.
2. Evaluates machine learning models using established metrics and validation techniques, critically interpreting results to ensure the models' reliability, accuracy, and applicability to specific problem domains.
3. Designs data pre-processing and feature engineering strategies to enhance machine learning model performance, demonstrating an understanding of the influence of data quality and feature selection on model outcomes.
4. Assesses the ethical implications of machine learning projects, identifying potential biases, fairness issues, and privacy concerns, and developing strategies to address these challenges in the design and deployment of models.
5. Communicates machine learning findings effectively to both technical and non-technical stakeholders, ensuring clarity and facilitating informed decision-making.
6. Collaborates with interdisciplinary teams on machine learning projects, leveraging collective expertise to overcome complex challenges and innovate while upholding ethical standards and achieving practical solutions.
7. Engages in professional development and community activities related to machine learning, including attending workshops, contributing to forums, and participating in collaborative research, to stay informed about industry trends and ethical discussions.

3. Assessment

Unit learning outcome	Assessment method
3.1	Practical assignment
3.2	Report
3.3	Practical assignment
3.4	Self-reflection report
3.5	360° assessment
3.6	360° assessment
3.7	360° assessment

4. PLO Human-Centered AI - EQF 6

The learner has demonstrated the ability to integrate human-centered design principles in AI development, ensuring sustainable, ethical, and effective AI solutions. This includes formulating and implementing AI governance policies, managing AI-related risks, devising strategic AI plans, and enhancing human-computer interaction to create AI systems that are aligned with human values and societal goals.

Unit learning outcomes

1. Incorporates human-centered design principles in the development of AI systems, focusing on user needs and ethical considerations to create solutions that enhance human well-being and productivity.
2. Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies and implementing strategies to mitigate these risks, ensuring the sustainability and reliability of AI systems.
3. Enhances human-computer interaction through the design of intuitive and accessible AI interfaces, improving user experience and engagement with AI systems across diverse application areas.
4. Evaluates the sustainability of AI solutions, considering their environmental, social, and economic impacts to promote responsible and sustainable AI development and use.
5. Communicates effectively with stakeholders about the benefits, challenges, and ethical implications of AI technologies, ensuring informed decision-making and fostering a culture of transparency and trust in AI.
6. Stays informed about emerging trends and best practices in human-centered AI, governance policies, risk management, and sustainability, contributing to the advancement of ethical and effective AI solutions.

4. Assessment

Unit learning outcome	Assessment method
4.1	Exam
4.2	Report
4.3	Practical assignment
4.4	Report
4.5	360° assessment
4.6	Self-reflection report

5. PLO AI Ethics - EQF 6

The learner has demonstrated the ability to critically assess the ethical implications of AI technologies, develop and implement strategies to address ethical challenges, and effectively advocate for responsible AI practices, ensuring AI innovations align with societal values and human rights across various contexts.

Unit learning outcomes

1. Identifies ethical considerations and challenges in AI development and deployment, such as bias, fairness, transparency, and accountability, emphasizing their importance for respecting human rights and societal norms.
2. Develops ethical guidelines and frameworks for AI projects, integrating ethical considerations into the AI lifecycle from design through deployment, to promote ethical AI practices within organizations and society.
3. Implements strategies to mitigate ethical risks in AI applications, employing methods for detecting and correcting biases, ensuring privacy, and maintaining transparency and accountability in AI systems.
4. Advocates for responsible AI by communicating the significance of ethical considerations in AI to diverse audiences, including technologists, policymakers, and the public, to foster an ethical AI culture.
5. Assesses AI projects for ethical implications, utilizing ethical frameworks and principles to evaluate AI's impact on individuals and communities and to ensure alignment with ethical standards and societal values.
6. Collaborates with interdisciplinary teams to address ethical challenges in AI, facilitating discussions and actions that balance technical possibilities with ethical considerations to achieve consensus on responsible AI development and use.
7. Engages in professional and community forums on AI ethics, contributing to the discourse on responsible AI practices and staying informed about emerging ethical issues and solutions in the field.
8. Knowledge of industry-specific laws (national and international) and any kind of regulations that affect AI development to ensure its compliance.
9. Reflects on personal ethical beliefs and practices in relation to AI technologies, committing to ethical professional conduct and continuous learning about ethical challenges and best practices in AI.

5. Assessment

Unit learning outcome	Assessment method
5.1	Report
5.2	Practical assignment
5.3	Practical assignment
5.4	360° assessment
5.5	Self-reflection report
5.6	360° assessment
5.7	360° assessment
5.8	Exam
5.9	Self-reflection report

6. PLO AI Futures and Innovation - EQF 6
The learner has demonstrated the ability to critically analyse future AI developments, leveraging research skills to innovate and contribute to the advancement of AI technologies. This encompasses a deep understanding of current trends, the capability to forecast technological evolutions, and the application of this knowledge to drive forward-thinking AI solutions that address emerging challenges and opportunities for companies.
Unit learning outcomes
1. Analyses current AI developments and trends, applying critical thinking to evaluate the potential impact, benefits, and challenges of emerging AI technologies in various industrial sectors. 2. Forecasts future trends in AI technology, using research methodologies and future literacy skills to anticipate changes, identify opportunities for innovation, and prepare for potential societal and ethical implications. 3. Conducts research to explore new possibilities in AI, demonstrating proficiency in designing and implementing studies that contribute to the knowledge base and development of AI technologies. 4. Innovates in the field of AI by applying insights from research and trend analysis to develop novel AI solutions or improve existing technologies, focusing on addressing unmet needs and capitalizing on future opportunities. 5. Communicates insights and predictions about future AI developments to a variety of audiences, including academic, industry, and public stakeholders, effectively bridging the gap between current research and practical applications. 6. Collaborates with experts from various fields to explore interdisciplinary approaches to AI innovation, fostering a culture of creativity and shared knowledge that supports the advancement of AI technologies. 7. Evaluates the ethical, social, and economic implications of future AI innovations, incorporating ethical considerations into the forecasting and development process to ensure responsible and beneficial outcomes. 8. Knowledge of the regulations and ethical use of data and data practices to ensure data privacy and compliance. 9. Engages in continuous learning and professional development to stay at the forefront of AI research and innovation, actively participating in forums, conferences, and professional networks to exchange ideas and keep abreast of cutting-edge developments.

6. Assessment

Unit learning outcome	Assessment method
6.1	Exam
6.2	Report
6.3	Report
6.4	Practical assignment
6.5	360° assessment
6.6	360° assessment
6.7	Self-reflection report
6.8	Exam

7. PLO AI Awareness - EQF 6
The learner has demonstrated the ability to understand the fundamentals of artificial intelligence, its applications across various markets, and its transformative impact on business processes. This encompasses an appreciation of AI technologies, their potential for innovation, and the strategic considerations necessary for integrating AI into business operations.
Unit learning outcomes
1. Understands the basic concepts and technologies underlying artificial intelligence, including machine learning, natural language processing, and robotics, recognizing their roles in driving innovation. 2. Identifies key AI applications in the programming application market, assessing the competitive landscape and potential for disruptive innovation across industries. 3. Analyses the implications of AI on business processes, evaluating how AI technologies can optimize operations, enhance customer experiences, and create new business models. 4. Assesses the strategic considerations for integrating AI into business operations, including technical feasibility, cost-benefit analysis, and alignment with business goals. 5. Recognizes the ethical, legal, and societal challenges associated with AI deployment, advocating for responsible AI use that respects privacy, fairness, and transparency. 6. Communicates effectively about AI technologies and their business applications to a range of audiences, fostering AI literacy and supporting informed decision-making within organizations. 7. Collaborates with technical and non-technical teams to explore AI opportunities, facilitating cross-functional understanding and strategic alignment on AI initiatives. 8. Knowledge of current trends in AI technology to evaluate how these might influence industry innovation and competitive strategies. 9. Engages in continuous learning to keep pace with rapid advancements in AI technology and its evolving impact on the business landscape, maintaining an informed perspective on future opportunities and challenges

6.9	360° assessment

7. Assessment

Unit learning outcome	Assessment method
7.1	Exam
7.2	Report
7.3	Report
7.4	Self-reflection report
7.5	Self-reflection report
7.6	360° assessment
7.7	360° assessment
7.8	Exam
7.9	360° assessment

8. PLO Cyber and Data Security - EQF 6
The learner has demonstrated the ability to identify cybersecurity threats and vulnerabilities, implement and manage robust security measures, and develop comprehensive strategies to protect digital assets and ensure data privacy across various operational environments, while understanding the ethical, legal, and societal implications.
Unit learning outcomes
1. Identifies a variety of cybersecurity threats and vulnerabilities, understanding their mechanisms and the potential impact they pose on information systems, to enhance awareness and preparedness in a dynamic digital landscape. 2. Implements key cybersecurity measures such as firewalls, encryption, and intrusion detection systems, showcasing the ability to safeguard information assets against unauthorized access and cyber threats in compliance with relevant regulations. 3. Designs security architectures for information systems that incorporate risk management principles and security-by-design approaches, aiming to minimize vulnerabilities and ensure the integrity, confidentiality, and availability of data across diverse applications. 4. Manages cybersecurity incidents by effectively deploying incident response strategies and techniques to promptly address and mitigate the impact of security breaches, ensuring a rapid return to normal operations and compliance with legal and reporting obligations. 5. Evaluates the ethical, legal, and societal implications of cybersecurity practices, considering issues such as data protection laws, privacy rights, and ethical hacking, to promote responsible and lawful security measures that respect individual and societal values. 6. Conveys complex cyber and data security concepts, policies, and protocols clearly to a broad audience, including technical and non-technical stakeholders, enhancing the organizational culture of security, and fostering best practices in cybersecurity awareness and training. 7. Collaborates within teams to develop and implement comprehensive cybersecurity solutions, leveraging interdisciplinary knowledge and perspectives to address complex security challenges with innovative, ethical, and effective strategies. 8. Reflects on personal and professional growth in the field of cyber and data security, engaging in continuous learning to stay abreast of evolving threats, technologies, and regulatory landscapes, contributing to the advancement of cybersecurity knowledge and practices.

8. Assessment

Unit learning outcome	Assessment method
8.1	Report
8.2	Practical assignment
8.3	Practical assignment
8.4	360° assessment
8.5	Self-reflection report
8.6	360° assessment
8.7	360° assessment
8.8	Self-reflection report

9. PLO Natural Language Processing (NLP) - EQF 6
The learner has demonstrated the ability to apply natural language processing techniques to analyse, understand, and generate human language, leveraging computational methods to solve complex problems in linguistics and communication. This includes proficiency in utilizing NLP tools and algorithms to extract insights from text data, enhance human-computer interaction, and create applications that can process and produce language effectively.
Unit learning outcomes
1. Applies NLP techniques to analyse text data, extracting relevant information and insights to support decision-making and knowledge discovery across various domains. 2. Develops applications that utilize NLP for tasks such as sentiment analysis, language translation, and chatbot development, demonstrating the ability to design and implement systems that improve human-computer interaction through natural language understanding. 3. Implements machine learning models for NLP, including supervised and unsupervised learning approaches, to automate the processing and interpretation of large text datasets, enhancing the scalability and efficiency of language-based applications. 4. Knowledge of advanced NLP techniques based on deep learning and attention methods and architectures and pipelines for LLM. 5. Evaluates the performance of NLP systems, using appropriate metrics and validation techniques to ensure their accuracy, reliability, and fairness in real-world applications. 6. Integrates NLP with other AI technologies, such as speech recognition and computer vision, to create multidimensional applications that can process and understand multimodal inputs. 7. Communicates the capabilities and limitations of NLP technologies to technical and non-technical audiences, facilitating understanding and ethical use of NLP in various applications. 8. Addresses ethical and societal considerations in NLP applications, including issues of bias, privacy, and the ethical use of language data, advocating for responsible development and deployment of NLP technologies. 9. Engages in continuous learning and professional development in the field of NLP, staying informed about emerging trends, technologies, and research findings to lead innovation and advance the state of the art in natural language processing.

9. Assessment

Unit learning outcome	Assessment method
9.1	Exam
9.2	Practical assignment
9.3	Practical assignment
9.4	Exam
9.5	Report
9.6	360° assessment
9.7	360° assessment
9.8	Self-reflection report

9.9	360° assessment

10. PLO Generative AI - EQF 6
The learner has demonstrated the ability to design, implement, and evaluate generative AI systems, utilizing advanced techniques including prompt engineering for Large Language Models. This includes the capacity to identify AI-generated content, create innovative applications using generative AI models, and apply best practices in prompt engineering to achieve desired outcomes in various industrial domains.
Unit learning outcomes
1. Designs generative AI models to create novel content, including text, images, and audio, demonstrating an understanding of the underlying technologies and their application in generating high-quality, creative outputs. 2. Identifies AI-generated content, employing analytical methods and tools to distinguish between human and machine-generated outputs, addressing concerns related to authenticity, copyright, and ethics. 3. Develops prompt engineering skills, crafting effective prompts to guide generative AI models in producing specific and relevant outputs, optimizing the interaction between users and AI systems for enhanced creativity and efficiency. 4. Implements Large Language Models (LLMs) in generative AI projects, leveraging their capabilities for text generation, language understanding, and complex problem-solving, tailoring model parameters and prompts to specific use cases. 5. Evaluates the performance of generative AI systems, using criteria such as originality and relevance to assess system outputs and guide improvements. 6. Assesses the ethical implications of generative AI systems, considering the impact on stakeholders and societal norms to ensure responsible use and development of AI technologies. 7. Integrates generative AI into diverse applications, from content creation and augmentation to problem-solving and innovation, demonstrating the ability to apply generative AI technologies across various fields and industries. 8. Conveys the principles and potential of generative AI to a broad audience, including technical and non-technical stakeholders, facilitating understanding and ethical use of generative technologies. 9. Engages in continuous learning and professional development in the field of generative AI, staying informed about advancements in AI models, prompt engineering techniques, and emerging ethical standards, to lead in the development of responsible and innovative AI-driven solutions.

10. Assessment

Unit learning outcome	Assessment method
10.1	Practical assignment
10.2	Report
10.3	Practical assignment
10.4	Practical assignment
10.5	Self-reflection report

10.6	Self-reflection report
10.7	360° assessment
10.8	360° assessment
10.9	360° assessment

11. PLO Change Management - EQF 5
The learner has demonstrated the ability to effectively lead and manage organizational change, applying systematic approaches to plan, implement, and sustain changes that align with strategic objectives and enhance organizational performance.
Unit learning outcomes
1. Analyses the need for change within organizations, identifying key drivers such as technological advancement, market dynamics, and internal challenges that necessitate adaptation. 2. Plans and designs change management strategies that are clear, structured, and aligned with the organization's long-term goals and values. 3. Implements change initiatives effectively, using project management tools and techniques to monitor progress, manage resources, and mitigate risks. 4. Communicates change effectively to all stakeholders, using appropriate methods to ensure buy-in, address concerns, and minimize resistance. 5. Evaluates the impact of change initiatives, using metrics and feedback to assess outcomes and determine the effectiveness of the strategies employed. 6. Adapts change strategies in response to evolving circumstances and feedback, demonstrating flexibility and resilience to ensure the sustainability of change. 7. Leads and inspires others during times of change, exhibiting strong leadership qualities that foster a culture of continuous improvement and readiness for change

11. Assessment

Unit learning outcome	Assessment method
11.1	Self-reflection report
11.2	Report
11.3	Practical assignment
11.4	360° assessment
11.5	Report
11.6	Practical assignment
11.7	360° assessment

12. PLO Soft Skills - EQF 6
The learner has demonstrated the ability to effectively apply a wide range of soft skills in diverse professional and personal contexts. This includes mastering communication, collaboration, problem-solving, and adaptability, as well as the ability to manage change and conflict, think critically, and innovate.
Unit learning outcomes
1. Collaborates within teams, contributing positively to group efforts, sharing responsibility, and supporting colleagues to achieve collective goals. 2. Solves problems creatively and efficiently, applying logical and innovative thinking to overcome challenges and optimize outcomes. 3. Delivers impactful presentations, effectively using verbal and visual communication to engage audiences and clearly convey information. 4. Cultivates an innovative mindset, embracing and fostering creativity, questioning conventional approaches, and generating novel solutions. 5. Communicates effectively across a variety of platforms and media, adapting messages for different audiences and purposes to enhance understanding and engagement. 6. Thinks critically, analysing situations, evaluating diverse perspectives, and synthesizing information to make informed decisions. 7. Manages conflicts constructively, employing negotiation and mediation skills to resolve disputes and maintain harmonious relationships.

12. Assessment

Unit learning outcome	Assessment method
12.1	360° assessment
12.2	Practical assignment
12.3	360° assessment
12.4	Self-reflection report
12.5	360° assessment
12.6	Self-reflection report
12.7	360° assessment

EDUCATIONAL PROFILE

NLP engineer

EQF 7

This educational profile belongs to the field of Software Engineering

NLP engineer EQF 7

NLP engineer (language engineer) Role Description:

NLP Engineers specializes in developing and optimizing natural language processing (NLP) models and systems. They apply advanced AI technologies, deep learning, machine learning, and explainable AI techniques to interpret, analyze, and generate human language data. They also have skills in ML Ops, HPC and cloud services, ensuring graduates can deploy scalable and efficient NLP solutions. Finally, skills on human-centered AI, AI ethics, AI awareness, cyber and data security and soft skills and change management are integrated to navigate the evolving landscape of AI futures and innovation, making NLP Engineers versatile and ethically aware leaders in the field.

Programme Learning Outcomes (PLO)

1. PLO Deep Learning - EQF 7
The learner has demonstrated the ability to critically analyse and synthesize deep learning concepts and methodologies, as well as to develop and implement advanced deep learning models in complex, interdisciplinary contexts. This includes taking responsibility for managing the development process of these models and contributing to the advancement of knowledge and practice within the field of deep learning.
Unit learning outcomes
1. Critically evaluates the theoretical underpinnings of deep learning, including neural network architectures, optimization algorithms, and loss functions, to understand their applicability and limitations in various domains. 2. Designs innovative deep learning models by integrating knowledge from computational theory, data science, and domain-specific requirements to address complex problems, ensuring the models are efficient, scalable, and ethical. 3. Develops advanced deep learning models using current frameworks and tools, demonstrating the ability to manage datasets, pre-process data, and optimize model performance in unpredictable and multifaceted environments. 4. Analyses complex datasets using deep learning models to extract meaningful patterns and insights, applying critical thinking to assess the validity and reliability of the findings in a specific context. 5. Reflects on the ethical, legal, and social implications of deploying deep learning models, including considerations of bias, fairness, transparency, and accountability, leading discussions on ethical AI development practices. 6. Collaborates effectively in interdisciplinary teams to design, develop, and deploy deep learning solutions, demonstrating leadership in guiding strategic approaches to problem-solving and innovation. 7. Communicates complex deep learning concepts, methodologies, and outcomes clearly and effectively to both technical and non-technical stakeholders, adapting the communication style as necessary to ensure understanding and ethical use of AI technology. 8. Applies innovative problem-solving skills to extend the frontiers of knowledge in deep learning, contributing to the development of new methodologies, applications, or approaches that integrate knowledge from different fields. 9. Manages the lifecycle of deep learning projects, from conceptualization through development and evaluation, demonstrating the ability to adapt to new challenges and requirements in complex and unpredictable environments.

1. Assessment

Unit learning outcome	Assessment method
1.1	Self-reflection report
1.2	Practical assignment
1.3	Practical assignment
1.4	Exam

1.5	Self-reflection report
1.6	360° assessment
1.7	360° assessment
1.8	Practical assignment
1.9	360° assessment

2. PLO AI Technologies - EQF 7

The learner has demonstrated the ability to critically evaluate and apply various AI technologies across different domains, managing complex projects that innovate and integrate AI solutions, thereby enhancing professional practice and contributing to the field.

Unit learning outcomes

1. Assesses the capabilities and limitations of different AI technologies, including machine learning, neural networks, and natural language processing, within diverse operational environments.
2. Integrates AI technologies to create comprehensive systems that improve decision-making and operational efficiency in business, healthcare, or other domains.
3. Implements AI solutions using best practices in software engineering and data management, ensuring scalability, security, and compliance with regulatory standards.
4. Critiques the impact of AI technologies on society, addressing ethical considerations like privacy, bias, and job displacement, and proposes mitigation strategies.
5. Fosters multidisciplinary collaboration in developing AI technologies, demonstrating leadership and effective communication in team settings.
6. Innovates with AI technologies to solve novel or unstructured problems, contributing to new knowledge and methods in the field.
7. Leads strategic planning and execution of AI projects, ensuring alignment with organizational goals and adapting to new technological advancements and market trends.
8. Disseminates findings and developments in AI technologies through scholarly articles, conferences, or workshops, enhancing the knowledge base and application of AI in various fields.

2. Assessment

Unit learning outcome	Assessment method
2.1	Report
2.2	Practical assignment
2.3	Practical assignment
2.4	Self-reflection report
2.5	360° assessment

2.6	Practical assignment
2.7	360° assessment
2.8	360° assessment

3. PLO ML Ops - EQF 7

The learner has demonstrated the ability to design, implement, and manage ML Ops systems that efficiently operationalize machine learning models within production environments, ensuring scalable, reproducible, and ethical AI solutions.

Unit learning outcomes

1. Designs robust ML Ops architectures that integrate machine learning models with production systems to streamline deployment, monitoring, and maintenance processes.
2. Implements continuous integration, continuous delivery (CI/CD) pipelines for machine learning applications, demonstrating proficiency in automating model training, testing, and deployment.
3. Optimizes machine learning pipelines for performance and efficiency, applying best practices in data handling, model versioning, and experiment tracking.
4. Evaluates the effectiveness and efficiency of ML Ops systems, using metrics to monitor model performance and resource utilization in real-world scenarios.
5. Collaborates with data scientists, developers, and IT professionals to ensure ML Ops strategies align with organizational goals and technical requirements.
6. Adapts ML Ops practices to emerging technologies and methodologies, maintaining agility in dynamic and complex environments.
7. leads cross-functional teams in the development and implementation of ML Ops initiatives, taking responsibility for project outcomes and strategic alignment.
8. Communicates the strategic value and operational impact of ML Ops to stakeholders, including technical teams, management, and external partners, ensuring transparency and alignment with business objectives.

3. Assessment

Unit learning outcome	Assessment method
3.1	Practical assignment
3.2	Practical assignment
3.3	Practical assignment
3.4	Report
3.5	360° assessment
3.6	Practical assignment
3.7	360° assessment

3.8	360° assessment

4. PLO HPC and Cloud services - EQF 7
The learner has demonstrated the ability to architect, deploy, and manage high-performance computing and cloud services solutions that meet advanced computing needs across various industries, ensuring scalability, reliability, and security.
Unit learning outcomes
1. Architects scalable and secure HPC and cloud infrastructures that meet the specific computational and data requirements of diverse applications. 2. Conduct detailed performance monitoring and tuning to enhance the efficiency of HPC and cloud applications. 3. Deploys complex applications on HPC and cloud platforms, utilizing automation tools to ensure efficiency and accuracy in resource allocation and service provisioning. 4. Manages HPC and cloud environments, overseeing operational aspects such as performance tuning, cost optimization, and compliance with security standards. 5. Analyses the performance of HPC and cloud systems, employing advanced monitoring tools and techniques to optimize resource utilization and service delivery. 6. Innovates with emerging technologies in HPC and cloud computing, integrating them into existing systems to enhance capabilities and address new market challenges. 7. Collaborates effectively with IT specialists, software developers, and business managers to ensure that HPC and cloud solutions align with organizational goals and user needs. 8. Evaluates new HPC and cloud technologies and services for potential adoption, assessing their strategic impact on business and technology operations. 9. Communicates technical and strategic aspects of HPC and cloud services to a diverse range of stakeholders, ensuring clarity and supporting strategic decision-making processes.

4. Assessment

Unit learning outcome	Assessment method
4.1	Practical assignment
4.2	Practical assignment
4.3	Practical assignment
4.4	360° assessment
4.5	Exam
4.6	Report
4.7	360° assessment
4.8	Report
4.9	Report

5. PLO Machine Learning - EQF 7
The learner has demonstrated the ability to independently develop, evaluate, and refine machine learning models, using advanced techniques to address and solve complex, real-world problems across various sectors. This includes leading projects that integrate machine learning into existing systems, enhancing their efficiency and effectiveness.
Unit learning outcomes
1. Independently develops robust machine learning models using advanced algorithms and techniques, tailored to solve specific problems in areas such as finance, healthcare, or technology. 2. Critically evaluates the performance of machine learning models using sophisticated validation techniques to ensure accuracy, reliability, and generalizability of the results. 3. Optimizes machine learning algorithms and systems for improved performance, focusing on aspects such as computational efficiency, model accuracy, and data handling. 4. Integrates machine learning models into existing business processes and systems, demonstrating the ability to enhance operational capabilities and address strategic business goals. 5. Leads multidisciplinary teams in the design and implementation of machine learning projects, taking responsibility for decision-making, strategic direction, and project outcomes. 6. Applies innovative approaches to extend the capabilities of machine learning, exploring new algorithms, data sources, and modelling techniques to advance the field. 7. Effectively communicates complex machine learning concepts and results to stakeholders, including technical and non-technical audiences, ensuring transparency, and facilitating informed decision-making. 8. Assesses the ethical implications of machine learning applications, ensuring that models adhere to ethical standards and contribute positively to societal goals.

5. Assessment

Unit learning outcome	Assessment method
5.1	Practical assignment
5.2	Self-reflection report
5.3	Practical assignment
5.4	Practical assignment
5.5	360° assessment
5.6	Practical assignment
5.7	360° assessment
5.8	Self-reflection report

6. PLO Explainable AI - EQF 7
The learner has demonstrated the ability to design, implement, and evaluate artificial intelligence (AI) systems that are not only effective but also transparent and understandable by humans, ensuring these systems can be audited and trusted by users and stakeholders. This capability includes leading the integration of explainable AI components into broader AI projects to enhance accountability and foster trust in AI applications.
Unit learning outcomes
1. Designs AI systems with a focus on explainability, ensuring that all outputs of AI models can be interpreted by end-users and stakeholders. 2. Implements techniques such as feature importance scores, model-agnostic methods, and visualization of AI decision paths to make complex AI models more understandable. 3. Evaluates the effectiveness of explainable AI models by comparing their performance and transparency with traditional AI models, ensuring that explainability does not compromise system performance. 4. Researches and applies the latest advancements in explainable AI to remain at the forefront of the field, incorporating innovative methods that enhance transparency without sacrificing functionality. 5. Communicates the importance and benefits of explainable AI to a variety of audiences, including technical teams, business stakeholders, and regulatory bodies, highlighting how transparency leads to better trust and adoption. 6. Critically assesses AI models for biases and ethical implications, ensuring that explanations accurately reflect the decision-making process and do not mislead users. 7. Leads cross-functional teams in projects that require the integration of explainable AI, coordinating efforts between data scientists, developers, and business analysts to meet project goals and compliance requirements. 8. Advocates for ethical AI practices, using explainability as a cornerstone for ethical discussions and decision-making in AI development and deployment.

6. Assessment

Unit learning outcome	Assessment method
6.1	Practical assignment
6.2	Practical assignment
6.3	Report
6.4	Report
6.5	360° assessment
6.6	Self-reflection report
6.7	360° assessment
6.8	360° assessment

7. PLO Human-Centered AI - EQF 7
The learner has demonstrated the ability to design and lead the development of AI systems that are user-friendly, ethical, and transparent, integrating human-centered design principles into AI development to enhance user trust and engagement.
Unit learning outcomes
1. Designs AI solutions that incorporate human-centered design principles, ensuring that the end user's needs and experiences are at the forefront of AI development. 2. Implements interactive AI systems that facilitate effective human-AI collaboration, enhancing user satisfaction and system usability. 3. Evaluates AI systems from a human-centered perspective, assessing usability, accessibility, and the ethical implications of AI technologies to ensure they align with human values. 4. Innovates by applying the latest research in psychology, cognitive science, and user experience design to AI development, creating more intuitive and empathetic AI systems. 5. Leads interdisciplinary teams that include UX designers, psychologists, and AI developers, fostering a collaborative environment where diverse perspectives enhance the human-centered approach to AI. 6. Communicates the benefits and limitations of human-centered AI systems to stakeholders, including technical teams, business leaders, and end-users, ensuring clear understanding and appropriate expectations. 7. Advocates for ethical standards in AI development, emphasizing the importance of transparency, fairness, and accountability in systems that impact human users. 8. Critically assesses societal impacts of AI, considering how AI systems can be designed to contribute positively to societal needs and mitigate potential harms.

7. Assessment

Unit learning outcome	Assessment method
7.1	Practical assignment
7.2	Practical assignment
7.3	Report
7.4	Practical assignment
7.5	360° assessment
7.6	360° assessment
7.7	360° assessment
7.8	Self-reflection report

8. PLO AI Ethics - EQF 7
The learner has demonstrated the ability to critically analyse and navigate the ethical challenges associated with AI technologies, developing, and implementing strategies to ensure AI systems are designed and used in a responsible and ethical manner.
Unit learning outcomes
1. Analyse the ethical implications of AI systems, identifying potential risks and benefits to individuals and society, and proposing balanced solutions to mitigate ethical concerns. 2. Develop ethical guidelines for AI projects, ensuring that all phases of AI development, from design to deployment, adhere to these principles to protect user privacy and promote fairness. 3. Evaluate AI systems for ethical compliance, using established frameworks and tools to assess the transparency, accountability, and fairness of AI technologies. 4. Lead discussions and workshops on AI ethics, educating and engaging stakeholders from various backgrounds to foster a broader understanding and commitment to ethical AI practices. 5. Innovate in the creation of tools and methods for ethical AI, contributing to the development of new ways to address ethical issues in AI research and practical applications. 6. Advocate for policies and regulations that encourage ethical AI practices, influencing public and private sector approaches to AI development and governance. 7. Collaborate with ethicists, technologists, and business leaders to integrate ethical considerations into the corporate and public-sector use of AI. 8. Research and apply interdisciplinary knowledge from philosophy, law, social science, and technology to enrich the understanding and application of AI ethics.

8. Assessment

Unit learning outcome	Assessment method
8.1	Report
8.2	Practical assignment
8.3	Report
8.4	360° assessment
8.5	Practical assignment
8.6	360° assessment
8.7	360° assessment
8.8	Report

9. PLO AI Futures and Innovation - EQF 7
The learner has demonstrated the ability to critically assess and creatively engage with emerging AI technologies, predicting future trends and spearheading innovative projects that explore new possibilities and applications of AI in various fields.
Unit learning outcomes
1. Assess the emerging trends in AI technology, evaluating potential future developments and their implications for various industries and societal norms. 2. Develop innovative AI applications, utilizing cutting-edge AI technologies and methodologies to create novel solutions that address unmet needs or open new markets. 3. Lead multidisciplinary teams in experimental AI projects, fostering a collaborative environment that encourages creative problem-solving and rapid prototyping of new ideas. 4. Evaluate the impact of new AI technologies on existing business models and strategies, providing insights that help organizations adapt to technological changes. 5. Advocate for a proactive approach to AI innovation, emphasizing the importance of ethical considerations, sustainability, and long-term societal impacts in the development of new AI technologies. 6. Communicate the potential and risks of future AI innovations to a range of stakeholders, including investors, policymakers, and the public, to foster informed decision-making. 7. Integrate diverse knowledge from fields such as cognitive science, engineering, and digital ethics to enrich AI innovation processes, ensuring that new developments are well-rounded and grounded in interdisciplinary insights. 8. Pioneer research and development in AI, pushing the boundaries of what is technically possible while also considering the practical and ethical challenges associated with advanced AI technologies.

9. Assessment

Unit learning outcome	Assessment method
9.1	Self - reflection report
9.2	Practical assignment
9.3	360° assessment
9.4	Report
9.5	360° assessment
9.6	360° assessment
9.7	Report
9.8	Report

10. PLO AI Awareness - EQF 6
The learner has demonstrated the ability to understand the fundamentals of artificial intelligence, its applications across various markets, and its transformative impact on business processes. This encompasses an appreciation of AI technologies, their potential for innovation, and the strategic considerations necessary for integrating AI into business operations.
Unit learning outcomes
1. Understands the basic concepts and technologies underlying artificial intelligence, including machine learning, natural language processing, and robotics, recognizing their roles in driving innovation. 2. Identifies key AI applications in the programming application market, assessing the competitive landscape and potential for disruptive innovation across industries. 3. Analyses the implications of AI on business processes, evaluating how AI technologies can optimize operations, enhance customer experiences, and create new business models. 4. Assesses the strategic considerations for integrating AI into business operations, including technical feasibility, cost-benefit analysis, and alignment with business goals. 5. Recognizes the ethical, legal, and societal challenges associated with AI deployment, advocating for responsible AI use that respects privacy, fairness, and transparency. 6. Communicates effectively about AI technologies and their business applications to a range of audiences, fostering AI literacy and supporting informed decision-making within organizations. 7. Collaborates with technical and non-technical teams to explore AI opportunities, facilitating cross-functional understanding and strategic alignment on AI initiatives. 8. Knowledge of current trends in AI technology to evaluate how these might influence industry innovation and competitive strategies. 9. Engages in continuous learning to keep pace with rapid advancements in AI technology and its evolving impact on the business landscape, maintaining an informed perspective on future opportunities and challenges

10. Assessment

Unit learning outcome	Assessment method
10.1	Exam
10.2	Report
10.3	Report
10.4	Self-reflection report
10.5	Self-reflection report
10.6	360° assessment
10.7	360° assessment
10.8	Exam
10.9	360° assessment

11. PLO Cyber and Data Security - EQF 7
The learner has demonstrated the ability to design, implement, and lead comprehensive cybersecurity strategies that protect information assets against emerging threats and vulnerabilities, while ensuring compliance with international data protection regulations.
Unit learning outcomes
1. Analyse and mitigate security risks associated with organizational data assets, utilizing advanced risk assessment tools and techniques to identify vulnerabilities and threats. 2. Design and implement robust security frameworks that incorporate best practices in cybersecurity, including the use of encryption, intrusion detection systems, and secure software development life cycles. 3. Develop policies and procedures that enforce data security standards and regulatory compliance, including GDPR and other international data protection laws. 4. Lead cybersecurity incident response teams, coordinating efforts to quickly address and mitigate the impact of security breaches. 5. Evaluate the effectiveness of security measures by regularly conducting security audits and penetration testing to ensure systems are resilient against attacks. 6. Train and mentor staff on cybersecurity best practices, raising awareness and fostering a security-minded culture within the organization. 7. Stay abreast of the latest developments in cybersecurity technology and threat landscapes, continuously updating and adapting security strategies to address new challenges. 8. Advocate for ethical considerations in data handling and security practices, ensuring that the privacy and rights of individuals are protected in the face of increasing digital surveillance and data collection.

11. Assessment

Unit learning outcome	Assessment method
11.1	Report
11.2	Practical assignment
11.3	Practical assignment
11.4	360° assessment
11.5	Report
11.6	360° assessment
11.7	360° assessment
11.8	360° assessment

12. PLO Natural Language Processing (NLP) - EQF 7
The learner has demonstrated the ability to critically design, develop, and optimize NLP systems, using advanced algorithms and machine learning techniques to efficiently process and analyse large volumes of natural language data, leading projects that innovate and enhance communication technologies.
Unit learning outcomes
1. Design and implement advanced NLP models, utilizing state-of-the-art techniques such as deep learning and transformer architectures to solve complex language processing challenges. 2. Evaluate NLP systems, using rigorous testing and validation methods to ensure their accuracy, efficiency, and applicability to real-world scenarios. 3. Optimize NLP algorithms for various computational environments, enhancing performance without sacrificing accuracy or increasing computational costs. 4. Apply NLP techniques to extract insights and information from textual data across different languages and dialects, supporting diverse applications such as sentiment analysis, chatbots, and automated translation. 5. Lead interdisciplinary teams in NLP projects, coordinating efforts between linguists, software developers, and data scientists to achieve project goals and push the boundaries of current technology. 6. Communicate NLP concepts and results effectively to both technical and non-technical stakeholders, ensuring that the benefits and limitations of NLP technologies are understood. 7. Stay informed on the latest developments in NLP research and industry applications, integrating cutting-edge research findings into practical applications. 8. Advocate for ethical AI practices in NLP, addressing issues such as bias, privacy, and the potential for misuse of language technologies. 9. Engages in continuous learning and professional development in the field of NLP, staying informed about emerging trends, technologies, and research findings to lead innovation and advance the state of the art in natural language processing.

12. Assessment

Unit learning outcome	Assessment method
12.1	Practical assignment
12.2	Report
12.3	Practical assignment
12.4	Exam
12.5	360° assessment
12.6	360° assessment
12.7	360° assessment
12.8	360° assessment

13. PLO Generative AI - EQF 7
The learner has demonstrated the ability to design, implement, and evaluate generative AI models, leveraging their capabilities to innovate and drive forward creative solutions in various sectors such as media, healthcare, and technology.
Unit learning outcomes
1. Design and implement advanced generative AI models, such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Transformer models, to generate novel images, texts, and data structures. 2. Evaluate the effectiveness and safety of generative AI models, ensuring they produce high-quality, innovative outputs while addressing potential risks like misinformation or unethical use. 3. Optimize generative models for efficiency and scalability, ensuring they can be deployed effectively in diverse environments, including cloud platforms and edge devices. 4. Knowledge in fine tuning and customizing generative models and use of transfer learning while implementing strategies to identify and mitigate biases in generative AI outputs. 5. Apply generative AI in novel applications, exploring uses in fields such as synthetic data generation for training other AI models, creative arts, and product design. 6. Lead projects and teams in the development of generative AI applications, managing cross-disciplinary groups to foster innovation and ensure project alignment with strategic goals. 7. Communicate the capabilities and limitations of generative AI, educating stakeholders on both the potential and the challenges of generative models, ensuring informed decision-making. 8. Stay abreast of technological advancements in the field of generative AI, incorporating the latest research and tools into ongoing projects to maintain cutting-edge knowledge and application. 9. Advocate for responsible use of generative AI technologies, ensuring that ethical considerations are integrated into the development and deployment processes to mitigate harm and bias.

13. Assessment

Unit learning outcome	Assessment method
13.1	Practical assignment
13.2	Report
13.3	Practical assignment
13.4	Exam
13.5	Practical assignment
13.6	360° assessment
13.7	360° assessment
13.8	Self-reflection report
13.9	360° assessment

14. PLO Change Management - EQF 5
The learner has demonstrated the ability to effectively lead and manage organizational change, applying systematic approaches to plan, implement, and sustain changes that align with strategic objectives and enhance organizational performance.
Unit learning outcomes
1. Analyses the need for change within organizations, identifying key drivers such as technological advancement, market dynamics, and internal challenges that necessitate adaptation. 2. Plans and designs change management strategies that are clear, structured, and aligned with the organization's long-term goals and values. 3. Implements change initiatives effectively, using project management tools and techniques to monitor progress, manage resources, and mitigate risks. 4. Communicates change effectively to all stakeholders, using appropriate methods to ensure buy-in, address concerns, and minimize resistance. 5. Evaluates the impact of change initiatives, using metrics and feedback to assess outcomes and determine the effectiveness of the strategies employed. 6. Adapts change strategies in response to evolving circumstances and feedback, demonstrating flexibility and resilience to ensure the sustainability of change. 7. Leads and inspires others during times of change, exhibiting strong leadership qualities that foster a culture of continuous improvement and readiness for change.

14. Assessment

Unit learning outcome	Assessment method
14.1	Self-reflection report
14.2	Report
14.3	Practical assignment
14.4	360° assessment
14.5	Report
14.6	Practical assignment
14.7	360° assessment

15. PLO Soft Skills - EQF 7
The learner has demonstrated the ability to integrate and apply a broad range of advanced soft skills to lead teams, manage change, solve complex problems, and communicate effectively, enhancing organizational performance and driving innovation.
Unit learning outcomes
1. Masters advanced communication techniques, tailoring messaging and employing diverse media to effectively reach and engage varied audiences in different contexts. 2. Leads and enhances team performance through effective collaboration, motivational strategies, and conflict resolution, fostering a cooperative and productive workplace environment. 3. Develops and implements creative problem-solving strategies, using innovative and critical thinking to address complex challenges and achieve strategic goals. 4. Delivers compelling presentations, utilizing state-of-the-art presentation tools and persuasive communication techniques to influence and drive decisions. 5. Cultivates an innovative mindset, encouraging creativity and continuous improvement in personal and organizational practices. 6. Applies critical thinking to evaluate information, make informed decisions, and develop well-reasoned arguments to support organizational objectives. 7. Resolves conflicts effectively, using advanced negotiation and mediation skills to handle disputes and maintain positive relationships among stakeholders.

15. Assessment

Unit learning outcome	Assessment method
15.1	360° assessment
15.2	360° assessment
15.3	Practical assignment
15.4	Practical assignment
15.5	Self-reflection report
15.6	Self-reflection report
15.7	360° assessment

Basic information on non-practitioner roles

Table 2: Table of EQF levels for each skill related to the policy- and decisionmakers, and AI advisors/ consultants

PLO	(governmental) Policy makers	(organisational) Decisionmakers	AI advisor/ consultant
AI fundamentals	EQF 6	EQF 6	EQF 6
AI and policy	EQF 7		
Organisational decision-making on AI		EQF 7	
AI Strategy			EQF 7
AI implementation			EQF 7
AI Ethics advanced			EQF 7
Impact of AI			EQF 7

PLOs for policy- and decisionmakers, and AI advisors/ consultants

Programme Learning Outcome
AI fundamentals - EQF 6 The learner has demonstrated capability to explain the concept of AI, as well as related methods, tools and techniques and its potential risks and impact to generate information using a common AI tool.
Unit learning outcomes
1. Explains the history of AI, its benefits and common terms and concepts related to AI, such as algorithms, machine learning and deep learning, neural networks, supervised and unsupervised learning, narrow and broad AI 2. Explains common AI methods, tools and techniques, such as generative AI, algorithmic decision-making, autonomous systems, computer vision, natural language processing 3. Indicates the differences and the relationship between AI and fields such as data analytics, data science, robotics, RPA, etc. 4. Explains business and other AI applications and tools, such as predictive analytics 5. Discusses the economic and social impact of AI 6. Describes general concerns, fears, risks and pitfalls commonly associated with AI 7. Explains ethical issues such as fairness, bias, transparency and accountability raised by AI 8. Shows awareness of emerging and recent innovations in AI (or: Explores emerging developments in the field of AI and their potential implications for business and society)

Programme Learning Outcome
AI and policy - EQF 7 The learner has demonstrated capability to understand the impact and consequences of AI on policy and public affairs**.**
Unit learning outcomes
1. Lists the main authoritative EU and global publications and sources on AI, such as those of the European Council and the European Commission, the OECD and UNESCO 2. Distinguishes current and emerging laws and regulations related to AI, such as the EU AI Act, data protection laws, sectoral regulatory frameworks, intellectual property (IP) laws, anti-trust/competition laws, consumer protection laws, cyber and information security laws 3. Recognises the balance and interaction between regulation and innovation 4. Indicates the impact of AI on human rights, economic well-being and its implications on economic, social, medical, security, and environmental developments 5. Discusses main building blocks and best practices (case studies) of national AI and data strategies 6. Recognises the importance of a well-governed, transparant and structured AI policy development and assessment process

Programme Learning Outcome
Organisational decision-making on AI - EQF 7 The learner has demonstrated capability to understand the impact and consequences of AI on organisational decision-making
Unit learning outcomes
1. Lists the main authoritative EU and global publications and sources on AI, such as those of the European Council and the European Commission, the OECD and UNESCO 2. Distinguishes current and emerging laws and regulations related to AI, such as the EU AI Act, data protection laws, sectoral regulatory frameworks, intellectual property (IP) laws, anti-trust/competition laws, consumer protection laws, cyber and information security laws 3. Describes the relation between AI and business strategy and the way AI can support corporate objectives (AI vision), e.g., by explaining how AI can be used to create value and be a source of competitive advantage to a business 4. Discusses main building blocks and best practices (case studies) of AI and data strategies in a range of businesses and industries 5. Indicates the potential impact of implementing an AI solution in terms of organisation (e.g., structure, processes, governance), technology (e.g., infrastructure, data), and people (e.g., know-how, roles, functions) 6. Interprets a risk analysis of implementing an AI solution 7. Critically discusses and evaluates proposals (plans, recommendations, etc.) on the application of AI in a specific business 8. Recognises the importance of a well-governed, transparent and structured AI adoption and implementation process

Programme Learning Outcome
AI strategy - EQF 7 The learner has demonstrated capability to advise on and formulate an AI strategy, aligned with the organisation strategy, compliant with relevant laws and regulations and taking into account opportunities, risks and ethical considerations
Unit learning outcomes
1. Distinguishes current and emerging laws and regulations related to AI, such as the EU AI Act, data protection laws, sectoral regulatory frameworks, intellectual property (IP) laws, anti-trust/competition laws, consumer protection laws, cyber and information security laws 2. Explains related concepts such as digital transformation and digital strategy 3. Guides the process of identifying customer needs 4. Proposes and evaluates creative ideas on the application of AI technologies, by applying idea generation and evaluation techniques 5. Describes the relation between AI and the business strategy and the way AI supports corporate objectives (AI vision), e.g. by setting high-level goals of for AI applications in line with business objectives 6. Explains how AI can be used to create value and be a source of competitive advantage to a business by using structured methods and analysis techniques 7. Identifies and prioritizes AI use cases/ scenarios to determine when and what AI solutions are best applicable in a specific situation 8. Provides advice about the possibilities, advantages and limitations of existing and emerging AI applications in general 9. Formulates an AI strategy (or a digital strategy that incorporates AI) in a coherent, clear, convincing, well-argued manner, aligned with the organisation strategy, compliant with relevant laws and regulations and while taking into account opportunities, risks, and ethical considerations

Programme Learning Outcome
AI implementation - EQF 7 The learner has demonstrated capability to advise on the implementation of an AI solution considering risks, benefits, costs and enabling factors
Unit learning outcomes
1. Explains practices, principles, methods, tools and techniques related to risk management 2. Performs a risk analysis with identification and assessment of risks of possible AI solutions, taking into account corporate and societal values and interests 3. Proposes appropriate actions to handle risks and formulates an AI risk management plan, including governance mechanisms 4. Explains methods and techniques to manage change and reach consensus and commitment 5. Determines enabling factors for implementing an AI solution in terms of organisation (e.g., structure, processes, governance), technology (e.g., infrastructure, data), and people (e.g., know-how, roles, functions) 6. Explains the dependence upon data and how to acquire, prepare, manage and provide and scale data for AI applications 7. Performs a costs and benefits analysis of possible AI solutions 8. Provides advice on appropriate AI solutions based upon benefits, risks and overall impact for a specific situation 9. Formulates an AI implementation plan 10. Formulates an AI project plan by applying relevant project management methods and tools, e.g., CRISP-DM and agile methodologies 11. Explains the evaluation of AI solutions 12. Communicates and presents advice on an AI implementation in a coherent, clear, convincing, well-argued and inspiring way

Programme Learning Outcome
AI Ethics advanced – EQF 7 The learner has demonstrated the ability to realise and critically evaluate ethical ways of working around AI and develop an ethical AI policy, taking into account prevailing laws and relevant frameworks and criteria.
Unit learning outcomes
1. Describes the essence and key concepts of fundamental human rights and human values 2. Explains the nature and the field of ethics, its importance and main theories, concepts and principles 3. Recognises ethical dilemmas 4. Describes the regulatory and policy landscape for AI, including in the EU, e.g. AI Act, and in supra-national bodies like the IEEE and OECD. 5. Identifies and describes the concepts of bias, trust, fairness, transparency, equality, accountability and empowerment in the context of artificial intelligence 6. Explains criteria for trustworthy AI, such as lawful, ethical and robust 7. Explains main recommendations, codes and frameworks related to the ethics of AI, such as the framework for achieving Trustworthy AI of the High-Level Expert Group on Artificial Intelligence and the values-based principles of the OECD 8. Explains methods to implement ethical work practices regarding AI, such as the AI Ethics maturity model 9. Indicates how to support a culture that preserves AI ethical behavior and work practices 10. Analyses and assesses algorithmic rules against ethical criteria and policy 11. Applies technical and non-technical methods to monitor and evaluate the development, deployment and use of the AI system and its learning processes 12. Defines an AI ethical policy 13. Names initiatives, organisations and communities of interest related to AI ethics, such as the OECD AI Policy Observatory

Programme Learning Outcome
Impact of AI – EQF 7 The learner has demonstrated the ability to explain the abilities of AI-based technology and its implications in different areas and perform an AI impact assessment of an AI-based technology in a specific context.
Unit learning outcomes
1. Describes the terms “impact” and “impact assessment” and explains the importance of impact assessments related to AI. 2. Explains the abilities of AI-based technology and its possible applications to be misused in general, such as privacy violations, algorithmic bias, socio-economic inequalities, misinformation and deep fake technologies, lack of transparency and explainability and social surveillance. 3. Explains the abilities of AI-based technology and its possible applications to be used for good in general, such as solving complex problems in fields like climate science, drug discovery and engineering, the amplification of people's abilities e.g. by improving accessibility and self-expression 4. Describes the political implications of AI by distinguishing the main issues, concerns, advantages and disadvantages, such as the potential to affect the democratic process and elections in a negative way, but also improve the policy-making process and the alignment between citizens and politicians. 5. Describes the societal implications of AI by distinguishing the main issues, concerns, advantages and disadvantages, such as facilitating individual services and improving customer satisfaction, but also its ability to undermine as well as to support human autonomy, well-being and safety. 6. Describes the economic implications of AI by distinguishing the main issues, concerns, advantages and disadvantages, such as automation-spurred job loss, but also the creation of new jobs, the automation of routine and time-consuming tasks and optimisation of workflows. 7. Describes the implications of AI in specific areas, such as the automatisation of weapons in defence, algorithmic trading in financial markets, AI-powered recruiting in HR and use of AI-driven robotic devices in healthcare. 8. Performs an overall AI impact assessment for an AI project or a specific AI application in a certain context by applying an impact assessment model or tool, such as the AI Impact Assessment of the Dutch government, the Microsoft Responsible AI Impact Assessment Guide or OECD's Algorithmic Impact Assessment (AIA) 9. Explains how to perform impact assessments of AI projects or applications from different perspectives, such as a Data Protection Impact Assessment, an Environmental Impact Assessment, a Health Impact Assessment, a Human rights impact assessment, a Racial equity impact assessment and a Gender impact assessment.

Annex 2: Learning Unit Matrix (LUM) Example

Data Scientist (EQF 7)				Learning unit	*[Please provide the Title of the Learning Unit. Add a column for each Learning Unit under the Learning Section.]*	.....	*[Write a Learning Unit. Add a column for each Learning Unit under the section.]*
ULO ID	**PLOs**	**ULOs**	**ULOs Entry Requirements**				
1.1	**1 - Deep Learning (EQF 7)**	Critically evaluates the theoretical underpinnings of deep learning			*[Tick the box with an **X** if the Learning Unit covers the ULO]*	...	
1.2		Designs innovative deep learning models			...	...	
1.3		Develops advanced deep learning models using current frameworks and tools					
1.4		Analyses complex datasets using deep learning models					
1.5		Reflects on the ethical, legal, and social implications of deploying deep learning models					
1.6		Collaborates effectively in interdisciplinary teams to design, develop, and deploy deep learning solutions					
1.7		Communicates complex deep learning concepts, methodologies, and outcomes					
1.8		Applies innovative problem-solving skills					
1.9		Manages the lifecycle of deep learning projects					

Annex 3: Curriculum Template

Curriculum Template

[Curriculum Title]

1. General information

Name	[Curriculum Name, taken from the LUM]
EQF level	[EQF level, taken from the LUM]
Goals	[Write Goal 1] [Write Goal 2] …
Scope	[Please indicate the Scope of the Curriculum and the Target Groups]
Entry requirements	[Description of the Entry Requirement]
Programme learning outcomes (PLOs)	[PLOs taken from the Educational Profile (ED)]

2. Description of the structure

[Explain the whole rationale and structure of the curriculum. Focus on aspects as the modularity and connection between learning units]

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
[taken from the LUM]	[…]	[…]	[…]
[taken from the LUM]		[…]	

[taken from the LUM]		[…]	

4. Details of Learning Units

4.1. [Learning Unit Title]

Description
[Write a brief description of the learning unit]
Related Programme Learning Outcome(s)
[taken from the LUM]
Unit learning outcomes
• [taken from the LUM]
Delivery method(s)
[Choose the best fitting Delivery method]
Materials
[Describe the materials you will develop in detail in T4.4 to implement this Learning Unit]

Annex 4: Core Curricula and Specific Curricula

AI Professionals

DATA ANALYST EQF 4/5

1. General information

Name	Data Analyst
EQF level	EQF 4/5
Goals	The Data Analyst curriculum at EQF 4/5 provides participants with foundational skills in data analysis and business intelligence. It covers essential topics such as data mining, big data analytics, and the basics of machine learning and AI. Participants will learn to develop data pipelines, implement ETL processes, and use Python for data analysis tasks. The program emphasizes the ability to communicate data insights effectively, apply ethical practices in data handling, and leverage AI technologies to inform business decisions.
Scope	This course is aimed at people interested in exploring data-driven roles and who seek to gain practical experience early in their educational path, paving the way for future opportunities in data analytics and business intelligence.
Entry requirements	General Entry requirements: • Basic Mathematical Knowledge • Foundational Computer Skills • Basic Problem-Solving Skills
Programme learning outcomes (PLOs)	1 - AI Technologies (EQF 5) 2 - Big Data & Data Analytics (EQF 5) 3 - AI Ethics (EQF 5) 4 - Business Intelligence (EQF 5) 5 - AI Awareness (EQF 5) 6 - Machine Learning (EQF 5) 7 - Explainable AI (EQF 5) 8 - Soft Skills (EQF 5)

2. Description of the structure

The course is structured into 11 modules for a total of 200 hours. It begins with an introduction to business intelligence and foundational AI concepts. The curriculum progresses to data mining and big data analysis, focusing on data warehousing and OLAP.

Further modules cover Python programming for data analysis, including libraries like NumPy and Pandas, and fundamentals of machine learning with a focus on clustering, classification, and regression in Python. The course addresses explainability in AI and concludes with ethical and legal considerations in data science.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Introduction to Business Intelligence	15	EQF 5	Exam
ETL, Data Warehouses, OLAP	20	EQF 5	Exam
Introduction to Artificial Intelligence and its applications	10	EQF 5	Exam
Introduction to Data Mining	15	EQF 5	Exam
Fundamentals of Data Mining and Big Data Analysis	20	EQF 5	Exam
Python Basics	15	EQF 5	Practical Assignment
Programming for Data Mining (NumPy, Pandas, Matplotlib)	25	EQF 5	Practical Assignment
Fundamentals of Machine Learning	20	EQF 5	Exam
Clustering, Classification and Regression in Python	25	EQF 5	Practical Assignment
Explainability in Artificial Intelligence	15	EQF 5	Exam
Ethical and Legal issues in Data Science	10	EQF 5	Exam

4. Details of Learning Units

4.1. Introduction to Business Intelligence

Description
Covers the basics of business intelligence, including tools and techniques to transform data into actionable insights.
Related Programme Learning Outcome(s)
1 - Business Intelligence (EQF 5) 2 - AI Awareness (EQF 5) 3 - Soft Skills (EQF 5)
Unit learning outcomes
• Utilizes specialized knowledge in business intelligence systems • Develops and implements analytical models and reports that transform raw data into actionable insights • Evaluates the effectiveness of business intelligence strategies and tools • Manages business intelligence projects • Communicates complex data insights in a clear and understandable manner • Leads the adoption of new business intelligence technologies and practices • Evaluates real-world case studies where AI has been successfully implemented • Solves problems creatively and efficiently • Cultivates an innovative mindset
Delivery method(s)
• Case study analysis • Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Berthold, M.R., Borgelt, C., Höppner, F., Klawonn, F. GUIDE TO INTELLIGENT DATA ANALYSIS. Springer Verlag, 1st Edition., 2010. ISBN 978-1-84882-259-7

4.2. ETL, Data Warehouses, OLAP

Description
Introduces ETL processes, data warehousing concepts, and Online Analytical Processing (OLAP) for efficient data management.
Related Programme Learning Outcome(s)
1 - Business Intelligence (EQF 5) 2 - AI Awareness (EQF 5) 3 - Soft Skills (EQF 5)
Unit learning outcomes
• Utilizes specialized knowledge in business intelligence systems • Develops and implements analytical models and reports that transform raw data into actionable insights • Evaluates the effectiveness of business intelligence strategies and tools • Manages business intelligence projects • Communicates complex data insights in a clear and understandable manner • Leads the adoption of new business intelligence technologies and practices • Evaluates real-world case studies where AI has been successfully implemented • Solves problems creatively and efficiently • Cultivates an innovative mindset
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.3. Introduction to Artificial Intelligence and its applications

Description
Provides an overview of AI technologies and their practical applications in various domains.
Related Programme Learning Outcome(s)
1 - AI Awareness (EQF 5) 2 - Explainable AI (EQF 5) 3 - Soft Skills (EQF 5)
Unit learning outcomes
• Identifies and explains the key technologies and methodologies that underpin AI • Analyses the potential impacts of AI on society • Discusses the challenges and risks associated with AI deployment • Evaluates real-world case studies where AI has been successfully implemented • Communicates effectively about AI technologies and their implications • Understands and explains the theoretical foundations of explainable AI • Communicates effectively the principles and benefits of explainable AI to non-technical audiences • Cultivates an innovative mindset
Delivery method(s)
• Workshop • Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.4. Introduction to Data Mining

Description
Introduces fundamental techniques in data mining, including methods for discovering patterns in large datasets.
Related Programme Learning Outcome(s)
1 – Big Data & Data Analytics (EQF 5) 2 - AI Awareness (EQF 5)
Unit learning outcomes
• Utilizes comprehensive, specialized knowledge of big data technologies and data analytics processes • Identifies and explains the key technologies and methodologies that underpin AI
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison Wesley, ISBN 0-321-32136-7, 2006

4.5. Fundamentals of Data Mining and Big Data Analysis

Description
Expands on data mining with a focus on big data technologies and analysis techniques.
Related Programme Learning Outcome(s)
1 – Big Data & Data Analytics (EQF 5) 2 - AI Ethics (EQF 5) 3 - AI Awareness (EQF 5) 4 - Soft Skills (EQF 5)
Unit learning outcomes
• Utilizes comprehensive, specialized knowledge of big data technologies and data analytics processes • Evaluates the effectiveness of data analytics strategies and tools in real-world applications • Communicates findings from data analytics clearly to stakeholders • Leads and manages teams in data-driven projects • Evaluates AI systems for potential ethical issues and biases • Identifies and explains the key technologies and methodologies that underpin AI • Cultivates an innovative mindset
Delivery method(s)
• Workshop • Lectures • Project work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Dasgupta, N. (2018). Practical big data analytics: Hands-on techniques to implement enterprise analytics and machine learning using Hadoop, Spark, NoSQL and R. Packt Publishing Ltd.

4.6. Python Basics

Description
Covers basic Python programming skills essential for data analysis and manipulation.
Related Programme Learning Outcome(s)
1 – Big Data & Data Analytics (EQF 5) 2 - Soft Skills (EQF 5)
Unit learning outcomes
• Develops scalable data pipelines and architectures that ensure data integrity and accessibility • Solves problems creatively and efficiently
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Matthes, E. (2023). Python crash course: A hands-on, project-based introduction to programming.

4.7. Programming for Data Mining (NumPy, Pandas, Matplotlib)

Description
Teaches data mining using Python libraries, focusing on data handling, analysis, and visualization.
Related Programme Learning Outcome(s)
1 – Big Data & Data Analytics (EQF 5) 2 - Machine Learning (EQF 5) 3 - Soft Skills (EQF 5)
Unit learning outcomes
• Analyses complex data using statistical models and machine learning techniques • Develops scalable data pipelines and architectures that ensure data integrity and accessibility • Evaluates the effectiveness of data analytics strategies and tools in real-world applications • Applies comprehensive and specialized knowledge in machine learning techniques • Solves problems creatively and efficiently • Manages conflicts by implementing effective resolution strategies
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** McKinney, W. (2022). Python for data analysis. " O'Reilly Media, Inc.".

4.8. Fundamentals of Machine Learning

Description
Introduces key concepts and techniques in machine learning, including algorithms for data classification and prediction.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 5) 2 – Big Data & Data Analytics (EQF 5) 3 – AI Awareness (EQF 5) 4 - Machine Learning (EQF 5)
Unit learning outcomes
• Designs and optimizes AI models to solve specific problems • Analyses complex data using statistical models and machine learning techniques • Evaluates the effectiveness of data analytics strategies and tools in real-world applications • Communicates findings from data analytics clearly to stakeholders • Leads and manages teams in data-driven projects • Identifies and explains the key technologies and methodologies that underpin AI • Applies comprehensive and specialized knowledge in machine learning techniques • Designs and evaluates machine learning models to optimize performance • Implements advanced data pre-processing, feature engineering, and algorithm tuning techniques • Communicates complex machine learning concepts and results • Stays abreast of emerging trends and technologies in machine learning
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Burkov, A. (2019). The hundred-page machine learning book (Vol. 1, p. 32). Quebec City, QC, Canada: Andriy Burkov.

4.9. Clustering, Classification and Regression in Python

Description
Covers practical implementation of clustering, classification, and regression techniques using Python.
Related Programme Learning Outcome(s)
1 – Big Data & Data Analytics (EQF 5) 2 – AI Awareness (EQF 5) 3 - Machine Learning (EQF 5) 4 - Soft Skills (EQF 5)
Unit learning outcomes
• Designs and optimizes AI models to solve specific problems • Analyses complex data using statistical models and machine learning techniques • Identifies and explains the key technologies and methodologies that underpin AI • Applies comprehensive and specialized knowledge in machine learning techniques • Designs and evaluates machine learning models to optimize performance • Manages and leads machine learning projects • Implements advanced data pre-processing, feature engineering, and algorithm tuning techniques • Solves problems creatively and efficiently • Manages conflicts by implementing effective resolution strategies
Delivery method(s)
• Workshop • Lectures • Project Work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.10. Explainability in Artificial Intelligence

Description
Focuses on methods and best practices for developing explainable AI models and interpreting their results.
Related Programme Learning Outcome(s)
1 – AI Awareness (EQF 5) 2 - Explainable AI (EQF 5) 3 - Soft Skills (EQF 5)
Unit learning outcomes
• Advocates for ethical AI practices • Understands and explains the theoretical foundations of explainable AI • Implements techniques for developing explainable AI models • Assesses the impact of AI systems on stakeholders • Evaluates the trade-offs between model complexity and interpretability • Develops guidelines and best practices for creating explainable AI solutions • Communicates effectively the principles and benefits of explainable AI to non-technical audiences • Leads interdisciplinary teams in projects that integrate explainable AI • Cultivates an innovative mindset
Delivery method(s)
• Workshop • Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.11. Ethical and Legal issues in Data Science

Description
Explores the ethical and legal considerations in data science, including data privacy and responsible AI practices.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 5) 2 - Big Data & Data Analytics (EQF 5) 3 - AI Ethics (EQF 5) 4 - Business Intelligence (EQF 5) 5 – AI Awareness (EQF 5) 6 - Machine Learning (EQF 5) 7 - Soft Skills (EQF 5)
Unit learning outcomes
• Assesses and addresses ethical, legal, and social implications of AI technologies • Implements data governance and compliance measures • Analyses and understands the foundational ethical theories and principles • Evaluates AI systems for potential ethical issues and biases • Develops guidelines and best practices for ethical AI • Implements strategies for ethical auditing and compliance in AI projects • Communicates effectively the importance of ethics in AI • Leads multidisciplinary teams in ethical decision-making processes • Stays abreast of emerging ethical issues and debates in AI • Assesses ethical considerations in data handling and analytics • Analyses the potential impacts of AI on society • Discusses the challenges and risks associated with AI deployment • Communicates effectively about AI technologies and their implications • Participates in debates and discussions about the future of AI • Advocates for ethical AI practices • Assesses the ethical implications of machine learning projects • Manages conflicts by implementing effective resolution strategies
Delivery method(s)
• Workshop • Lectures • Case studies

Materials

Lecturer Materials:

Tutorial Materials (Slide and Presentations)

Student readings suggested:

Barocas, S., & Boyd, D. (2017). Engaging the ethics of data science in practice. Communications of the ACM, 60(11), 23-25.

DATA ANALYST EQF 6

1. General information

Name	Data Analyst
EQF level	EQF 6 for all units with exception on neural networks units where EQF level is 7 and 8
Goals	1. **Master Machine Learning Techniques:** Equip learners with essential skills in supervised and unsupervised learning, including clustering, classification, and regression. 2. **Develop Data Analysis Skills:** Enable proficient exploratory data analysis, visualization, and implementation of data analytic workflows. 3. **Design and Build Advanced Neural Networks:** Foster comprehensive knowledge in constructing, optimizing, and implementing neural networks and deep learning models from scratch. 4. **Apply Practical Machine Learning Tools:** Train learners to effectively use machine learning tools, recognize opportunities for their application, and implement solutions in various real-world scenarios. 5. **Ensure Ethical AI Deployment:** Instill understanding of ethical considerations, explainability, and best practices for responsible AI implementation.
Scope	**Scope of the Curriculum:** The curriculum provides a comprehensive and practical education in machine learning, data science, and AI, covering a broad range of topics from foundational concepts to advanced techniques. It encompasses unsupervised and supervised learning methods, neural network construction, text and image analytics, and ethical AI deployment. The training is designed to be accessible, requiring no prior knowledge of math or statistics for most learning units, and leverages advanced training techniques and modern visual analytics software to facilitate rapid and effective learning. **Target Groups:** The curriculum is tailored for employees in the industry and public sector who aim to delve deeply into machine learning, data science, and AI. It is ideal for professionals seeking to enhance their skills and apply cutting-edge technologies in their work. The pedagogical approach ensures that learners can quickly grasp complex concepts using advanced training techniques and state-of-the-art visual analytics tools, enabling them to achieve competency efficiently and effectively.
Entry requirements	No prior knowledge of mathematics, statistics, computer science, or programming is required. Exceptions are "Neural Networks from Ground-Up", which requires basic knowledge of Python and its programming environment

	(editing code, basic debugging, running Python applications), and "Generative AI - Large Language Model from Ground-Up", which requires solid Python programming skills.
Programme learning outcomes (PLOs)	1 - Deep Learning (EQF 6) 2 - PLO AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 8 - AI Ethics (EQF 6) 9 - AI Futures and Innovation (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 13 - Generative AI (EQF 6) 14 - Soft Skills (EQF 6)

2. Description of the structure

The curriculum is structured into distinct yet interconnected learning units, each focusing on a specific aspect of data science, machine learning, and AI, emphasizing a modular approach for a comprehensive understanding. The "Unsupervised Learning" unit lays a foundation in data exploration and clustering techniques, essential for understanding data patterns without labeled outcomes. This is complemented by the two "Supervised Learning" units, which train the classification and regression techniques, providing a detailed study of predictive modeling, accuracy assessment, overfitting prevention, and model explanation and understanding. The unit on "Mining of Unstructured Data" extends the knowledge to text and image analytics, introducing practical applications in unstructured data through deep neural network embedding and combining the data analysis techniques from the previous learning units. Again, this unit emphasizes pattern discovery, interpretation, and data understanding.

While these introductory machine learning units emphasize an intuitive understanding of machine learning techniques and utility in practical cases, the "Neural Networks from Ground-Up" offers an in-depth mathematical and practical understanding of neural network construction and optimization, paving the way for the "Generative AI - Large Language Model from Grounds-Up," where students replicate GPT-2, enhancing their skills in implementing and optimizing large-scale AI models. These two units were designed for those who want to gain a deep understanding of AI and state-of-the-art methods and require prior knowledge of Python programming.

The curriculum concludes with "Data Science, AI, and Society," which integrates ethical considerations, explainability, and industry practices, ensuring a holistic education that prepares students for real-world applications and responsible AI deployment. Like other units, the training focuses on examples, case studies, and practical work.

Each unit in this Data Analyst curriculum builds on the previous ones, ensuring a seamless transition from fundamental to advanced topics while also highlighting the practical interconnections and applications of the concepts learned.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment
Unsupervised Learning	50 / 2	6	Quizzes, Project Report
Supervised Learning - Classification	50 / 2	6	Quizzes, Project Report
Supervised Learning - Regression	50 / 2	6	Quizzes, Project Report
Mining of Unstructured Data: Text and Image Analytics	50 / 2	6	Quizzes, Project Report
Neural Networks from Ground-Up	50 / 2	6	Quizzes, Project Report
Generative AI - Large Language Model from Grounds-Up	50 / 2	7	Quizzes, Project Report
Data Science, AI and Society	50 / 2	8	Quizzes, Project Report

4. Details of Learning Units

4.1. Unsupervised Learning

Description of "Unsupervised Learning"
This unit delves into unsupervised learning techniques, starting with data representation and exploratory data analysis. It covers statistical fundamentals such as distributions and correlations, complemented by extensive data visualization methods. The curriculum includes an introduction to data analysis workflows and visual programming, with a focus on various clustering methods such as hierarchical, k-means, DBSCAN, and Gaussian mixture modelling using the expectation maximization algorithm. Dimensionality reduction techniques such as principal component analysis, multidimensional scaling, and t-SNE are explained. The unit also explores distance measurement, silhouette scoring for cluster validation, and techniques for explaining point-based visualizations. No prior knowledge of programming, computer science, statistics, or mathematics is required.
Related Programme Learning Outcomes
2 - PLO AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 14 - Soft Skills (EQF 6)
Unit learning outcomes
Program-specific learning outcomes will enable course participant to acquire the following skills: • Communicates technical details and project outcomes related to AI technologies • Implements AI projects by applying foundational ML Ops principles • Adapts machine learning models to evolving data and requirements • Communicates effectively with stakeholders involved in AI projects • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Communicates machine learning findings effectively • Develops AI models using explainable AI techniques to ensure transparency and interpretability • Implements strategies to improve the explainability of existing AI models • Creates effective data visualizations that clearly communicate analytical findings • Enhances human-computer interaction through the design of intuitive and accessible AI interfaces

- Designs and implements data visualization techniques to effectively communicate
- Understands the basic concepts and technologies underlying artificial intelligence
- Solves problems creatively and efficiently
- Thinks critically, analysing situations, evaluating diverse perspectives

Learning unit-specific outcomes related to gaining an intuitive and operational understanding of AI methods include acquiring knowledge and skills in:

- Feature-based data representation
- Exploratory data analysis methods
- Data distributions, correlations
- Various data visualization techniques, including box plots, distribution graphs, and scatter plots
- Data analysis workflows and visual programming in Orange Data Mining
- Measuring distances between data instances and between data clusters
- Hierarchical clustering method
- Cluster explanation
- Silhouette Scoring
- Complexity of clustering, clustering of large data sets, k-means clustering
- Other types of clustering, including DBSCAN and Gaussian Mixture Modeling, expectation-maximization algorithm
- Dimensionality reduction techniques: projections and embedding
- Principal component analysis, multidimensional scaling, and t-SNE
- Explanation of point-based visualizations

Delivery methods

- On-site lectures with practical demonstrations of methods, tools, and cases
- Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges
- Project-based study with structured delivery of findings
- On-line discussion of project results and quizzes
- On-line forum, discussions and assistance on Discord channel

Material

- Lecture notes with practical examples, cases, and demonstrations of how to use data mining tool Orange, delivered electronically to in-class participants
- Quizzes and interactive lecture notes in a mini-MOOC environment
- About 15 short educational videos
- Rescha S (2024) Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters)
- Kneusel RT (2023) How AI Works, No Starch Press (optional reading, selected chapters)

4.2. Supervised Learning – Classification

Description of "Supervised Learning – Classification"
This unit introduces the fundamentals of supervised learning with a focus on classification. It begins with data representation techniques specific to classification problems and an introduction to classification trees, discussing their interpretation and accuracy assessment. The unit covers crucial concepts such as overfitting, accuracy estimation through cross-validation, and the use of diverse classifiers including random forests, k-nearest neighbours, gradient boosting, logistic regression, and the naive Bayesian classifier. It also explores model performance metrics like sensitivity, specificity, and the area under the ROC curve. Additionally, the curriculum addresses the explainability of complex models using SHAP values. No prior knowledge of programming, computer science, statistics, or mathematics is required. The successful completion of "Unsupervised Learning" from this Data Science curricula is strongly advised.
Related Programme Learning Outcomes
2 - PLO AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 14 - Soft Skills (EQF 6)
Unit learning outcomes
Program-specific learning outcomes will enable course participant to acquire the following skills: • Analyses the performance and efficiency of AI models and technologies • Implements AI projects by applying foundational ML Ops principles • Adapts machine learning models to evolving data and requirements • Communicates effectively with stakeholders involved in AI projects • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Communicates machine learning findings effectively • Develops AI models using explainable AI techniques to ensure transparency and interpretability • Analyses existing AI models to assess and measure their explainability • Develops data science solutions to tackle specific analytical challenges • Creates effective data visualizations that clearly communicate analytical findings • Incorporates human-centered design principles in the development of AI systems • Understands the basic concepts and technologies underlying artificial intelligence

- Solves problems creatively and efficiently
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Learning unit-specific outcomes related to gaining an intuitive and operational understanding of AI methods include acquiring knowledge and skills in:

- Classification and data representation for classification problems
- Classification trees
- Interpretation and accuracy of classification trees
- Accuracy on training and test data and effects of overfitting
- Estimation of accuracy, cross-validation
- Other classifiers, including random forests, k-nearest neighbors, gradient boosting, logistic regression
- Nomograms
- Model accuracy scoring through estimation of sensitivity, specificity, area under ROC
- Explainability of complex models and SHAP values

Delivery methods

- On-site lectures with practical demonstrations of methods, tools, and cases
- Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges
- Project-based study with structured delivery of findings
- On-line discussion of project results and quizzes
- On-line forum, discussions and assistance on Discord channel

Material

- Lecture notes with practical examples, cases, and demonstrations of how to use data mining tool Orange, delivered electronically to in-class participants
- Quizzes and interactive lecture notes in a mini-MOOC environment
- About 15 short educational videos
- Rescha S (2024) Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters)
- Kneusel RT (2023) How AI Works, No Starch Press (optional reading, selected chapters)

4.3. Supervised Learning – Regression

Description of "Supervised Learning – Regression"
This unit explores regression analysis within supervised learning, starting with the basics of data representation for regression problems. It covers linear regression and extends to more complex forms such as polynomial regression, discussing key concepts like overfitting and regularization. The unit examines regularization techniques, including L1 and L2, and the impact of regularization on accuracy in training and test datasets. It also introduces other regression methods like random forests, k-nearest neighbors, and gradient boosting. Additionally, the curriculum delves into the selection and tuning of meta-parameters in machine learning, including strategies for searching and estimating accuracy through methods like RMSE and R^2. No prior knowledge of programming, computer science, statistics, or mathematics is required. The successful completion of "Unsupervised Learning" and "Supervised Learning – Classification" from this Data Science curricula is strongly advised.
Related Programme Learning Outcome
2 - PLO AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 14 - Soft Skills (EQF 6)
Unit learning outcomes
Program-specific learning outcomes will enable course participant to acquire the following skills: • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Communicates technical details and project outcomes related to AI technologies • Implements AI projects by applying foundational ML Ops principles • Adapts machine learning models to evolving data and requirements • Communicates effectively with stakeholders involved in AI projects • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Communicates machine learning findings effectively • Develops AI models using explainable AI techniques to ensure transparency and interpretability • Analyses existing AI models to assess and measure their explainability • Implements strategies to improve the explainability of existing AI models

- Develops data science solutions to tackle specific analytical challenges
- Interprets complex data sets to identify trends, patterns, and insights that inform business strategies
- Designs and implements data visualization techniques to effectively communicate
- Understands the basic concepts and technologies underlying artificial intelligence
- Solves problems creatively and efficiently
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Learning unit-specific outcomes related to gaining an intuitive and operational understanding of AI methods include acquiring knowledge and skills in:

- Regression in general and data representation for regression problems
- Linear regression, criteria function
- Regression accuracy scoring (RMSE, R2)
- Polynomial regression, overfitting
- Regularization
- Effects of regularization on training and test set accuracy
- L1 and L2 regularization, model complexity
- Regularization path
- Other regression techniques: random forests, k-nearest neighbors, gradient boosting
- Meta parameters in machine learning and strategies of meta-parameter search and accuracy estimation

Delivery methods

- On-site lectures with practical demonstrations of methods, tools, and cases
- Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges
- Project-based study with structured delivery of findings
- On-line discussion of project results and quizzes
- On-line forum, discussions and assistance on Discord channel

Material

- Lecture notes with practical examples, cases, and demonstrations of how to use data mining tool Orange, delivered electronically to in-class participants
- Quizzes and interactive lecture notes in a mini-MOOC environment
- About 15 short p videos
- Rescha S (2024) Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters)
- Kneusel RT (2023) How AI Works, No Starch Press (optional reading, selected chapters)

4.4. Mining of Unstructured Data: Text and Image Analytics

Description of "Mining of Unstructured Data: Text and Image Analytics"
This unit provides an overview of mining unstructured data, focusing on text and image analytics. It starts with a recap of logistic regression and an intuitive introduction to neural networks, followed by deep convolutional neural networks and the principles of image embedding. Techniques such as image clustering and classification through transfer learning are explored. The curriculum also introduces large language models and text embedding, discussing how to mine text through clustering, classification, and regression. Additionally, it covers alternative classical text mining approaches, including the bag-of-words model and text preprocessing techniques like TF-IDF. No prior knowledge of programming, computer science, statistics, or mathematics is required. The successful completion of "Unsupervised Learning", "Supervised Learning – Regression", and "Supervised Learning – Classification" from this Data Science curricula is strongly advised.
Related Programme Learning Outcome
1 - Deep Learning (EQF 6) 2 - PLO AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 14 - Soft Skills (EQF 6)
Unit learning outcomes
Program-specific learning outcomes will enable course participant to acquire the following skills: • Develops AI models using chosen frameworks and libraries • Adapts existing AI models to new contexts and problems • Communicates technical details and project outcomes related to AI technologies • Implements AI projects by applying foundational ML Ops principles • Adapts machine learning models to evolving data and requirements • Communicates effectively with stakeholders involved in AI projects • Applies fundamental machine learning concepts and algorithms • Designs data pre-processing and feature engineering strategies • Communicates machine learning findings effectively

- Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets
- Develops data science solutions to tackle specific analytical challenges
- Interprets complex data sets to identify trends, patterns, and insights that inform business strategies
- Designs and implements data visualization techniques to effectively communicate
- Understands the basic concepts and technologies underlying artificial intelligence
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI technology
- Solves problems creatively and efficiently
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Learning unit-specific outcomes related to gaining an intuitive and operational understanding of AI methods include acquiring knowledge and skills in:

- Logistic regression, and intuitive understanding of neural networks
- Deep convolutional neural networks and image embedding
- Image clustering and classification through transfer learning and image representation in the embedded space
- Utility of large language models for document embedding
- Text mining through clustering, classification and regression using text embedding
- Dimensionality reduction, image and text maps
- Text and image classification
- Alternative classical approaches to text mining using bag-of-words representation, and text pre-processing (including TF-IDF)

Delivery methods

- On-site lectures with practical demonstrations of methods, tools, and cases
- Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges
- Project-based study with structured delivery of findings
- On-line discussion of project results and quizzes
- On-line forum, discussions and assistance on Discord channel

Materials

- Lecture notes with practical examples, cases, and demonstrations of how to use data mining tool Orange, delivered electronically to in-class participants
- Quizzes and interactive lecture notes in a mini-MOOC environment
- About five short educational videos

- Rescha S (2024) Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters)
- Kneusel RT (2023) How AI Works, No Starch Press (optional reading, selected chapters)

4.5. Neural Networks from Ground-Up

Description of "Neural Networks from Ground-Up"
This unit offers a deep dive into the fundamental concepts and mathematics behind neural networks, starting with functions, derivatives, and gradient descent. Participants will learn the principles of backpropagation and engage in hands-on development of a Python-based framework for specifying and training models from scratch. The course includes building our own implementations of linear regression, logistic regression, softmax regression, a basic neural network, and a convolutional neural network. Additionally, the curriculum features a comparative analysis with state-of-the-art deep learning toolboxes like PyTorch, highlighting differences and advantages. Trainees in this course are required to have basic knowledge of programming in Python and knowledge about Python programming infrastructure (editors, debugging, running Python programs).
Related Programme Learning Outcome
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 9 - AI Futures and Innovation (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 13 - Generative AI (EQF 6) 14 - Soft Skills (EQF 6)
Unit learning outcomes
Program-specific learning outcomes will enable course participant to acquire the following skills: • Analyzes the fundamental principles of neural networks • Designs deep learning models by selecting appropriate architectures • Applies deep learning techniques to solve problems • Analyses the performance and efficiency of AI models and technologies • Communicates technical details and project outcomes related to AI technologies • Implements AI projects by applying foundational ML Ops principles • Adapts machine learning models to evolving data and requirements • Applies fundamental machine learning concepts and algorithms • Designs data pre-processing and feature engineering strategies • Identifies suitable applications for deep and shallow neural architectures

- Designs and implements data visualization techniques to effectively communicate
- Thinks critically, analysing situations, evaluating diverse perspectives

Learning unit-specific outcomes related to gaining an intuitive and operational understanding of the AI methods and following topics that include:

- Functions and derivatives
- Gradient descent
- Backpropagation learning
- Development of Python-based framework for model specification and training through back-propagation (from zero!)
- Trainee's own implementation of linear regression, logistic regression, and softmax regression
- Trainee's own implementation of a neural network
- Trainee's own implementation of a convolutional neural network
- Comparison of trainee's own implementation with state-of-the-art toolbox PyTorch for Deep Learning

Delivery method

- On-site lectures with practical demonstrations of methods, tools, and cases
- Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges
- Project-based study with structured delivery of findings
- On-line discussion of project results and quizzes
- On-line forum, discussions and assistance on Discord channel

Material

- Lecture notes with practical examples, delivered electronically to in-class participants
- Quizzes and interactive lecture notes in a mini-MOOC environment
- Rescha S (2024) Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters)
- Kneusel RT (2023) How AI Works, No Starch Press (optional reading, selected chapters)
- Andrej Karpathy's videos on YouTube from playlist "Neural Networks: Zetto To Hero"

4.6. Generative AI - Large Language Model from Grounds-Up

Description of "Generative AI - Large Language Model from Grounds-Up"
This intensive unit guides participants through reproducing the GPT-2 (124M) model from scratch. Starting with an overview of the model's architecture and parameters, students will implement the neural network module, forward pass, and sampling mechanisms within a Python framework. The course covers detailed aspects of optimization, including overfitting a batch, implementing efficient data loaders, and parameter sharing techniques. Acceleration techniques using GPUs, mixed precision, and kernel fusion are taught to enhance training speed. Advanced topics such as hyperparameter tuning, gradient accumulation, and distributed data parallel setups are also explored. The unit concludes with evaluating the model's performance, comparing it with benchmarks, and enjoying generated text samples. Participants in this course are required to have good knowledge of programming in Python.
Related Programme Learning Outcome
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 9 - AI Futures and Innovation (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 13 - Generative AI (EQF 6) 14 - Soft Skills (EQF 6)
Unit learning outcomes
Program-specific learning outcomes will enable course participant to acquire the following skills: • Analyzes the fundamental principles of neural networks • Designs deep learning models by selecting appropriate architectures • Implements deep learning models using relevant frameworks and libraries • Applies deep learning techniques to solve problems • Critiques the current trends and advancements in deep learning • Collaborates effectively in teams to design, implement, and evaluate deep learning projects • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Communicates technical details and project outcomes related to AI technologies

- Implements AI projects by applying foundational ML Ops principles
- Applies fundamental machine learning concepts and algorithms
- Evaluates machine learning models using established metrics and validation techniques
- Designs data pre-processing and feature engineering strategies
- Implements strategies to improve the explainability of existing AI models
- Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets
- Engages in continuous learning and professional development related to big data
- Identifies suitable applications for deep and shallow neural architectures
- Engages in continuous learning and professional development to stay at the forefront of AI research and innovation
- Understands the basic concepts and technologies underlying artificial intelligence
- Knowledge of current trends in AI technology
- Designs generative AI models to create novel content
- Implements Large Language Models (LLMs) in generative AI projects
- Evaluates the performance of generative AI systems
- Engages in continuous learning and professional development
- Solves problems creatively and efficiently
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Learning unit-specific outcomes related to gaining an intuitive and operational understanding of AI methods include acquiring knowledge and skills in:

- Introduction to Generative AI and Language Models
- Understanding and Implementing GPT-2 Architecture
- Training Neural Networks Efficiently
- Data Preparation and Loading
- Optimization and Loss Functions
- Enhancing Training with GPUs and Precision Techniques
- Tuning Hyperparameters for Optimal Performance
- Model Evaluation and Performance Metrics

Delivery method

- On-site lectures with demonstrations of methods, tools, and cases
- Self-study assisted with interactive lecture notes with quizzes and challenges
- Project-based study with structured delivery of findings
- On-line discussion of project results and quizzes
- On-line forum, discussions and assistance on Discord channel

Material

- Lecture notes with practical examples, delivered electronically to in-class participants
- Quizzes and interactive lecture notes in a mini-MOOC environment
- Rescha S (2024) Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters)

- Kneusel RT (2023) How AI Works, No Starch Press (optional reading, selected chapters)
- Andrej Karpathy's videos on YouTube from playlist "Neural Networks: Zetto To Hero"

4.7. Data Science, AI, and Society

Description of "Data Science, AI, and Society"
This unit examines the societal implications of data science and AI, focusing on the interpretability of machine learning models and the evolution of explainability. It discusses the accuracy of machine learning, the trade-offs between explainability and accuracy, and reviews simpler, more explainable models. The unit delves into the explainability of deep neural networks, SHAP values, and addresses data and model biases, including quantitative measures of bias. It covers the AI and data science development cycle, best practices for industry application, and reviews the EU's AI Act. No prior knowledge required.
Related Programme Learning Outcome
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 8 - AI Ethics (EQF 6) 9 - AI Futures and Innovation (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 13 - Generative AI (EQF 6) 14 - Soft Skills (EQF 6)
Unit learning outcomes
Program-specific learning outcomes will enable course participant to acquire the following skills: • Identifies suitable applications for deep and shallow neural architectures • Discusses the ethical implications of deploying deep learning models • Critiques the current trends and advancements in deep learning • Discusses the ethical implications of deploying AI technologies • Critiques the current trends and advancements in AI • Demonstrates an ongoing commitment to advancing skills and knowledge • Applies AI quality control measures throughout the machine learning project lifecycle • Communicates effectively with stakeholders involved in AI projects • Evaluates the ethical and social implications of deploying AI solutions • Stays informed about emerging technologies, practices, and standards

- Evaluates machine learning models using established metrics and validation techniques
- Assesses the ethical implications of machine learning projects
- Communicates machine learning findings effectively
- Develops AI models using explainable AI techniques to ensure transparency and interpretability
- Analyses existing AI models to assess and measure their explainability
- Conveys the principles and benefits of explainable AI to stakeholders
- Navigates ethical and legal considerations associated with AI explainability
- Describes the results and implications of data analysis projects to stakeholders
- Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies
- Stays informed about emerging trends and best practices in human-centered AI
- Forecasts future trends in AI technology
- Knowledge of the regulations and ethical use of data and data practices
- Thinks critically, analysing situations, evaluating diverse perspectives

Learning unit-specific outcomes related to gaining an intuitive and operational understanding of AI methods include acquiring knowledge and skills in:

- Interpretation of machine learning models
- Evolution and understanding of explainability
- Assessments of accuracy of machine learning
- Trade-off between explainability and accuracy
- Review of simple and explainable machine learning models
- Explainability of deep neural networks, SHAP values
- Data and model bias, quantitative measures of bias
- AI and data science development cycle, best practices for introduction to industry
- Engineer's understanding of EU's AI Act

Delivery method

- On-site lectures with practical demonstrations of methods, tools, and cases
- Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges
- Project-based study with structured delivery of findings
- On-line discussion of project results and quizzes
- On-line forum, discussions and assistance on Discord channel

Material

- Lecture notes with practical examples, cases, and demonstrations of how to use data mining tool Orange, delivered electronically to in-class participants
- Quizzes and interactive lecture notes in a mini-MOOC environment
- About 15 short educational videos
- Rescha S (2024) Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters)
- Kneusel RT (2023) How AI Works, No Starch Press (optional reading, selected chapters)

DATA ANALYST EQF 6

1. General information

Name	Data Analyst
EQF level	EQF 6
Goals	The purpose of the Data Analyst EQF 6 curriculum is to provide participants with basic knowledge on how to find, use, analyze and use data in assessing, measuring and arguing a business decision with the introduction of relevant methodologies. In addition, participants will gain practical basic skills in managing the life cycle of data, i.e. valorizing data. To do this, participants perform practical tasks for data processing and analysis with the appropriate software.
Scope	This retraining course is designed for individuals looking to change their career and become data analysts, as well as for professionals who want to supplement their data analytics skills in their current profession.
Entry requirements	Entry Requirements: • Proficiency in computer skills at the user level • Proficiency in MS Excel at the user level • Basic problem-solving skills • A minimum of 2 years of prior work experience • Successful completion of a general aptitude test
Programme learning outcomes (PLOs)	6 - Big Data & Data Analytics (EQF 6) 8 - AI Ethics (EQF 6) 9 - AI Futures and Innovation (EQF 6) 10 - Business Intelligence (EQF 6) 12 - Cyber and Data Security (EQF 6)

2. Description of the structure

The Data Analyst course consists of ten learning modules, totalling 184 academic hours.

It begins with 16 hours on the Foundations of Data Analytics and another 16 hours focused on Making Data-Driven Decisions. Students then delve into Data Processing and Analysis (SQL) over 48 hours, followed by 36 hours of Data Analysis with R Programming. The course includes 12 hours of Data Visualization with Tableau and 24 hours of Data Visualization using Power BI. Additionally, there are 4-hour modules on Basics of Cyber Security, Data Analytics and AI Trends, and GDPR. The course concludes with a 20-hour final project to apply the learned skills.

3. Overview of Learning Units

Learning unit title	Academic hours	EQF level	Assessment(s)
Foundations of Data Analytics	16	EQF 6	Practical Excercises
Making data-driven decisions	16	EQF 6	Practical Exercises
Data Processing and analysis (SQL)	48	EQF 6	Practical Exercises
Data Analysis with R	36	EQF 6	Practical Exercises
Data visualization with Tableau	12	EQF 6	Practical Exercises
Data visualization using Power BI	24	EQF 6	Practical Exercises
Basics of Cyber Security	4	EQF 6	Practical Exercises
Data analytics and AI trends	4	EQF 6	Practical Exercises
GDPR	4	EQF 6	Practical Exercises
Case study (final project)	20	EQF 6	Successful completion of the Case Study

4. Details of Learning Units

4.1. Foundations of Data Analytics

Description of [learning unit title]
This unit provides an introduction to the fundamental concepts of data analytics, including an exploration of data, data analysis, and the broader data ecosystem. Students will perform a self-assessment of their analytical thinking skills, offering specific examples of how they have applied these skills in various contexts.

The unit also covers the importance of tools such as spreadsheets, query languages, and data visualization in the field of data analytics. Additionally, it delves into the role of a data analyst, highlighting specific job functions and responsibilities within the industry.

Related Programme Learning Outcome(s)

6 - Big Data & Data Analytics (EQF 6)

9 - AI Futures and Innovation (EQF 6)

Unit learning outcomes

- Collaborates with multidisciplinary teams on big data and data analytics projects
- Engages in continuous learning and professional development related to big data
- Analyses current AI developments and trends

Delivery method(s)

- Lectures
- Practical Exercises

Materials

Slide materials (acquired through request)

4.2. Making data-driven decisions

Description of [learning unit title]

This learning unit explores the application of a problem-solving road map in various analysis scenarios. It emphasizes the critical role of structured thinking in decision-making processes involving data. Participants will gain hands-on experience using spreadsheets to perform fundamental data analyst tasks such as data entry and organization. Key concepts include factors influencing data collection decisions and distinguishing between biased and unbiased data. Additionally, the unit covers databases, detailing their functions and components, and outlines best practices for effectively organizing data.

Related Programme Learning Outcome(s)

6 - Big Data & Data Analytics (EQF 6)

10 - Business Intelligence (EQF 6)

Unit learning outcomes

- Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets
- Develops data science solutions to tackle specific analytical challenges
- Describes the results and implications of data analysis projects to stakeholders
- Interprets complex data sets to identify trends, patterns, and insights that inform business strategies

• Evaluates the effectiveness of business intelligence strategies and tools • Explains findings and strategic recommendations based on business intelligence analysis to stakeholders
Delivery method(s)
• Lectures • Practical Exercises
Materials
Slide materials (acquired through request)

4.3. Data Processing and analysis (SQL)

Description of [learning unit title]
This learning unit begins with an exploration of various types of data integrity and examines the potential risks that threaten data integrity. Participants will learn to apply basic SQL functions to cleanse string variables within a database and develop foundational SQL queries for database operations. The unit also covers the process of verifying the effectiveness of data cleaning procedures. Furthermore, participants will gain proficiency in using SQL functions and syntax to merge data from multiple database tables. Lastly, the unit introduces the use of spreadsheet functions for conducting calculations on data.
Related Programme Learning Outcome(s)
6 - Big Data & Data Analytics (EQF 6)
Unit learning outcomes
• Utilizes big data technologies to efficiently process and analyse large volumes of data • Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets
Delivery method(s)
• Lectures • Practical Exercises
Materials
Slide materials (acquired through request)

4.4. Data Analysis using R

Description of [learning unit title]
This module introduces the R programming language and its environment, covering fundamental programming concepts such as functions, variables, data types, pipes, and vectors. Participants will explore various options for creating visualizations in R and learn basic formatting techniques in R Markdown to organize content effectively.
Related Programme Learning Outcome(s)
6 - Big Data & Data Analytics (EQF 6)
Unit learning outcomes
• Utilizes big data technologies to efficiently process and analyse large volumes of data • Creates effective data visualizations that clearly communicate analytical findings
Delivery method(s)
• Lectures • Practical Exercises
Materials
Slide materials (acquired through request)

4.5. Data Visualization with Tableau

Description of [learning unit title]
This module focuses on using data visualizations effectively to communicate insights from data analysis. Participants will learn about Tableau as a versatile tool for creating visual representations and its applications in data visualization. The module emphasizes the importance of data-driven storytelling, highlighting how structured narratives can enhance understanding and engagement with analytical findings. Participants will also explore principles for delivering impactful presentations, ensuring clear communication of data insights to stakeholders.
Related Programme Learning Outcome(s)
6 - Big Data & Data Analytics (EQF 6)
Unit learning outcomes
• Creates effective data visualizations that clearly communicate analytical findings • Describes the results and implications of data analysis projects to stakeholders
Delivery method(s)
• Lectures • Practical Exercises
Materials
Slide materials (acquired through request)

4.6. Data vizualisation using Power BI

Description of [learning unit title]
This unit provides a comprehensive introduction to a BI tool designed to facilitate informed decision-making. Participants will gain hands-on experience in importing data from various sources using Power Query and organizing this data into effective data models. The course covers techniques for cleaning, transforming, and combining data to create a cohesive data model. Additionally, participants will learn to visualize data using Power BI Desktop, enabling them to create insightful and interactive reports and dashboards. By the end of the training, attendees will be equipped with the skills to collect, manage, and present data in a way that supports strategic decision-making.
Related Programme Learning Outcome(s)
6 - Big Data & Data Analytics (EQF 6) 10 - Business Intelligence (EQF 6)
Unit learning outcomes
• Creates effective data visualizations that clearly communicate analytical findings • Utilizes business intelligence tools and software to collect, process, and analyse large datasets • Designs and implements data visualization techniques to effectively communicate • Collaborates with team members and departments
Delivery method(s)
• Lecture • Practical Exercises
Materials
Presentation Microsoft Learn Power BI documentation: https://learn.microsoft.com/en-us/power-bi/

4.7. Basics of Cyber Security

Description of [learning unit title]
This cybersecurity module covers fundamental principles of cybersecurity, provides an overview of internet threats, and explores various types of viruses and cyber attacks. Participants will learn strategies for threat prevention, the importance of strong passwords and backups, and where to seek help in case of security incidents.
Related Programme Learning Outcome(s)
12 - Cyber and Data Security (EQF 6)
Unit learning outcomes
• Identifies a variety of cybersecurity threats and vulnerabilities • Implements key cybersecurity measures
Delivery method(s)
• Lecture • Practical Exercises
Materials
Presentation

4.8. Data analytics and AI trends

Description of [learning unit title]
This module explores the latest trends in data analytics and AI. The module provides insights into how AI is transforming data analytics and offers a glimpse into the future advancements in the field.
Related Programme Learning Outcome(s)
6 - Big Data & Data Analytics (EQF 6) 9 - AI Futures and Innovation (EQF 6)
Unit learning outcomes
• Engages in continuous learning and professional development related to big data • Analyses current AI developments and trends
Delivery method(s)
Presentation
Materials
Presentation (acquired through request)

4.9. GDPR

Description of [learning unit title]
This module covers the essentials of GDPR, including key principles, compliance requirements, and best practices for data management. Participants will also learn about individuals' rights under GDPR and its impact on businesses in the EU.
Related Programme Learning Outcome(s)
8 - AI Ethics (EQF 6)
Unit learning outcomes
• Knowledge of industry-specific laws (national and international)
Delivery method(s)
Presentation
Materials
Presentation

4.10. Case study (final project)

Description of [learning unit title]
The final project allows participants to apply the practices and procedures learned during the course to a given dataset, demonstrating their proficiency in the data analysis process. This hands-on project integrates data collection, cleaning, analysis, and visualization techniques to solve real-world problems.
Related Programme Learning Outcome(s)
6 - Big Data & Data Analytics (EQF 6) 10 - Business Intelligence (EQF 6)
Unit learning outcomes
• Utilizes big data technologies to efficiently process and analyse large volumes of data • Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets • Creates effective data visualizations that clearly communicate analytical findings • Describes the results and implications of data analysis projects to stakeholders • Collaborates with multidisciplinary teams on big data and data analytics projects • Engages in continuous learning and professional development related to big data • Utilizes business intelligence tools and software to collect, process, and analyse large datasets • Interprets complex data sets to identify trends, patterns, and insights that inform business strategies • Designs and implements data visualization techniques to effectively communicate • Evaluates the effectiveness of business intelligence strategies and tools • Explains findings and strategic recommendations based on business intelligence analysis to stakeholders • Collaborates with team members and departments
Delivery method(s)
Individual learning
Materials
Case Study description (acquired through request)

DATA SCIENTIST EQF 6

1. General information

Name	Data Scientist
EQF level	EQF 6
Goals	The goal of the Data Science program is to provide a solid foundation in core data science techniques, develop advanced machine learning and AI skills, and ensure the ability to build and manage ethical and secure AI systems. These goals aim to produce graduates who are ready to lead and innovate in the data science field, capable of tackling complex problems and contributing to advancements in technology and society. The program is designed to ensure that graduates are proficient in both theoretical and practical aspects of data science and capable of applying their knowledge to real-world problems.
Scope	*The course is aimed at people who intend to become Data Scientist/EQF 6. It can also be used for upskilling or reskilling of individuals that already have a background in computer science and want to specialize in Data Science.*
Entry requirements	Generic requirements: programming (python), statistics, algebra, calculus, probability, data bases, data structures.
Programme learning outcomes (PLOs)	1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6) 4 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 8 - AI Ethics (EQF 6) 9 - Business Intelligence (EQF 6) 10 - AI Awareness (EQF 6) 11 - Cyber and Data Security (EQF 6) 12 - Generative AI (EQF 6) 13 - Change Management (EQF 6) 14 - Soft Skills (EQF 6)

2. Description of the structure

The curriculum presents 12 learning Units(LU) which can be grouped in four main areas: (1) Basic Data Science, which includes “Data Analytics” and “Signal Processing and Time Series”; (2) Machine Learning which includes “Machine Learning: Supervised”, “Machine Learning: Unsupervised” and “Neural Networks”; (3) Deep Learning which includes “Deep Learning”, “Generative AI” and “Foundation Models and LLMs” and (4) AI Infrastructure, comprising of “Human-Centered AI”, “AI Platforms & Architectures” and “Data Security”.

These four areas capture the breadth of knowledge and skills, from fundamental concepts to the latest advancements, that a Data Scientist should be familiar with. The curriculum begins with essential knowledge areas like "Data Analytics" and "Signal Processing and Time Series" under the Basic Data Science category. These units ensure that students have a strong grasp of the foundational techniques used to analyze and interpret data. Skills such as statistical analysis, data visualization, and understanding temporal data are crucial for any data scientist, providing the groundwork for more advanced studies. These LUs can be thought sequentially or in parallel but should be introduced before the other 3 areas.

As students progress, they delve deeper into Machine Learning, with units on both supervised and unsupervised learning, as well as neural networks. These units cover a broad spectrum of machine learning techniques, from regression and classification in supervised learning to clustering and dimensionality reduction in unsupervised learning. By understanding neural networks, students can begin to explore more complex models and algorithms that underpin many modern AI systems. This comprehensive approach ensures that students develop a robust understanding of both the theoretical and practical aspects of machine learning. These LUs can be taught sequentially or in parallel but should be taught before any LU of the third area.

The curriculum then advances into the specialized area of Deep Learning, where students learn about sophisticated deep network architectures and their applications. Furthermore, the inclusion of topics such as Generative AI and Foundation Models and LLMs (Large Language Models) introduces students to the forefront of Generative AI. These units cover innovative techniques for creating new data samples and utilizing large-scale models for natural language processing, ensuring that students are well-versed in the latest trends and technologies. These LU should be taught sequentially and only if the LUs of areas 1 and 2 have already been introduced.

Lastly, the AI Infrastructure area ensures that students are equipped with the skills necessary to build and deploy AI systems effectively and responsibly. Units such as "Human-Centered AI" emphasize the importance of designing AI systems that are ethical, transparent, and user-friendly. Topics in "AI Platforms & Architectures" focus on the infrastructure needed to deploy and scale AI solutions, including cloud platforms and distributed computing. The curriculum also addresses critical aspects of data privacy and security through the "Data Security" unit, ensuring that students understand how to protect data and comply with relevant regulations. These LUs can be taught in parallel or sequentially, and after the LU of areas 1, 2 and 3 have already been introduced.

There is also an extra Learning Unit, "Professional Abilities" whose goal is to equip students with the essential non-technical skills and behaviours that are critical for success in professional environments. These skills complement the technical knowledge and ensure that students can effectively apply their data science expertise in real-world settings. This LU can be taught in parallel with areas 2, 3 and 4, but after the LU of area 1.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Data Analytics	6 ECTS	EQF 6	Exam + Practical Assignment
Signal Processing and Time Series	6 ECTS	EQF 6	Exam+Practical Assignment
Machine Learning: Supervised	6 ECTS	EQF 6	Exam+Practical Assignment
Machine Learning: Unsupervised	6 ECTS	EQF 6	Exam+Practical Assignment
Neural Networks	6 ECTS	EQF 6	Exam+Practical Assignment
Deep Learning	6 ECTS	EQF 6	Exam+Practical Assignment
Generative AI	6 ECTS	EQF 6	Exam+Practical Assignment
Foundational Models and LLMs	6 ECTS	EQF 6	Exam+Practical Assignment
Human-Centered AI	6 ECTS	EQF 6	Exam+Practical Assignment
AI Platforms & Architecture	6 ECTS	EQF 6	Exam+Practical Assignment
Data Security	6 ECTS	EQF 6	Exam+Practical Assignment
Professional Abilities	6 ECTS	EQF 6	Practical Assignment

4. Details of Learning Units

4.1. Data Analytics

Description
The Data Analytics learning unit is designed to provide students with a comprehensive understanding of the fundamental techniques and tools used to analyze and interpret data. It comprises 4 modules: 1. Python for Data Analytics, 2. Data Collection and Data Cleaning, 2. Data Visualization, 3. Exploratory Data Analysis, 4. Introduction to SQL.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Machine Learning (EQF 6) 3 - Big Data & Data Analytics (EQF 6) 4 - Business Intelligence (EQF 6) 5 - AI Awareness (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Designs data pre-processing and feature engineering strategies • Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets • Develops data science solutions to tackle specific analytical challenges • Interprets complex data sets to identify trends, patterns, and insights that inform business strategies • Designs and implements data visualization techniques to effectively communicate • Understands the basic concepts and technologies underlying AI • Identifies key AI applications in the programming application market
Delivery method(s)
Face-to-face; Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: • SQL QuickStart Guide: The Simplified Beginner's Guide to Managing, Analyzing, and Manipulating Data With SQL • Python for Data Analysis 3e: Data Wrangling with pandas, NumPy, and Jupyter

4.2. Signal Processing and Time Series

Description
The "Signal Processing and Time Series" learning unit is designed to introduce students to the fundamental concepts and techniques used in analyzing and interpreting time-dependent data. This unit covers the principles of signal processing and the methodologies for handling and extracting meaningful insights from time series data. It contains the following modules: (1) Basic Signal Processing techniques, (2) AR, MA, ARMA, ARIMA, SARIMA models, (3) Spectral Analysis and Fourier transform and (4) Time Series Libraries: prophet & darts.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Machine Learning (EQF 6) 3 - Big Data & Data Analytics (EQF 6) 4 - Business Intelligence (EQF 6) 5 - AI Awareness (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Designs data pre-processing and feature engineering strategies • Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets • Develops data science solutions to tackle specific analytical challenges • Interprets complex data sets to identify trends, patterns, and insights that inform business strategies • Designs and implements data visualization techniques to effectively communicate • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Handbook of Time Series Analysis, Signal Processing, and Dynamics

4.3. Machine Learning: Supervised

Description
The "Machine Learning: Supervised" learning unit is designed to provide students with a deep understanding of supervised learning techniques. Students will learn how to develop, evaluate, and optimize predictive models to solve various classification and regression problems. Modules: (1) k-NN, Linear and Logistic regression, (2) Decision Trees & SVM, (3) Model Evaluation and Validation, (4) Hyperparameter Tuning and Model Optimization and (5) AutoML.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Machine Learning (EQF 6) 3 - AI Awareness (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Introduction to Machine Learning with Python: A Guide for Data Scientists

4.4. Machine Learning: Unsupervised

Description
The "Machine Learning: Unsupervised" learning unit is designed to introduce students to the techniques and algorithms used in unsupervised learning. Students will learn how to apply various unsupervised learning methods to identify clusters, reduce dimensionality, and extract useful features from data. Modules: (1) Introduction to Unsupervised Learning, (2) K-means and Hierarchical Clustering, (3) DBSCAN, GMM, (4) Dimensionality Reduction: PCA, t-SNE and UMAP, (5) Anomaly Detection
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Machine Learning (EQF 6) 3 - AI Awareness (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Introduction to Machine Learning with Python: A Guide for Data Scientists

4.5. Neural Networks

Description
The "Neural Networks" learning unit is focused on introducing students to the fundamentals of neural networks, a cornerstone of modern artificial intelligence and deep learning. This unit covers the architecture, functioning, and practical applications of different types of neural networks. Modules: (1) Introduction: Perceptrons and MLP, (2) Frameworks: TensorFlow, PyTorch, Keras, (3) Activation Functions, (4) Feedforward NN, (6) Training NN: Backpropagation and Gradient Descent and (5) Optimization Techniques.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6) 4 - AI Awareness (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Identifies suitable applications for deep and shallow neural architectures • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Evaluates machine learning models using established metrics and validation techniques • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Neural networks for pattern recognition - Neural Networks and Deep Learning: A Textbook

4.6. Deep Learning

Description
The "Deep Learning" learning unit delves into the advanced aspects of neural networks and their extensive applications across various fields, including computer vision, natural language processing, and audio recognition. Modules: (1) CNNs, (2) RNNs, (3) LSTM, (5) Autoencoders, (6) Transfer Learning and Fine-Tuning and (7) Applications: NLP and vision.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6)
Unit learning outcomes
• Identifies suitable applications for deep and shallow neural architectures • Designs deep learning models by selecting appropriate architectures • Implements deep learning models using relevant frameworks and libraries • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Evaluates machine learning models using established metrics and validation techniques
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Deep Learning with Python - Neural Networks and Deep Learning: A Textbook - ”Deep Learning” by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

4.7. Generative AI

Description
The "Generative AI" learning unit focuses on creating new data instances that resemble training data. This area includes techniques that allow models to generate novel images, texts, music, and other forms of media, simulating human-like creativity. Modules: (1) Deep Learning for Generative AI: GANs and VAEs, (2) Natural Language Generation, (3) Image and Video Generation, (4) Audio Generation.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Generative AI (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Designs generative AI models to create novel content • Integrates generative AI into diverse applications
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - ”Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play” by David Foster - ”GANs in Action: Deep Learning with Generative Adversarial Networks” by Jakub Langr and Vladimir Bok

4.8. Foundational Models and LLMs

Description
The "Foundational Models and Large Language Models (LLMs)" learning unit explores the rapidly evolving area of foundational models, particularly focusing on large-scale language models that are transforming natural language processing, and beyond. Modules: (1) Introduction to Foundational Models, (2) Transformers, (3) Training LLMs, (4) Fine Tuning and (5) Integration of foundational models.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Generative AI (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Develops prompt engineering skills • Implements Large Language Models (LLMs) in generative AI projects • Integrates generative AI into diverse applications
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Natural Language Processing with Transformers: Building Language Applications With Hugging Face - Generative AI with LangChain: Build large language model (LLM) apps with Python, ChatGPT and other LLMs

4.9. Human-Centered AI

Description
The "Human-Centered AI" learning unit focuses on the integration of humanistic principles into the design, development, and deployment of artificial intelligence systems. This unit explores how AI can be developed to be more interpretable, ethical, and supportive of human needs and values. Students will learn about the importance of designing AI systems that are not only technically proficient but also socially responsible and aligned with human goals. Modules: (1) Introduction to Human-Centered AI, (2) Ethical Considerations: Fairness, Explainability and Robustness, (3) AI Governance and Regulation, (4) AI Ethics in Generative AI and (5) Design for User Experience: Inclusivity and accessibility.
Related Programme Learning Outcome(s)
1 - Explainable AI (EQF 6) 2 - Human-Centered AI (EQF 6) 3 - AI Ethics (EQF 6)
Unit learning outcomes
• Develops AI models using explainable AI techniques to ensure transparency and interpretability • Analyses existing AI models to assess and measure their explainability • Incorporates human-centered design principles in the development of AI systems • Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies • Identifies ethical considerations and challenges in AI development and deployment • Implements strategies to mitigate ethical risks in AI applications • Knowledge of industry-specific laws (national and international)
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Human-Centered AI, Ben Shneiderman

4.10. AI Platforms & Architectures

Description
The "AI Platforms & Architectures" learning unit focuses on the technical underpinnings and infrastructure necessary for developing and deploying AI systems effectively. Students will learn about cloud computing services, edge computing, the importance of hardware accelerators like GPUs and TPUs, and software frameworks that are crucial for AI development. Modules: (1) Cloud Computing for AI, (2) Edge Computing and AI, (3) Hardware for AI, (4) Containers and (5) MLOps.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Big Data & Data Analytics (EQF 6) 3 - Business Intelligence (EQF 6) 4 - Cyber and Data Security (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Utilizes big data technologies to efficiently process and analyse large volumes of data • Utilizes business intelligence tools and software to collect, process, and analyse large datasets • Integrates data warehousing and data management practices • Designs security architectures for information systems
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Cloud Computing: Concepts, Technology & Architecture - https://aws.amazon.com/es/ai/ - Azure.microsoft.com - Data Science on AWS: Leveraging AWS for Advanced Data Science Solutions - Fundamentals of Data Engineering: Plan and Build Robust Data Systems

4.11. Data Security

Description
The "Data Security" learning unit presents the concepts regarding protection of data integrity, confidentiality, and availability in the context of AI and data science projects. Modules: (1) Introduction to Data Security, (2) Secure Data Management, (3) Security in Cloud Computing, (4) Data Governance and Data protection laws and (5) AI Robustness.
Related Programme Learning Outcome(s)
1 - Cyber and Data Security (EQF 6)
Unit learning outcomes
• Identifies a variety of cybersecurity threats and vulnerabilities • Implements key cybersecurity measures • Manages cybersecurity incidents by effectively deploying incident response
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Practical Data Privacy: Enhancing Privacy and Security in Data - Privacy Engineering: A Runbook for Engineers

4.12. Professional Abilities

Description
The "Professional Abilities" learning unit is designed to equip students with the essential non-technical skills necessary for a successful career in data science. Modules: (1) Professional skill in data Science, (2) Effective Communication and Presentation skills, (3) Collaboration and Teamwork, (4) Project Management and (5) professional writing and documentation.
Related Programme Learning Outcome(s)
1 - Change Management (EQF 6) 2 - Soft Skills (EQF 6)
Unit learning outcomes
• Understands the principles and theories of change management • Communicates change effectively, using clear, persuasive messaging • Collaborates within teams, contributing positively to group efforts • Solves problems creatively and efficiently • Delivers impactful presentations • Cultivates an innovative mindset, embracing and fostering creativity • Communicates effectively across a variety of platforms and media • Thinks critically, analysing situations, evaluating diverse perspectives • Manages conflicts constructively
Delivery method(s)
Face-to-face Online synchronous learning
Materials
Lecturer Materials: slides and Notebooks Suggested Readings: - Business Skills for Data Scientists: Practical Guidance in Six Key Topics

DATA SCIENTIST EQF 6

1. General information

Name	Data Scientist
EQF level	EQF 6
Goals	The Data Scientist curriculum at EQF 6 aims to equip students with comprehensive skills in data analysis, machine learning, big data, deep learning. It focuses on the development of neural networks and generative AI models. The program strives to cultivate analytical thinking, problem-solving abilities, and ethical considerations, empowering students to make data-driven decisions in diverse professional environments, also facing critical topics such as cybersecurity, change management, and human-robot interaction.
Scope	This program is intended for learners with a foundational understanding of computer science who wish to deepen their expertise in Data Science, Machine Learning, and Deep Learning.

Entry requirements	• Fundamental Programming Skills:
	  ○ Python (or R)
	• Database Fundamentals:
	  ○ SQL
	• Computer Science Fundamentals:
	  ○ Data Structures and Algorithms
	  ○ Software Engineering Principles
	  ○ Database Systems

Programme learning outcomes (PLOs)	1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6) 4 - Explainable AI (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 7 - Human-Centered AI (EQF 6) 8 - AI Ethics (EQF 6) 9 - AI Futures and Innovation (EQF 6)

	10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6) 12 - Cyber and Data Security (EQF 6) 13 - Generative AI (EQF 6) 14 - Change Management (EQF 6) 15 - Soft Skills (EQF 6)

2. Description of the structure

The course consists of 12 Learning Units totalling 84 hours. It begins with an overview of current AI innovations and their applications, followed by an introduction to machine learning and deep learning. The curriculum includes state-of-the-art machine learning techniques and architectures, as well as practical skills in neural networks and neural network implementation in Python using TensorFlow, Keras, PyTorch, CNNs, and RNNs. Further, it delves into deep learning and generative AI, covering foundational models and large language models (LLMs). The course also explores human-centered AI, AI platforms and architecture, and the fundamentals of cybersecurity and data privacy. Additionally, it addresses strategies to manage change in organizations implementing AI.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Overview of the current AI innovations and their applications	4	6	Exam
Introduction to Machine Learning and Deep Learning	6	6	Exam
State-of-the-Art Machine Learning Techniques and Architectures	8	6	Exam
Neural Networks	8	6	Exam
Neural Network in Python (TensorFlow, Keras, PyTorch, CNNs, RNNs)	10	6	Practical Assignment
Deep Learning	8	6	Exam
Introduction to Generative AI	6	6	Exam
Foundational Models and LLMs	8	6	Exam

Human-Centered AI	8	6	Exam
AI Platforms & Architecture	6	6	Exam
Fundamentals of Cybersecurity and Data Privacy	6	6	Exam
Strategies to manage change in organizations implementing AI	6	6	Exam

4. Details of Learning Units

4.1. Overview of the current AI innovations and their applications

Description of [learning unit title]
Introduces recent advancements in AI and their applications.
Related Programme Learning Outcome(s)
2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6) 9 - AI Futures and Innovation (EQF 6) 10 - Business Intelligence (EQF 6) 11 - AI Awareness (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Discusses the ethical implications of deploying AI technologies • Critiques the current trends and advancements in AI • Demonstrates an ongoing commitment to advancing skills and knowledge • Applies fundamental machine learning concepts and algorithms • Designs data pre-processing and feature engineering strategies • Analyses current AI developments and trends • Forecasts future trends in AI technology • Conducts research to explore new possibilities in AI • Interprets complex data sets to identify trends, patterns, and insights that inform business strategies • Designs and implements data visualization techniques to effectively communicate • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison Wesley, ISBN 0-321-32136-7, 2006

4.2. Introduction to Machine Learning and Deep Learning

Description of [learning unit title]
Covers the basics of machine learning and deep learning techniques.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6) 6 - Big Data & Data Analytics (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Identifies suitable applications for deep and shallow neural architectures • Designs deep learning models by selecting appropriate architectures • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Assesses the ethical implications of machine learning projects • Communicates machine learning findings effectively • Collaborates with interdisciplinary teams on machine learning projects • Engages in professional development and community activities related to machine learning • Utilizes big data technologies to efficiently process and analyse large volumes of data • Develops data science solutions to tackle specific analytical challenges
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Burkov, A. (2019). The hundred-page machine learning book (Vol. 1, p. 32). Quebec City, QC, Canada: Andriy Burkov.

4.3. State-of-the-Art Machine Learning Techniques and Architectures

Description of [learning unit title]
Explores advanced machine learning methods and model architectures.
Related Programme Learning Outcome(s)
2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6) 6 - Big Data & Data Analytics (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Assesses the ethical implications of machine learning projects • Communicates machine learning findings effectively • Collaborates with interdisciplinary teams on machine learning projects • Engages in professional development and community activities related to machine learning • Utilizes big data technologies to efficiently process and analyse large volumes of data • Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.4. Neural Networks

Description of [learning unit title]
Covers the basics of Neural Networks.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 9 - AI Futures and Innovation (EQF 6)
Unit learning outcomes
• Applies deep learning techniques to solve problems • Selects appropriate AI frameworks and libraries for specific project needs • Adapts existing AI models to new contexts and problems • Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets • Develops data science solutions to tackle specific analytical challenges • Innovates in the field of AI by applying insights from research and trend analysis to develop novel AI solutions
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.5. Neural Network in Python (TensorFlow, Keras, PyTorch, CNNs, RNNs)

Description of [learning unit title]
Covers the fundamentals of Neural Networks implementation and training in Python.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 6 - Big Data & Data Analytics (EQF 6) 9 - AI Futures and Innovation (EQF 6)
Unit learning outcomes
• Designs deep learning models by selecting appropriate architectures • Implements deep learning models using relevant frameworks and libraries • Applies deep learning techniques to solve problems • Selects appropriate AI frameworks and libraries for specific project needs • Adapts existing AI models to new contexts and problems • Implements data analytics methodologies to derive actionable insights from complex and unstructured datasets • Develops data science solutions to tackle specific analytical challenges • Innovates in the field of AI by applying insights from research and trend analysis to develop novel AI solutions
Delivery method(s)
• Workshop • Lectures • Project Work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** De Marchi, L., & Mitchell, L. (2019). Hands-On Neural Networks: Learn how to build and train your first neural network model using Python. Packt Publishing Ltd.

4.6. Deep Learning

Description of [learning unit title]
Covers the basics Deep Learning.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Identifies suitable applications for deep and shallow neural architectures • Designs deep learning models by selecting appropriate architectures • Implements deep learning models using relevant frameworks and libraries • Applies deep learning techniques to solve problems • Discusses the ethical implications of deploying deep learning models • Critiques the current trends and advancements in deep learning • Collaborates effectively in teams to design, implement, and evaluate deep learning projects • Engages with the AI community by participating in discussions
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.7. Introduction to Generative AI

Description of [learning unit title]
Covers the basics of Generative Artificial Intelligence theoretics and practical applications.
Related Programme Learning Outcome(s)
13 - Generative AI (EQF 6)
Unit learning outcomes
• Designs generative AI models to create novel content • Identifies AI-generated content, employing analytical methods and tools • Develops prompt engineering skills • Implements Large Language Models (LLMs) in generative AI projects • Evaluates the performance of generative AI systems • Assesses the ethical implications of generative AI systems • Integrates generative AI into diverse applications • Conveys the principles and potential of generative AI to a broad audience • Engages in continuous learning and professional development
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Foster, D. (2022). Generative deep learning. " O'Reilly Media, Inc.".

4.8. Foundational Models and LLMs

Description of [learning unit title]
Covers the basics of Foundational and Large Language Models.
Related Programme Learning Outcome(s)
13 - Generative AI (EQF 6)
Unit learning outcomes
• Designs generative AI models to create novel content • Identifies AI-generated content, employing analytical methods and tools • Develops prompt engineering skills • Implements Large Language Models (LLMs) in generative AI projects • Evaluates the performance of generative AI systems • Assesses the ethical implications of generative AI systems • Integrates generative AI into diverse applications • Conveys the principles and potential of generative AI to a broad audience • Engages in continuous learning and professional development
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.9. Human-Centered AI

Description of [learning unit title]
Covers the main issues related to Human-Centered AI.
Related Programme Learning Outcome(s)
7 - Human-Centered AI (EQF 6)
Unit learning outcomes
• Incorporates human-centered design principles in the development of AI systems • Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies • Identifies suitable applications for deep and shallow neural architectures • Enhances human-computer interaction through the design of intuitive and accessible AI interfaces • Evaluates the sustainability of AI solutions • Communicates effectively with stakeholders • Stays informed about emerging trends and best practices in human-centered AI
Delivery method(s)
• Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.10. AI Platforms & Architecture

Description of [learning unit title]
Covers the main AI Platforms and architectures.
Related Programme Learning Outcome(s)
2 - AI Technologies (EQF 6) 9 - AI Futures and Innovation (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Communicates technical details and project outcomes related to AI technologies • Discusses the ethical implications of deploying AI technologies • Critiques the current trends and advancements in AI • Collaborates with multidisciplinary teams on AI projects • Demonstrates an ongoing commitment to advancing skills and knowledge • Analyses current AI developments and trends • Forecasts future trends in AI technology • Conducts research to explore new possibilities in AI • Innovates in the field of AI by applying insights from research and trend analysis to develop novel AI solutions • Communicates insights and predictions about future AI developments
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.11. Fundamentals of Cybersecurity and Data Privacy

Description of [learning unit title]
Covers the basics of Cybersecurity and Data Privacy.
Related Programme Learning Outcome(s)
12 - Cyber and Data Security (EQF 6)
Unit learning outcomes
• Identifies a variety of cybersecurity threats and vulnerabilities • Implements key cybersecurity measures • Designs security architectures for information systems • Manages cybersecurity incidents by effectively deploying incident response • Evaluates the ethical, legal, and societal implications of cybersecurity practices • Conveys complex cyber and data security concepts, policies, and protocols • Collaborates within teams to develop and implement comprehensive cybersecurity solutions • Reflects on personal and professional growth in the field of cyber and data security
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Denning, D. E., & Denning, P. J. (1979). Data security. ACM computing surveys (CSUR), 11(3), 227-249.

4.12. Strategies to manage change in organizations implementing AI

Description of [learning unit title]
Managing organizational changes due to AI integration.
Related Programme Learning Outcome(s)
14 - Change Management (EQF 6)
Unit learning outcomes
• Understands the principles and theories of change management • Assesses organizational readiness for change • Designs change management strategies • Communicates change effectively, using clear, persuasive messaging • Engages stakeholders throughout the change process • Implements change management plans • Manages resistance to change • Evaluates the effectiveness of change management efforts • Cultivates resilience and adaptability in teams
Delivery method(s)
• Lectures • Case Studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Sartori, R., Costantini, A., Ceschi, A., & Tommasi, F. (2018). How do you manage change in organizations? Training, development, innovation, and their relationships. Frontiers in Psychology, 9, 320628.

DATA SCIENTIST EQF 7

1. General information

Name	Data Scientist
EQF level	EQF 7
Goals	The Data Scientist curriculum at EQF 7 is designed to enhance participants' expertise in advanced data analysis, machine learning, and AI technologies. It focuses on the development of robust big data infrastructures, sophisticated data analytics, and generative AI models. Participants will gain the ability to manage ML Ops, integrate explainable AI techniques, and apply human-centred design principles to AI solutions. The program also emphasizes ethical data handling, cybersecurity, and effective communication of complex data insights to drive data-driven decision-making and innovation across diverse business contexts.
Scope	This program is intended for individuals with a foundational understanding of data analysis who wish to deepen their expertise in machine learning, AI, and big data technologies.

Entry requirements	• Advanced Mathematics Proficiency:
	  ○ Linear Algebra
	  ○ Probability and Statistics
	  ○ Calculus
	• Programming Skills:
	  ○ Python
	  ○ R
	  ○ SQL
	• Computer Science Fundamentals:
	  ○ Data Structures and Algorithms
	  ○ Software Engineering Principles
	  ○ Database Systems

Programme learning outcomes (PLOs)	1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - ML Ops (EQF 7)

	4 - Machine Learning (EQF 7) 5 - Explainable AI (EQF 7) 6 - Big Data & Data Analytics (EQF 7) 7 - Human-Centered AI (EQF 7) 8 - AI Ethics (EQF 7) 9 - AI Futures and Innovation (EQF 7) 10 - Business Intelligence (EQF 7) 11 - AI Awareness (EQF 6) 12 - Cyber and Data Security (EQF 7) 13 - Generative AI (EQF 7) 14 - Change Management (EQF 6) 15 - Soft Skills (EQF 7)

2. Description of the structure

The course consists of 21 modules totalling 144 hours. It begins with an introduction to AI innovations and machine learning, followed by advanced techniques in ML Ops and deep learning. The curriculum covers practical skills in neural networks, big data infrastructure, and data analytics. It also addresses cybersecurity, generative AI, and the ethical implications of AI technologies. The course concludes with essential soft skills and project management to prepare for real-world data science challenges.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Overview of the current AI innovations and their applications	4	EQF 6-7	Exam
Introduction to Machine Learning and Deep Learning	6	EQF 6-7	Exam
State-of-the-Art Machine Learning Techniques and Architectures	8	EQF 7	Exam
Advanced ML Ops and Lifecycle Management	8	EQF 7	Exam
Theoretical and Advanced Deep Neural Networks	8	EQF 7	Exam

Neural Network in Python (TensorFlow, Keras, PyTorch, CNNs, RNNs)	10	EQF 7	Exam and Practical Assignment
Big Data Infrastructure Design (Hadoop, Spark, NoSQL database)	8	EQF 7	Exam and Practical Assignment
Advanced Data Analytics Techniques	6	EQF 7	Exam
Advanced Data Mining Techniques	6	EQF 7	Exam
Machine Learning and AI for Data Management	4	EQF 7	Exam
Fundamentals of Cybersecurity and Data Privacy	6	EQF 7	Exam
Database Security	8	EQF 7	Exam
Introduction to Generative AI	6	EQF 7	Exam
Generative AI applications in our society	4	EQF 6-7	Exam
Implications and potential drawbacks of Generative AI	4	EQF 6-7	Exam
Responsible AI practices for Human-Computer Interaction	8	EQF 6-7	Exam
Introduction and best practices to Explainability in ML	6	EQF 7	Exam
Strategies to manage change in organizations implementing AI	6	EQF 6	Exam
Data Analytics in Business Intelligence	12	EQF 6-7	Exam
Project Management	10	EQF 6-7	Exam
Ethical and legal issues of AI technologies in our society	6	EQF 6-7	Exam

4. Details of Learning Units

4.1. Overview of the current AI innovations and their applications

Description
Introduces recent advancements in AI and their applications.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 4 - Machine Learning (EQF 7) 9 - AI Futures and Innovation (EQF 7) 11 - AI Awareness (EQF 6)
Unit learning outcomes
• Communicates complex deep learning concepts, methodologies, and outcomes • Assesses the capabilities and limitations of different AI technologies • Critiques the impact of AI technologies on society • Disseminates findings and developments in AI technologies • Assesses the ethical implications of machine learning applications • Assess the emerging trends in AI technology • Lead multidisciplinary teams in experimental AI projects • Evaluate the impact of new AI technologies on existing business models and strategies • Advocate for a proactive approach to AI innovation • Communicate the potential and risks of future AI innovations to a range of stakeholders • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Collaborates with technical and non-technical teams to explore AI opportunities • Knowledge of current trends in AI technology • Engages in continuous learning to keep pace with rapid advancements in AI
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:**

Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison Wesley, ISBN 0-321-32136-7, 2006

4.2. Introduction to Machine Learning and Deep Learning

Description
Covers the basics of machine learning and deep learning techniques.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 4 - Machine Learning (EQF 7) 9 - AI Futures and Innovation (EQF 7) 11 - AI Awareness (EQF 6)
Unit learning outcomes
• Critically evaluates the theoretical underpinnings of deep learning • Reflects on the ethical, legal, and social implications of deploying deep learning models • Communicates complex deep learning concepts, methodologies, and outcomes • Assesses the capabilities and limitations of different AI technologies • Leads multidisciplinary teams in the design and implementation of machine learning projects • Lead multidisciplinary teams in experimental AI projects • Understands the basic concepts and technologies underlying artificial intelligence
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Burkov, A. (2019). The hundred-page machine learning book (Vol. 1, p. 32). Quebec City, QC, Canada: Andriy Burkov.

4.3. State-of-the-Art Machine Learning Techniques and Architectures

Description
Explores advanced machine learning methods and model architectures.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 4 - Machine Learning (EQF 7) 9 - AI Futures and Innovation (EQF 7)
Unit learning outcomes
• Communicates complex deep learning concepts, methodologies, and outcomes • Manages the lifecycle of deep learning projects • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Innovates with AI technologies to solve novel or unstructured problems • Disseminates findings and developments in AI technologies • Independently develops robust machine learning models using advanced algorithms • Critically evaluates the performance of machine learning models • Integrates machine learning models into existing business processes and systems • Leads multidisciplinary teams in the design and implementation of machine learning projects • Effectively communicates complex machine learning concepts and results • Lead multidisciplinary teams in experimental AI projects
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.4. Advanced ML Ops and Lifecycle Management

Description
Focuses on managing the lifecycle and operations of ML models.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - ML Ops (EQF 7) 9 - AI Futures and Innovation (EQF 7)
Unit learning outcomes
• Applies innovative problem-solving skills • Manages the lifecycle of deep learning projects • Implements AI solutions using best practices in software engineering and data management • Leads strategic planning and execution of AI projects • Designs robust ML Ops architectures • Implements continuous integration and continuous delivery (CI/CD) pipelines • Optimizes machine learning pipelines for performance and efficiency • Evaluates the effectiveness and efficiency of ML Ops systems • Collaborates with data scientists, developers, and IT professionals • Adapts ML Ops practices to emerging technologies and methodologies • Leads cross-functional teams in the development and implementation of ML Ops initiatives • Communicates the strategic value and operational impact of ML Ops to stakeholders • Develop innovative AI applications, utilizing cutting-edge AI technologies • Evaluate the impact of new AI technologies on existing business models and strategies
Delivery method(s)
• Workshop • Lectures • Project Work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.5. Theoretical and Advanced Deep Neural Networks

Description
In-depth study of complex deep neural network theories and designs.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 4 - Machine Learning (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Critically evaluates the theoretical underpinnings of deep learning • Designs innovative deep learning models • Communicates complex deep learning concepts, methodologies, and outcomes • Integrates AI technologies to create comprehensive systems that improve decision-making • Innovates with AI technologies to solve novel or unstructured problems • Independently develops robust machine learning models using advanced algorithms • Critically evaluates the performance of machine learning models • Optimizes machine learning algorithms and systems for improved performance • Integrates machine learning models into existing business processes and systems • Applies innovative approaches to extend the capabilities of machine learning • Effectively communicates complex machine learning concepts and results • Cultivates an innovative mindset • Applies critical thinking to evaluate information
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.6. Neural Network in Python (TensorFlow, Keras, PyTorch, CNNs, RNNs)

Description
Practical implementation of neural networks using Python frameworks.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 – ML Ops (EQF 7) 4 - Machine Learning (EQF 7) 9 - AI Futures and Innovation (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Designs innovative deep learning models • Develops advanced deep learning models using current frameworks and tools • Analyses complex datasets using deep learning models • Collaborates effectively in interdisciplinary teams to design, develop, and deploy deep learning solutions • Applies innovative problem-solving skills • Manages the lifecycle of deep learning projects • Implements AI solutions using best practices in software engineering and data management • Leads strategic planning and execution of AI projects • Optimizes machine learning pipelines for performance and efficiency • Independently develops robust machine learning models using advanced algorithms • Optimizes machine learning algorithms and systems for improved performance • Integrates machine learning models into existing business processes and systems • Applies innovative approaches to extend the capabilities of machine learning • Develop innovative AI applications, utilizing cutting-edge AI technologies • Develops and implements creative problem-solving strategies • Applies critical thinking to evaluate information
Delivery method(s)
• Workshop • Lectures • Project Work
Materials
Lecturer Materials:

Tutorial Materials (Slide and Presentations)

Student readings suggested:

De Marchi, L., & Mitchell, L. (2019). Hands-On Neural Networks: Learn how to build and train your first neural network model using Python. Packt Publishing Ltd.

4.7. Big Data Infrastructure Design (Hadoop, Spark, NoSQL database)

Description
Techniques for designing and managing big data systems.
Related Programme Learning Outcome(s)
6 - Big Data & Data Analytics (EQF 7)
Unit learning outcomes
• Designs and implements robust big data infrastructures
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Dasgupta, N. (2018). Practical big data analytics: Hands-on techniques to implement enterprise analytics and machine learning using Hadoop, Spark, NoSQL and R. Packt Publishing Ltd.

4.8. Advanced Data Analytics Techniques

Description
Advanced methods for analysing large and complex datasets.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 6 - Big Data & Data Analytics (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Analyses complex datasets using deep learning models • Develops and applies sophisticated data analytics algorithms and models to big data sets • Evaluates the performance of big data systems and analytics approaches • Develops and implements creative problem-solving strategies • Cultivates an innovative mindset
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Rogel-Salazar, J. (2018). Data science and analytics with Python. Chapman and Hall/CRC.

4.9. Advanced Data Mining Techniques

Description
Techniques for extracting useful patterns and insights from data.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 6 - Big Data & Data Analytics (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Analyses complex datasets using deep learning models • Develops and applies sophisticated data analytics algorithms and models to big data sets • Develops and implements creative problem-solving strategies • Cultivates an innovative mindset
Delivery method(s)
• Workshop • Lectures • Project Work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Layton, R. (2015). Learning data mining with python. Packt Publishing Ltd.

4.10. Machine Learning and AI for Data Management

Description
Application of ML and AI in effective data management.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 6 - Big Data & Data Analytics (EQF 7)
Unit learning outcomes
• Analyses complex datasets using deep learning models • Implements AI solutions using best practices in software engineering and data management • Develops and applies sophisticated data analytics algorithms and models to big data sets • Manages the entire lifecycle of data analytics projects • Evaluates the performance of big data systems and analytics approaches • Innovates with machine learning and artificial intelligence techniques
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Ramakrishnan, R., & Gehrke, J. (2002). Database management systems. McGraw-Hill, Inc.

4.11. Fundamentals of Cybersecurity and Data Privacy

Description
Basic principles of securing data and ensuring privacy.
Related Programme Learning Outcome(s)
12 - Cyber and Data Security (EQF 7)
Unit learning outcomes
• Analyse and mitigate security risks associated with organizational data assets • Design and implement robust security frameworks • Develop policies and procedures that enforce data security standards • Lead cybersecurity incident response teams • Evaluate the effectiveness of security measures • Train and mentor staff on cybersecurity best practices • Stay abreast of the latest developments in cybersecurity technology and threat landscapes • Advocate for ethical considerations in data handling and security practices
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Thakur, K., & Pathan, A. S. K. (2020). Cybersecurity fundamentals: a real-world perspective. CRC Press.

4.12. Database Security

Description
Approaches for securing databases against various threats.
Related Programme Learning Outcome(s)
12 - Cyber and Data Security (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Analyse and mitigate security risks associated with organizational data assets • Design and implement robust security frameworks • Develop policies and procedures that enforce data security standards • Evaluate the effectiveness of security measures • Train and mentor staff on cybersecurity best practices • Develops and implements creative problem-solving strategies
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Denning, D. E., & Denning, P. J. (1979). Data security. ACM computing surveys (CSUR), 11(3), 227-249.

4.13. Introduction to Generative AI

Description
Basics of generative AI and its potential applications.
Related Programme Learning Outcome(s)
9 - AI Futures and Innovation (EQF 7) 13 - Generative AI (EQF 7)
Unit learning outcomes
• Advocate for a proactive approach to AI innovation • Design and implement advanced generative AI models • Evaluate the effectiveness and safety of generative AI models • Lead projects and teams in the development of generative AI applications • Communicate the capabilities and limitations of generative AI
Delivery method(s)
• Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Foster, D. (2022). Generative deep learning. "O'Reilly Media, Inc.".

4.14. Generative AI applications in our society

Description
Practical uses and societal impacts of generative AI.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 4 - Machine Learning (EQF 7) 7 - Human-Centered AI (EQF 7) 11 – AI Awareness (EQF 6) 13 - Generative AI (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Reflects on the ethical, legal, and social implications of deploying deep learning models • Critiques the impact of AI technologies on society • Assesses the ethical implications of machine learning applications • Critically assesses societal impacts of AI • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Apply generative AI in novel applications • Communicate the capabilities and limitations of generative AI • Stay abreast of technological advancements in the field of generative AI • Cultivates an innovative mindset
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Fui-Hoon Nah, F., Zheng, R., Cai, J., Siau, K., & Chen, L. (2023). Generative AI and ChatGPT: Applications, challenges, and AI-human collaboration. Journal of Information Technology Case and Application Research, 25(3), 277-304.

4.15. Implications and potential drawbacks of Generative AI

Description
Challenges and risks associated with generative AI technologies.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 4 - Machine Learning (EQF 7) 7 - Human-Centered AI (EQF 7) 9 - AI Futures and Innovation (EQF 7) 11 - AI Awareness (EQF 6) 13 - Generative AI (EQF 7)
Unit learning outcomes
• Reflects on the ethical, legal, and social implications of deploying deep learning models • Critiques the impact of AI technologies on society • Assesses the ethical implications of machine learning applications • Critically assesses societal impacts of AI • Evaluate the impact of new AI technologies on existing business models and strategies • Communicate the potential and risks of future AI innovations to a range of stakeholders • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Collaborates with technical and non-technical teams to explore AI opportunities • Engages in continuous learning to keep pace with rapid advancements in AI • Communicate the capabilities and limitations of generative AI • Stay abreast of technological advancements in the field of generative AI • Advocate for responsible use of generative AI technologies
Delivery method(s)
• Lectures • Case studies • Group Discussions
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

Student readings suggested:

- Barros, A., Prasad, A., & Śliwa, M. (2023). Generative artificial intelligence and academia: Implication for research, teaching and service. Management Learning, 54(5), 597-604.
- Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., ... & Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. International Journal of Information Management, 71, 102642.

4.16. Responsible AI practices for Human-Computer Interaction

Description
Ensuring ethical AI interactions with a focus on user experience.
Related Programme Learning Outcome(s)
7 - Human-Centered AI (EQF 7) 8 - AI Ethics (EQF 7) 13 - Generative AI (EQF 7)
Unit learning outcomes
• Designs AI solutions that incorporate human-centered design principles • Implements interactive AI systems that facilitate effective human-AI collaboration • Evaluates AI systems from a human-centered perspective • Communicates the benefits and limitations of human-centered AI systems • Critically assesses societal impacts of AI • Analyse the ethical implications of AI systems • Advocate for responsible use of generative AI technologies
Delivery method(s)
• Lectures • Workshop
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.17. Introduction and best practices to Explainability in ML

Description
Methods to make ML models interpretable and understandable.
Related Programme Learning Outcome(s)
2 - AI Technologies (EQF 7) 5 - Explainable AI (EQF 7) 7 - Human-Centered AI (EQF 7) 9 - AI Futures and Innovation (EQF 7)
Unit learning outcomes
• Innovates with AI technologies to solve novel or unstructured problems • Designs AI systems with a focus on explainability • Implements techniques such as feature importance scores, model-agnostic methods, and visualization of AI decision paths • Evaluates the effectiveness of explainable AI models • Researches and applies the latest advancements in explainable AI • Communicates the importance and benefits of explainable AI to a variety of audiences • Critically assesses AI models for biases and ethical implications • Leads cross-functional teams in projects that require the integration of explainable AI • Advocates for ethical AI practices • Designs AI solutions that incorporate human-centered design principles • Pioneer research and development in AI
Delivery method(s)
• Lectures • Workshop
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Angelov, P. P., Soares, E. A., Jiang, R., Arnold, N. I., & Atkinson, P. M. (2021). Explainable artificial intelligence: an analytical review. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 11(5), e1424.

4.18. Strategies to manage change in organizations implementing AI

Description
Managing organizational changes due to AI integration.
Related Programme Learning Outcome(s)
14 - Change Management (EQF 6)
Unit learning outcomes
• Understands the principles and theories of change management • Assesses organizational readiness for change • Designs change management strategies • Communicates change effectively, using clear, persuasive messaging • Engages stakeholders throughout the change process • Implements change management plans • Cultivates resilience and adaptability in teams
Delivery method(s)
• Lectures • Case Studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Sartori, R., Costantini, A., Ceschi, A., & Tommasi, F. (2018). How do you manage change in organizations? Training, development, innovation, and their relationships. Frontiers in psychology, 9, 320628.

4.19. Data Analytics in Business Intelligence

Description
Applying data analytics to enhance business decision-making.
Related Programme Learning Outcome(s)
2 - AI Technologies (EQF 7) 6 - Big Data & Data Analytics (EQF 7) 9 - AI Futures and Innovation (EQF 7) 10 - Business Intelligence (EQF 7) 11 - AI Awareness (EQF 6) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Integrates AI technologies to create comprehensive systems that improve decision-making • Communicates complex data insights to non-technical audiences • Evaluate the impact of new AI technologies on existing business models and strategies • Develop comprehensive BI strategies that align with organizational goals • Implement BI tools and technologies effectively to collect, store, and analyse data • Lead BI projects • Evaluate the effectiveness of BI systems • Innovate with emerging BI technologies and methodologies • Assesses the strategic considerations for integrating AI into business operations • Develops and implements creative problem-solving strategies
Delivery method(s)
• Lectures • Case Studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Berthold, M.R., Borgelt, C., Höppner, F., Klawonn, F. GUIDE TO INTELLIGENT DATA ANALYSIS. Springer Verlag, 1st Edition., 2010. ISBN 978-1-84882-259-7

4.20. Project Management

Description
Skills and techniques for managing AI and data science projects.
Related Programme Learning Outcome(s)
6 - Big Data & Data Analytics (EQF 7) 9 - AI Futures and Innovation (EQF 7) 10 - Business Intelligence (EQF 7) 11 - AI Awareness (EQF 6) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Communicates complex data insights to non-technical audiences • Communicate the potential and risks of future AI innovations to a range of stakeholders • Lead BI projects • Communicate complex data insights to stakeholders at all levels of the organization • Advocate for data-driven culture within the organization • Communicates effectively about AI technologies and their business applications to a range of audiences • Masters advanced communication techniques • Leads and enhances team performance through effective collaboration • Develops and implements creative problem-solving strategies • Delivers compelling presentations, utilizing state-of-the-art presentation tools • Resolves conflicts effectively, using advanced negotiation and mediation skills
Delivery method(s)
• Lectures • Project Work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Heerkens, G. (2002). Project management. McGraw-Hill.

4.21. Ethical and legal issues of AI technologies in our society

Description
Ethical and legal considerations in the deployment of AI technologies.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 4 - Machine Learning (EQF 7) 5 - Explainable AI (EQF 7) 6 - Big Data & Data Analytics (EQF 7) 7 - Human-Centered AI (EQF 7) 8 - AI Ethics (EQF 7) 9 - AI Futures and Innovation (EQF 7) 10 - Business Intelligence (EQF 7) 11 - AI Awareness (EQF 6) 12 - Cyber and Data Security (EQF 7) 14 - Change Management (EQF 6) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Reflects on the ethical, legal, and social implications of deploying deep learning models • Critiques the impact of AI technologies on society • Assesses the ethical implications of machine learning applications • Critically assesses AI models for biases and ethical implications • Advocates for responsible data usage • Advocates for ethical standards in AI development • Analyse the ethical implications of AI systems • Develop ethical guidelines for AI projects • Evaluate AI systems for ethical compliance • Lead discussions and workshops on AI ethics • Innovate in the creation of tools and methods for ethical AI • Advocate for policies and regulations that encourage ethical AI practices • Advocate for a proactive approach to AI innovation • Integrate diverse knowledge from fields such as cognitive science, engineering, and digital ethics • Ensure ethical considerations in data handling and analysis • Recognizes the ethical, legal, and societal challenges associated with AI deployment • Advocate for ethical considerations in data handling and security practices • Engages stakeholders throughout the change process

- Applies critical thinking to evaluate information

Delivery method(s)

- Lectures
- Case studies
- Group Discussions

Materials

Lecturer Materials:

Tutorial Materials (Slide and Presentations)

Student readings suggested:

Barocas, S., & Boyd, D. (2017). Engaging the ethics of data science in practice. Communications of the ACM, 60(11), 23-25.

NLP ENGINEER EQF 6

1. General information

Name	NLP Engineer
EQF level	EQF 6
Goals	The NLP Engineer curriculum provides participants with foundational and advanced knowledge in Natural Language Processing and Artificial Intelligence. It covers essential topics such as machine learning, deep learning, generative AI, and the ethical implications of AI technologies. The curriculum equips learners with the skills to develop and implement innovative AI solutions, apply human-centred design principles, and address cybersecurity and data privacy concerns.
Scope	This course is aimed at individuals with an interest in computer science, data analysis, or linguistics who want to build foundational skills in NLP, machine learning, and AI applications.

Entry requirements	General Entry Requirements:
	• Mathematics Proficiency:
	  ○ Algebra
	  ○ Calculus.
	  ○ Linear Algebra
	  ○ Statistics
	• Programming Knowledge:
	  ○ Python
	  ○ Java
	  ○ C++
	• Computer Science Fundamentals:
	  ○ Data Structures
	  ○ Algorithms
	  ○ Computational Thinking

Programme learning outcomes (PLOs)	1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6)

	4 - Human-Centered AI (EQF 6) 5 - AI Ethics (EQF 6) 6 - AI Futures and Innovation (EQF 6) 7 - AI Awareness (EQF 6) 8 - Cyber and Data Security (EQF 6) 9 - NLP (EQF 6) 10 - Generative AI (EQF 6) 11 - Change Management (EQF 5) 12 - Soft Skills (EQF 6)

2. Description of the structure

The course is structured into 15 modules for a total of 115 hours. It starts with an introduction to AI innovations and basic machine learning, including regression, classification, and clustering. The curriculum advances to deep learning fundamentals, CNNs, RNNs, and transfer learning.

It explores practical applications of generative AI and prompt engineering, along with text mining and NLP using Python. The program covers training and fine-tuning large language models and discusses the implications and ethical issues of generative AI. The course concludes with responsible AI practices, cybersecurity, and strategies for managing organizational change in AI implementation.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Introduction to the current AI innovations and their applications	6	EQF 6	Exam
Fundamentals of Machine Learning: regression, classification and clustering	8	EQF 6	Exam
Data Preparation and Performance Evaluation	8	EQF 6	Exam and Practical Assignment
Deep Learning introduction: Neural Network Basics	6	EQF 6	Exam

Overview of CNN, RNN and Transfer Learning	6	EQF 6	Exam
Introduction to Generative AI and its applications in our society	8	EQF 6	Exam
Prompt Engineering	8	EQF 6	Exam and Practical Assignment
Introduction to Text Mining	6	EQF 6	Exam
NLP in Python (NLTK, SpaCy, Gensim, Transformers)	10	EQF 6	Practical Assignment
Generative AI for Natural Language (LLM training and fine-tuning)	12	EQF 6	Exam and Practical Assignment
Implications and potential drawbacks of Generative AI	6	EQF 6	Exam
Ethical and legal issues of AI technologies in our society	6	EQF 6	Exam
Responsible AI practices for Human-Computer Interaction	8	EQF 6	Exam
Strategies to manage change in organizations implementing AI	8	EQF 5-6	Exam
Introduction to Cybersecurity and Data Privacy	6	EQF 6	Exam

4. Details of Learning Units

4.1. Introduction to the current AI innovations and their applications

Description
Provides an overview of the latest advancements in AI and their applications across various fields.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - AI Futures and Innovation (EQF 6) 3 - AI Awareness (EQF 6) 4 - Soft Skills (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Communicates technical details and project outcomes related to AI technologies • Critiques the current trends and advancements in AI • Analyses current AI developments and trends • Conducts research to explore new possibilities in AI • Communicates insights and predictions about future AI developments • Evaluates the ethical, social, and economic implications of future AI innovations • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Knowledge of current trends in AI technology • Cultivates an innovative mindset, embracing and fostering creativity • Thinks critically, analysing situations, evaluating diverse perspectives
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison Wesley, ISBN 0-321-32136-7, 2006

4.2. Fundamentals of Machine Learning: regression, classification and clustering

Description
Introduces fundamental machine learning techniques and their application in regression, classification, and clustering.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Machine Learning (EQF 6) 3 - Soft Skills (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Applies fundamental machine learning concepts and algorithms • Communicates machine learning findings effectively • Solves problems creatively and efficiently
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Burkov, A. (2019). The hundred-page machine learning book (Vol. 1, p. 32). Quebec City, QC, Canada: Andriy Burkov.

4.3. Data Preparation and Performance Evaluation

Description
Focuses on data preprocessing techniques and methods for evaluating the performance of machine learning models.
Related Programme Learning Outcome(s)
1 - Machine Learning (EQF 6)
Unit learning outcomes
• Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.4. Deep Learning introduction: Neural Network Basics

Description
Covers the basics of neural networks and introduces deep learning concepts and architectures.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Futures and Innovation (EQF 6) 3 – Soft Skills (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Designs deep learning models by selecting appropriate architectures • Implements deep learning models using relevant frameworks and libraries • Applies deep learning techniques to solve problems • Collaborates effectively in teams to design, implement, and evaluate deep learning projects • Conducts research to explore new possibilities in AI • Thinks critically, analysing situations, evaluating diverse perspectives
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Stevens, E., Antiga, L., & Viehmann, T. (2020). Deep learning with PyTorch. Manning Publications.bu

4.5. Overview of CNN, RNN and Transfer Learning

Description
Examines convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transfer learning techniques.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 – Soft Skills (EQF 6)
Unit learning outcomes
• Identifies suitable applications for deep and shallow neural architectures • Designs deep learning models by selecting appropriate architectures • Applies deep learning techniques to solve problems • Critiques the current trends and advancements in deep learning • Communicates effectively across a variety of platforms and media • Thinks critically, analysing situations, evaluating diverse perspectives
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.6. Introduction to Generative AI and its applications in our society

Description
Introduces generative AI, its practical applications, and societal implications.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6) 2 - Human-Centered AI (EQF 6) 3 - AI Futures and Innovation (EQF 6) 4 - Generative AI (EQF 6) 5 – Soft Skills (EQF 6)
Unit learning outcomes
• Selects appropriate AI frameworks and libraries for specific project needs • Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies • Innovates in the field of AI by applying insights from research and trend analysis to develop novel AI solutions • Identifies AI-generated content, employing analytical methods and tools • Evaluates the performance of generative AI systems • Integrates generative AI into diverse applications • Conveys the principles and potential of generative AI to a broad audience • Delivers impactful presentations
Delivery method(s)
• Case Studies • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Foster, D. (2022). Generative deep learning. " O'Reilly Media, Inc.".

4.7. Prompt Engineering

Description
Teaches skills in crafting and refining prompts to effectively interact with AI models and improve their outputs.
Related Programme Learning Outcome(s)
1 - AI Futures and Innovation (EQF 6) 2 - Generative AI (EQF 6)
Unit learning outcomes
• Communicates insights and predictions about future AI developments • Develops prompt engineering skills
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.8. Introduction to Text Mining

Description
Covers techniques for extracting meaningful information from text data using text mining methodologies.
Related Programme Learning Outcome(s)
1 - NLP (EQF 6)
Unit learning outcomes
• Applies NLP techniques to analyse text data • Communicates the capabilities and limitations of NLP technologies
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Manning, C. D. (2008). Introduction to information retrieval. Syngress Publishing.

4.9. NLP in Python (NLTK, SpaCy, Gensim, Transformers)

Description
Focuses on implementing NLP techniques using Python libraries such as NLTK, SpaCy, Gensim, and Transformers.
Related Programme Learning Outcome(s)
1 - NLP (EQF 6)
Unit learning outcomes
• Applies NLP techniques to analyse text data • Develops applications that utilize NLP for tasks such as sentiment analysis, language translation, and chatbot development • Implements machine learning models for NLP • Evaluates the performance of NLP systems • Integrates NLP with other AI technologies • Communicates the capabilities and limitations of NLP technologies • Engages in continuous learning and professional development in the field of NLP
Delivery method(s)
• Workshop • Lectures • Project Work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.10. Generative AI for Natural Language (LLM training and fine-tuning)

Description
Teaches the training and fine-tuning of large language models (LLMs) for generating and understanding natural language.
Related Programme Learning Outcome(s)
1 - NLP (EQF 6) 2 - Generative AI (EQF 6) 3 - Soft Skills (EQF 6)
Unit learning outcomes
• Applies NLP techniques to analyse text data • Develops applications that utilize NLP for tasks such as sentiment analysis, language translation, and chatbot development • Implements machine learning models for NLP • Knowledge of advance NLP techniques • Evaluates the performance of NLP systems • Integrates NLP with other AI technologies • Communicates the capabilities and limitations of NLP technologies • Designs generative AI models to create novel content • Develops prompt engineering skills • Implements Large Language Models (LLMs) in generative AI projects • Integrates generative AI into diverse applications • Solves problems creatively and efficiently
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.11. Implications and potential drawbacks of Generative AI

Description
Explores the ethical, social, and technical challenges associated with generative AI technologies.

Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 6)
2 - Human-Centered AI (EQF 6)
3 - AI Futures and Innovation (EQF 6)
4 - Generative AI (EQF 6)
5 - Soft Skills (EQF 6)

Unit learning outcomes
• Analyses the performance and efficiency of AI models and technologies • Discusses the ethical implications of deploying AI technologies • Critiques the current trends and advancements in AI • Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies • Evaluates the sustainability of AI solutions • Analyses current AI developments and trends • Communicates insights and predictions about future AI developments • Evaluates the ethical, social, and economic implications of future AI innovations • Identifies AI-generated content, employing analytical methods and tools • Evaluates the performance of generative AI systems • Assesses the ethical implications of generative AI systems • Engages in continuous learning and professional development • Delivers impactful presentations • Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)
• Group Discussions • Lectures

Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Brynjolfsson, E., Li, D., & Raymond, L. R. (2023). Generative AI at work (No. w31161). National Bureau of Economic Research.

4.12. Ethical and legal issues of AI technologies in our society

Description
Addresses the ethical and legal considerations surrounding the use of AI technologies in various societal contexts.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - Machine Learning (EQF 6) 4 - Human-Centered AI (EQF 6) 5 - AI Ethics (EQF 6) 6 - AI Futures and Innovation (EQF 6) 7 - AI Awareness (EQF 6) 8 - Cyber and Data Security (EQF 6) 9 - NLP (EQF 6) 10 - Generative AI (EQF 6)
Unit learning outcomes
• Discusses the ethical implications of deploying deep learning models • Discusses the ethical implications of deploying AI technologies • Assesses the ethical implications of machine learning projects • Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies • Identifies ethical considerations and challenges in AI development and deployment • Implements strategies to mitigate ethical risks in AI applications • Advocates for responsible AI by communicating the significance of ethical considerations • Assesses AI projects for ethical implications • Reflects on personal ethical beliefs and practices in relation to AI technologies • Evaluates the ethical, social, and economic implications of future AI innovations • Recognizes the ethical, legal, and societal challenges associated with AI deployment • Evaluates the ethical, legal, and societal implications of cybersecurity practices • Addresses ethical and societal considerations in NLP applications • Assesses the ethical implications of generative AI systems
Delivery method(s)
• Lectures • Case studies • Group Discussions

Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Coeckelbergh, M. (2020). AI ethics. Mit Press.

4.13. Responsible AI practices for Human-Computer Interaction

Description
Focuses on designing AI systems with human-centered approaches and ensuring responsible interaction between humans and AI.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - Human-Centered AI (EQF 6)
Unit learning outcomes
• Applies deep learning techniques to solve problems • Adapts existing AI models to new contexts and problems • Incorporates human-centered design principles in the development of AI systems • Manages AI risks by identifying potential ethical, legal, and operational issues associated with AI technologies • Enhances human-computer interaction through the design of intuitive and accessible AI interfaces • Communicates effectively with stakeholders
Delivery method(s)
• Lectures • Case studies • Group Discussions
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., & Carey, T. (1994). Human-computer interaction. Addison-Wesley Longman Ltd.

4.14. Strategies to manage change in organizations implementing AI

Description
Teaches strategies for effectively managing organizational changes when implementing AI technologies.
Related Programme Learning Outcome(s)
1 - Change Management (EQF 5) 2 - Soft Skills (EQF 6)
Unit learning outcomes
• Analyses the need for change within organizations • Plans and designs change management strategies that are clear • Communicates change effectively to all stakeholders • Evaluates the impact of change initiatives • Adapts change strategies in response to evolving circumstances and feedback • Collaborates within teams, contributing positively to group efforts • Delivers impactful presentations • Manages conflicts constructively
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.15. Introduction to Cybersecurity and Data Privacy

Description
Provides an introduction to cybersecurity principles and data privacy considerations relevant to AI and data-intensive applications.
Related Programme Learning Outcome(s)
1 - Human-Centered AI (EQF 6) 2 - Cyber and Data Security (EQF 6)
Unit learning outcomes
• Incorporates human-centered design principles in the development of AI systems • Identifies a variety of cybersecurity threats and vulnerabilities • Implements key cybersecurity measures • Designs security architectures for information systems • Manages cybersecurity incidents by effectively deploying incident response • Conveys complex cyber and data security concepts, policies, and protocols
Delivery method(s)
• Lectures • Workshop
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Thakur, K., & Pathan, A. S. K. (2020). Cybersecurity fundamentals: a real-world perspective. CRC Press.

NLP ENGINEER EQF 7

1. General information

Name	NLP Engineer
EQF level	EQF 7
Goals	The NLP Engineer curriculum at EQF 7 equips participants with advanced expertise in Natural Language Processing and Artificial Intelligence. It emphasizes the mastery of cutting-edge machine learning techniques, deep neural networks, and generative AI models, integrating these with cloud services and ML Ops for scalable AI solutions. The program fosters the ability to design explainable AI systems, apply human-centred AI principles, and address complex ethical, legal, and societal challenges.
Scope	This program is aimed at individuals with a background in computer science or related fields who seek to advance their expertise in NLP, deep learning, and AI-driven language technologies.

Entry requirements	• Advanced Mathematics Proficiency:
	  ○ Linear Algebra
	  ○ Probability and Statistics
	  ○ Calculus
	• Programming Skills:
	  ○ Python
	  ○ Java or C++
	• Computer Science Fundamentals:
	  ○ Data Structures and Algorithms
	  ○ Software Engineering Principles
	  ○ Database Management

Programme learning outcomes (PLOs)	1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - ML Ops (EQF 7) 4 - HPC and Cloud services (EQF 7) 5 - Machine Learning (EQF 7)

	6 - Explainable AI (EQF 7) 7 - Human-Centered AI (EQF 7) 8 - AI Ethics (EQF 7) 9 - AI Futures and Innovation (EQF 7) 10 - AI Awareness (EQF 6) 12 - NLP (EQF 7) 13 - Generative AI (EQF 7) 14 - Change Management (EQF 5) 15 - Soft Skills (EQF 7)

2. Description of the structure

The course is structured into 17 modules for a total of 110 hours. It begins with foundational concepts in machine learning and deep learning, advancing to state-of-the-art ML techniques and deep neural networks. Students then explore practical applications of neural networks in Python, advanced ML Ops, and cloud services for AI.

The curriculum includes specialized modules in generative AI and NLP using frameworks like NLTK and SpaCy, and it covers large language models. The program also addresses the implications and drawbacks of generative AI, as well as ethical and legal issues in AI. The course concludes with strategies for responsible AI practices and managing organizational change in AI deployment.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Introduction to Machine Learning and Deep Learning	8	EQF 6-7	Exam
State-of-the-Art Machine Learning Techniques and Architectures	8	EQF 7	Exam
Theoretical and Advanced Deep Neural Networks	10	EQF 7	Exam

Neural Network in Python (TensorFlow, Keras, PyTorch, CNNs, RNNs)	10	EQF 7	Exam and Practical Assignment
Advanced ML Ops and Lifecycle Management	8	EQF 7	Exam
Introduction to cloud services and infrastructure for AI	6	EQF 7	Exam
Generative AI	6	EQF 7	Exam
Generative AI applications in our society	6	EQF 7	Exam
NLP in Python (NLTK, SpaCy, Gensim, Transformers)	8	EQF 7	Practical Assignment
Large Language Models	8	EQF 7	Exam
Implications and potential drawbacks of Generative AI	6	EQF 6-7	Exam
Ethical and legal issues of AI technologies in our society	6	EQF 6-7	Exam
Responsible AI practices for Human-Computer Interaction	6	EQF 7	Exam
Overview of best practices to Explainability in ML	6	EQF 7	Exam
Strategies to manage change in organizations implementing AI	8	EQF 5	Exam
Project and thesis work	25	EQF 5/6/7	Practical Assignment

4. Details of Learning Units

4.1. Introduction to Machine Learning and Deep Learning

Description
Introduces fundamental concepts of machine learning and deep learning, providing a basis for understanding advanced AI techniques.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 9 - AI Futures and Innovation (EQF 7) 10 - AI Awareness (EQF 6)
Unit learning outcomes
• Critically evaluates the theoretical underpinnings of deep learning • Reflects on the ethical, legal, and social implications of deploying deep learning models • Assesses the capabilities and limitations of different AI technologies • Understands the basic concepts and technologies underlying artificial intelligence • Lead multidisciplinary teams in experimental AI projects
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Burkov, A. (2019). The hundred-page machine learning book (Vol. 1, p. 32). Quebec City, QC, Canada: Andriy Burkov.

4.2. State-of-the-Art Machine Learning Techniques and Architectures

Description
Explores cutting-edge machine learning techniques and architectural designs used in modern AI systems.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 5 - Machine Learning (EQF 7) 9 - AI Futures and Innovation (EQF 7)
Unit learning outcomes
• Manages the lifecycle of deep learning projects • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Innovates with AI technologies to solve novel or unstructured problems • Disseminates findings and developments in AI technologies • Independently develops robust machine learning models using advanced algorithms • Critically evaluates the performance of machine learning models • Integrates machine learning models into existing business processes and systems • Lead multidisciplinary teams in experimental AI projects
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.3. Theoretical and Advanced Deep Neural Networks

Description
Covers advanced topics in deep neural networks, including complex architectures and theoretical underpinnings.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 5 - Machine Learning (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Critically evaluates the theoretical underpinnings of deep learning • Designs innovative deep learning models • Integrates AI technologies to create comprehensive systems that improve decision-making • Innovates with AI technologies to solve novel or unstructured problems • Independently develops robust machine learning models using advanced algorithms • Critically evaluates the performance of machine learning models • Optimizes machine learning algorithms and systems for improved performance • Integrates machine learning models into existing business processes and systems • Applies innovative approaches to extend the capabilities of machine learning • Cultivates an innovative mindset • Applies critical thinking to evaluate information
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Stevens, E., Antiga, L., & Viehmann, T. (2020). Deep learning with PyTorch. Manning Publications.

4.4. Neural Network in Python (TensorFlow, Keras, PyTorch, CNNs, RNNs)

Description
Provides hands-on experience with Python libraries and frameworks for developing and deploying neural networks.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - ML Ops (EQF 7) 5 - Machine Learning (EQF 7) 9 - AI Futures and Innovation (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Designs innovative deep learning models • Develops advanced deep learning models using current frameworks and tools • Analyses complex datasets using deep learning models • Manages the lifecycle of deep learning projects • Implements AI solutions using best practices in software engineering and data management • Optimizes machine learning pipelines for performance and efficiency • Independently develops robust machine learning models using advanced algorithms • Optimizes machine learning algorithms and systems for improved performance • Integrates machine learning models into existing business processes and systems • Applies innovative approaches to extend the capabilities of machine learning • Develops and implements creative problem-solving strategies • Applies critical thinking to evaluate information • Develop innovative AI applications, utilizing cutting-edge AI technologies
Delivery method(s)
• Workshop • Lectures • Project Work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:**

De Marchi, L., & Mitchell, L. (2019). Hands-On Neural Networks: Learn how to build and train your first neural network model using Python. Packt Publishing Ltd.

4.5. Advanced ML Ops and Lifecycle Management

Description
Focuses on best practices for managing machine learning operations and the full lifecycle of ML models.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 – ML Ops (EQF 7) 9 - AI Futures and Innovation (EQF 7)
Unit learning outcomes
• Manages the lifecycle of deep learning projects • Implements AI solutions using best practices in software engineering and data management • Designs robust ML Ops architectures • Implements continuous integration and continuous delivery (CI/CD) pipelines • Optimizes machine learning pipelines for performance and efficiency • Evaluates the effectiveness and efficiency of ML Ops systems • Communicates the strategic value and operational impact of ML Ops to stakeholders • Develop innovative AI applications, utilizing cutting-edge AI technologies • Evaluate the impact of new AI technologies on existing business models and strategies
Delivery method(s)
• Workshop • Lectures • Project Work
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Gift, N., & Deza, A. (2021). Practical MLOps. " O'Reilly Media, Inc.".

4.6. Introduction to cloud services and infrastructure for AI

Description
Introduces cloud services and infrastructure setups that support scalable AI deployments.
Related Programme Learning Outcome(s)
4 - HPC and Cloud services (EQF 7) 9 - AI Futures and Innovation (EQF 7)
Unit learning outcomes
• Architects scalable and secure HPC and cloud infrastructures • Conduct detailed performance monitoring and tuning • Deploys complex applications on HPC and cloud platforms • Manages HPC and cloud environments • Analyses the performance of HPC and cloud systems • Evaluates new HPC and cloud technologies and services for potential adoption • Communicates technical and strategic aspects of HPC and cloud services • Evaluate the impact of new AI technologies on existing business models and strategies
Delivery method(s)
• Workshop • Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Velte, A. T., Velte, T. J., & Elsenpeter, R. C. (2010). Cloud computing: a practical approach. McGraw-Hill.

4.7. Generative AI

Description
Provides an overview of generative AI models, including their design, implementation, and applications.
Related Programme Learning Outcome(s)
9 - AI Futures and Innovation (EQF 7) 13 - Generative AI (EQF 7)
Unit learning outcomes
• Design and implement advanced generative AI models • Evaluate the effectiveness and safety of generative AI models • Advocate for a proactive approach to AI innovation
Delivery method(s)
• Lectures
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Foster, D. (2022). Generative deep learning. " O'Reilly Media, Inc.".

4.8. Generative AI applications in our society

Description
Examines the societal impact and applications of generative AI, including real-world case studies.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 7 - Human-Centered AI (EQF 7) 10 - AI Awareness (EQF 6) 13 - Generative AI (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Reflects on the ethical, legal, and social implications of deploying deep learning models • Critically assesses societal impacts of AI • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Apply generative AI in novel applications • Stay abreast of technological advancements in the field of generative AI • Cultivates an innovative mindset
Delivery method(s)
• Lectures • Case studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.9. NLP in Python (NLTK, SpaCy, Gensim, Transformers)

Description
Teaches practical NLP techniques using Python libraries to handle and analyse textual data.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 12 - NLP (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Analyses complex datasets using deep learning models • Develops and implements creative problem-solving strategies • Applies critical thinking to evaluate information • Design and implement advanced NLP models • Evaluate NLP systems, using rigorous testing and validation methods • Optimize NLP algorithms for various computational environments • Apply NLP techniques to extract insights and information from textual data across different languages
Delivery method(s)
• Lectures • Workshop
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Bird, S., Klein, E., & Loper, E. (2009). Natural language processing with Python: analyzing text with the natural language toolkit. " O'Reilly Media, Inc.".

4.10. Large Language Models

Description
Focuses on the development, fine-tuning, and application of large language models (LLMs) for NLP tasks.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 9 - AI Futures and Innovation (EQF 7) 12 - NLP (EQF 7) 13 - Generative AI (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Develops advanced deep learning models using current frameworks and tools • Analyses complex datasets using deep learning models • Implements AI solutions using best practices in software engineering and data management • Design and implement advanced generative AI models • Evaluate the effectiveness and safety of generative AI models • Optimize generative models for efficiency and scalability • Knowledge in fine tuning and customizing generative models and use of transfer learning • Applies critical thinking to evaluate information • Develop innovative AI applications, utilizing cutting-edge AI technologies • Pioneer research and development in AI • Design and implement advanced NLP models
Delivery method(s)
• Lectures • Workshop
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Ozdemir, S. (2023). Quick Start Guide to Large Language Models: Strategies and Best Practices for Using ChatGPT and Other LLMs. Addison-Wesley Professional.

4.11. Implications and potential drawbacks of Generative AI

Description
Explores ethical, legal, and societal challenges associated with generative AI technologies and their applications.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 7 - Human-Centered AI (EQF 7) 9 - AI Futures and Innovation (EQF 7) 10 - AI Awareness (EQF 6) 13 - Generative AI (EQF 7)
Unit learning outcomes
• Reflects on the ethical, legal, and social implications of deploying deep learning models • Critically assesses societal impacts of AI • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Engages in continuous learning to keep pace with rapid advancements in AI • Stay abreast of technological advancements in the field of generative AI • Advocate for responsible use of generative AI technologies • Evaluate the impact of new AI technologies on existing business models and strategies
Delivery method(s)
• Lectures • Case studies • Group Discussions
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.12. Ethical and legal issues of AI technologies in our society

Description
Discusses the ethical and legal aspects of AI technologies, emphasizing responsible usage and compliance.

Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 7 - Human-Centered AI (EQF 7) 8 - AI Ethics (EQF 7) 10 – AI Awareness (EQF 6) 12 - NLP (EQF 7)

Unit learning outcomes
• Reflects on the ethical, legal, and social implications of deploying deep learning models • Critically assesses societal impacts of AI • Analyse the ethical implications of AI systems • Develop ethical guidelines for AI projects • Evaluate AI systems for ethical compliance • Lead discussions and workshops on AI ethics • Innovate in the creation of tools and methods for ethical AI • Research and apply interdisciplinary knowledge from philosophy, law, social science, and technology • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Recognizes the ethical, legal, and societal challenges associated with AI deployment • Advocate for ethical AI practices in NLP

Delivery method(s)
• Lectures • Case studies • Group Discussions

Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Coeckelbergh, M. (2020). AI ethics. Mit Press.

4.13. Responsible AI practices for Human-Computer Interaction

Description
Focuses on developing AI systems that prioritize user experience and ethical interaction with humans.
Related Programme Learning Outcome(s)
7 - Human-Centered AI (EQF 7) 8 - AI Ethics (EQF 7) 13 – Generative AI (EQF 7)
Unit learning outcomes
• Designs AI solutions that incorporate human-centered design principles • Implements interactive AI systems that facilitate effective human-AI collaboration • Evaluates AI systems from a human-centered perspective • Critically assesses societal impacts of AI • Analyse the ethical implications of AI systems • Advocate for responsible use of generative AI technologies
Delivery method(s)
• Lectures • Workshop
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations) **Student readings suggested:** Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., & Carey, T. (1994). Human-computer interaction. Addison-Wesley Longman Ltd.

4.14. Introduction and best practices to Explainability in ML

Description
Teaches methods and practices for creating explainable machine learning models and interpreting their outputs.
Related Programme Learning Outcome(s)
2 - AI Technologies (EQF 7) 6 - Explainable AI (EQF 7) 7 - Human-Centered AI (EQF 7) 9 - AI Futures and Innovation (EQF 7)
Unit learning outcomes
• Innovates with AI technologies to solve novel or unstructured problems • Designs AI systems with a focus on explainability • Implements techniques such as feature importance scores, model-agnostic methods, and visualization of AI decision paths • Evaluates the effectiveness of explainable AI models • Researches and applies the latest advancements in explainable AI • Critically assesses AI models for biases and ethical implications • Advocates for ethical AI practices • Designs AI solutions that incorporate human-centred design principles • Pioneer research and development in AI
Delivery method(s)
• Lectures • Workshop
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.15. Strategies to manage change in organizations implementing AI

Description
Provides strategies for managing organizational changes necessitated by the integration of AI technologies.
Related Programme Learning Outcome(s)
14 - Change Management (EQF 5)
Unit learning outcomes
• Analyses the need for change within organizations • Plans and designs change management strategies that are clear • Implements change initiatives effectively • Communicates change effectively to all stakeholders • Evaluates the impact of change initiatives • Adapts change strategies in response to evolving circumstances and feedback • Leads and inspires others during times of change
Delivery method(s)
• Lectures • Case Studies
Materials
Lecturer Materials: Tutorial Materials (Slide and Presentations)

4.16. Project and thesis work

Description
Involves practical project work and thesis development, applying the concepts learned to solve real-world problems.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 5 - Machine Learning (EQF 7) 10 - AI Awareness (EQF 6) 12 - NLP (EQF 7) 15 - Soft Skills (EQF 7)
Unit learning outcomes
• Critically evaluates the theoretical underpinnings of deep learning • Designs innovative deep learning models • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Disseminates findings and developments in AI technologies • Independently develops robust machine learning models using advanced algorithms • Critically evaluates the performance of machine learning models • Optimizes machine learning algorithms and systems for improved performance • Integrates machine learning models into existing business processes and systems • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Knowledge of current trends in AI technology • Engages in continuous learning to keep pace with rapid advancements in AI • Design and implement advanced NLP models • Evaluate NLP systems, using rigorous testing and validation methods • Leads and enhances team performance through effective collaboration • Develops and implements creative problem-solving strategies • Delivers compelling presentations, utilizing state-of-the-art presentation tools • Cultivates an innovative mindset • Applies critical thinking to evaluate information
Delivery method(s)

- Project Work

Materials
-

MACHINE LEARNING ENGINEER EQF 6

1. General information

Name	Machine Learning Engineer
EQF level	EQF 6
Goals	The intent of the EQF 6 Machine Learning (ML) Engineer curriculum is to provide a solid base in ML techniques, develop machine learning and AI skills, and ensure the ability to join teams that build and manage ethical and secure AI systems. Its aim is to produce graduate professional who are ready to enter the job market as entry-level ML Engineers, capable of assisting in tackling complex problems and contributing to advancements in technology and society, as well as being capable of applying their knowledge to real-world problems.
Scope	The curriculum is aimed at people who intend to become entry-level ML Engineers. It can also be used to upskill or reskill individuals that already have a background in computer science and want to specialize in ML. It is also intended to both articulate how to instantiate this curriculum for both microcredentials/short courses as well as a specialisation for conventional first-cycle degree courses, as both options are valid for aspiring ML Engineers (for example if they possess a related degree already) It is also agnostic as regards platforms and APIs so to allow customisation to local requirements
Entry requirements	As expected from the first two years of a bachelor's degree in computer science or a related subject, specifically: Python programming, basic data preprocessing, basic databases Linear Algebra Calculus Probability theory Resources such as the following may be used for already competent programmers who wish to familiarise themselves with Python beforehand: https://cs231n.github.io/python-numpy-tutorial/ https://pandas.pydata.org/pandas-docs/stable/user_guide/10min.html

Programme learning outcomes (PLOs)	1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 6 - AI Ethics (EQF 6) 7 - AI Awareness (EQF 6) 8 - Cyber and Data Security (EQF 5) 9 - Generative AI (EQF 6) 11 - Soft Skills (EQF 6)

2. Description of the structure

The two learning units ML Foundations and Deep Learning comprise a base that covers the key concepts that underpin the role.

Thereafter there are two sets of extension learning units. The first set deepens and broadens ML technical knowledge and skills in important areas (MLOps, Generative AI, Explainable AI). An AI Applications learning unit has also been articulated to allow customisable delivery in specific application areas such as cybersecurity and NLP.

Following from this, two additional extension learning units are aimed at developing aspiring graduate ML Engineers to be effective deliverers of technological solutions to clients (AI for Business and AI Ethics).

It is worth noting that it is assumed that soft skills will be developed through the curriculum.

Though 5 ECTS is assumed as a default to support conventional first-cycle studies, a range is given. For example, a microcredential aimed at upskilling established developers might require fewer ECTS as some of the outcomes could be deemed to have been already met to some degree.

There is a capstone Project and Thesis Work learning unit. This supports both a traditional academic project typical of first-cycle studies, as well as a work-based or industrial project. It could also be used as a concluding unit in a microcredential-based scheme that leads to a larger award. A minimum of 5 ECTS is suggested to allow for an extended piece of work to be produced.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Machine Learning Foundation	5-10 ECTS	EQF 6	Exam and/or Practical Assignment, Project work
Deep Learning	2-8 ECTS	EQF 6	Exam and/or Practical Assignment, Project work
Machine Learning Operations (MLOps)	2-5 ECTS	EQF 6	Exam and/or Practical Assignment, Project work
AI Applications (NLP, coding tools, CV, Speech, cybersec, etc.)	1-5	EQF 6	Exam and/or Practical Assignment, Project work
Generative AI	2-5 ECTS	EQF 6	Exam and/or Practical Assignment, Project work
Explainable AI	2-5 ECTS	EQF 6	Exam and/or Practical Assignment, Project work
AI for Business	1-5 ECTS	EQF 6	Exercises based on the analysis of case studies and/or realistic scenarios (can be under exam conditions if required, also scope for groupwork)
AI Ethics	1-5 ECTS	EQF 6	Exercises based on the analysis of case studies and/or realistic scenarios (can be under exam conditions if required, also scope for groupwork)
Project and Thesis work	5+ ECTS	EQF 6	Project report, presentation/demonstration.

4. Details of Learning Units

4.1. Machine Learning Foundation

Description
The "Machine Learning foundation" learning unit is designed to provide students with a deep understanding of machine learning foundations, including supervised and unsupervised learning techniques. Students will learn how to develop, evaluate, and optimize predictive models to solve various classification and regression problems, and to identify clusters, reduce dimensionality, and extract useful features from data. Topics: 1. Types of machine learning (e.g. supervised, unsupervised, self-supervised, reinforcement learning) 2. (1) k-NN, Linear and Logistic regression, (2) 3. Decision Trees, Random Forrest, XGBoost and & SVM, (3) 4. Model Evaluation and Validation, (4) 5. Hyperparameter Tuning and Model Optimization and (5) AutoMLK-means and Hierarchical Clustering, (3) 6. DBSCAN, 7. GMM, 8. Dimensionality Reduction: PCA, t-SNE and UMAP, 9. Anomaly Detection Model Evaluation and Validation,
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 7 - AI Awareness (EQF 6) 8 - Cyber and Data Security (EQF 5) 9 - Generative AI (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Demonstrates an ongoing commitment to advancing skills and knowledge • Adapts machine learning models to evolving data and requirements

- Applies fundamental machine learning concepts and algorithms
- Evaluates machine learning models using established metrics and validation techniques
- Designs data pre-processing and feature engineering strategies
- Assesses the ethical implications of machine learning projects
- Develops AI models using explainable AI techniques to ensure transparency and interpretability
- Analyses existing AI models to assess and measure their explainability
- Implements strategies to improve the explainability of existing AI models
- Evaluates the impact of explainable AI on model performance
- Conveys the principles and benefits of explainable AI to stakeholders
- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI technology
- Conveys the principles and potential of generative AI to a broad audience
- Engages in continuous learning and professional development
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and example practical exercises.

Suggested materials:

- Bishop, C. M., & Nasrabadi, N. M. (2006). Pattern recognition and machine learning (Vol. 4, No. 4, p. 738). New York: sSpringer.
- Géron, A. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. " O'Reilly Media, Inc.".
- Stuart Russell, Peter Norvig (2021), Artificial Intelligence: A Modern Approach, 4th edition, Pearson

4.2. Deep Learning

Description
The "Deep Learning" learning unit is focused on introducing students to the fundamentals of neural networks, a cornerstone of modern artificial intelligence, the deep learning paradigm and related methods. This unit covers the architecture, functioning, and practical applications of different types of neural networks. Topics: 1. Introduction: Perceptrons and MLP, 2. Frameworks: TensorFlow, PyTorch, Keras, 3. Activation Functions, 4. Feedforward NN, 5. Training NN: Backpropagation and Gradient Descent, 6. Adaptive optimization techniques and fine-tuning, 7. Regularization methods, 8. Deep learning frameworks, 9. Convolutional Neural Networks (CNNs), 10. Recurrent Neural Networks (RNNs), 11. Transformer networks, 12. Applications (e.g. speech, natural language, vision, etc.).
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 7 - AI Awareness (EQF 6) 8 - Cyber and Data Security (EQF 5) 9 - Generative AI (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Identifies suitable applications for deep and shallow neural architectures • Designs deep learning models by selecting appropriate architectures • Implements deep learning models using relevant frameworks and libraries • Applies deep learning techniques to solve problems • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries

- Analyses the performance and efficiency of AI models and technologies
- Adapts existing AI models to new contexts and problems
- Demonstrates an ongoing commitment to advancing skills and knowledge
- Adapts machine learning models to evolving data and requirements
- Applies fundamental machine learning concepts and algorithms
- Evaluates machine learning models using established metrics and validation techniques
- Designs data pre-processing and feature engineering strategies
- Assesses the ethical implications of machine learning projects
- Develops AI models using explainable AI techniques to ensure transparency and interpretability
- Analyses existing AI models to assess and measure their explainability
- Implements strategies to improve the explainability of existing AI models
- Evaluates the impact of explainable AI on model performance
- Conveys the principles and benefits of explainable AI to stakeholders
- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI technology
- Identifies AI-generated content, employing analytical methods and tools
- Conveys the principles and potential of generative AI to a broad audience
- Engages in continuous learning and professional development
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and example practical exercises.

Suggested materials:

- Chollet, Francois. Deep learning with Python. Simon and Schuster, 2021. Online: https://www.manning.com/books/deep-learning-with-python-second-edition
- Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, 2016, MIT Press, online: http://www.deeplearningbook.org
- Bishop, C. M., & Bishop, H. (2023). Deep learning: Foundations and concepts. Springer Nature.

4.3. Machine Learning Operations (MLOps)

Description
The "MLOps" (Machine Learning Operations (MLOps) learning unit is designed to introduce students to the principles and practices of deploying, monitoring, and maintaining machine learning models in production environments. This unit covers the end-to-end lifecycle of machine learning projects, focusing on the operational aspects of ML systems. Topics: 1. Introduction to MLOps: ML lifecycle, challenges, and types of MLOps, 2. Data Engineering for ML: Data pipelines, feature stores, and data versioning, 3. ML Model Development: Model training, hyperparameter tuning, and experiment tracking, 4. Model Evaluation and Validation: Performance metrics, cross-validation, and model selection, 5. Model Deployment: Containerization, orchestration, and serving infrastructure, 6. Model Monitoring: Data drift, concept drift, and model performance monitoring 7. Model Maintenance: Model retraining, versioning, and continuous improvement, 8. ML Pipelines: Orchestrating end-to-end ML workflows, 9. ML Observability: Logging, tracing, and debugging ML systems, 10. CI/CD for ML: Continuous Integration and Continuous Deployment pipelines for ML 11. MLOps Tools and Platforms: Overview of popular MLOps tools and platforms (e.g., MLflow, Kubeflow, TensorFlow Extended).
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 7 - AI Awareness (EQF 6) 9 - Generative AI (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Identifies suitable applications for deep and shallow neural architectures • Selects appropriate AI frameworks and libraries for specific project needs • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Demonstrates an ongoing commitment to advancing skills and knowledge • Implements AI projects by applying foundational ML Ops principles • Utilizes project management techniques specific to ML Ops • Integrates continuous integration and continuous delivery (CI/CD) pipelines • Applies AI quality control measures throughout the machine learning project lifecycle • Adapts machine learning models to evolving data and requirements

- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Analyses the implications of AI on business processes
- Assesses the strategic considerations for integrating AI into business operations
- Engages in continuous learning and professional development
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and example practical exercises.

Suggested materials:

- Mark Treveil et al., Introducing MLOps: How to Scale Machine Learning in the Enterprise, O'Reilly, 2021
- MLOps: Continuous delivery and automation pipelines in machine learning (2023), online: *https://cloud.google.com/architecture/mlops-continuous-delivery-and-automation-pipelines-in-machine-learning*
- Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann (2020). Introducing MLOps, O'Reilly Media, Inc.

4.4. AI Applications (NLP, coding tools, CV, Speech, cybersec, etc.)

Description
This learning unit has been articulated to allow customisable delivery in specific AI application areas. The broad aim of the learning unit is to showcase how AI is transforming products and services. The narrower aim of the learning unit is to introduce students to the latest AI solutions, mainly based on deep learning models, and to give them practice in developing project-based AI solutions, developing their prompt engineer skills. Application areas within this learning unit may include • conversational AI applications, • natural language processing (NLP) aided applications and coding tools, • computer vision-based applications, • speech and audio processing, • cybersecurity, • anomaly detection.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 7 - AI Awareness (EQF 6) 8 - Cyber and Data Security (EQF 5) 9 - Generative AI (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Identifies suitable applications for deep and shallow neural architectures • Designs deep learning models by selecting appropriate architectures • Applies deep learning techniques to solve problems • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Adapts machine learning models to evolving data and requirements • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Assesses the ethical implications of machine learning projects • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes

- Assesses the strategic considerations for integrating AI into business operations
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI technology
- Analyses the landscape of cyber threats and vulnerabilities
- Implements advanced security measures
- Develops and tests robust cybersecurity policies and procedures
- Manages incident response and recovery operations
- Evaluates the effectiveness of security protocols through regular audits and updates
- Designs generative AI models to create novel content
- Identifies AI-generated content, employing analytical methods and tools
- Integrates generative AI into diverse applications
- Conveys the principles and potential of generative AI to a broad audience
- Engages in continuous learning and professional development
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and *example practical exercises, resources document.*

4.5. Generative AI

Description
The "Generative AI" learning unit focuses on creating new data instances that resemble training data or that interacts with the user. This area includes techniques that allow models to generate novel images, texts, music, and other forms of media, simulating human-like creativity. Topics: 1. Deep learning for generative AI: a. GANs and VAEs, Generative Adversarial Networks b. Variational Autoencoders c. Diffusion 2. Natural language and code generation, 3. Image and video generation, 4. Audio generation.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 7 - AI Awareness (EQF 6) 9 - Generative AI (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Identifies suitable applications for deep and shallow neural architectures • Designs deep learning models by selecting appropriate architectures • Implements deep learning models using relevant frameworks and libraries • Applies deep learning techniques to solve problems • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Demonstrates an ongoing commitment to advancing skills and knowledge • Adapts machine learning models to evolving data and requirements • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Assesses the ethical implications of machine learning projects • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market

- Analyses the implications of AI on business processes
- Assesses the strategic considerations for integrating AI into business operations
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI technology
- Designs generative AI models to create novel content
- Identifies AI-generated content, employing analytical methods and tools
- Develops prompt engineering skills
- Implements Large Language Models (LLMs) in generative AI projects
- Evaluates the performance of generative AI systems
- Assesses the ethical implications of generative AI systems
- Integrates generative AI into diverse applications
- Conveys the principles and potential of generative AI to a broad audience
- Engages in continuous learning and professional development
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and Jupyter notebooks

Suggested materials:

- David Foster: Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, O'Reilly, 2019
- Chris Fregly, Antje Barth, Shelbee Eigenbrode (2023). Generative AI on AWS: Building Context-Aware Multimodal Reasoning Applications 1st Edition, O'Reilly Media, Inc.

4.17. Explainable AI

Description
The "Explainable AI" learning unit is designed to provide students with a comprehensive understanding of the principles and methods for making AI systems explainable, interpretable and transparent. This unit emphasizes the importance of explainability in AI for trust, accountability, and regulatory compliance. Students will explore various techniques and tools used to create explainable AI models, along with their practical applications. Topics: 1. Fundamentals of Explainable AI (definitions, key concepts), 2. Interpretable machine learning models (linear and logistic regression, decision trees, etc.), 3. Post-hoc explainability techniques (feature importance, sensitivity analysis, partial dependence plot, individual conditional expectation), 4. Visualization techniques for explainability, dimension reduction, 5. Model-agnostic methods (Local Interpretable Model/agnostic Explanations, SHapley Additive exPlanations), 6. Explainability in Deep Learning, model specific techniques, 7. Tools and Frameworks (e.g. Alibi, ELI5, interpretML).
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 3 - ML Ops (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 7 - AI Awareness (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Demonstrates an ongoing commitment to advancing skills and knowledge • Adapts machine learning models to evolving data and requirements • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Assesses the ethical implications of machine learning projects • Develops AI models using explainable AI techniques to ensure transparency and interpretability

- Analyses existing AI models to assess and measure their explainability
- Implements strategies to improve the explainability of existing AI models
- Evaluates the impact of explainable AI on model performance
- Conveys the principles and benefits of explainable AI to stakeholders
- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Analyses the implications of AI on business processes
- Assesses the strategic considerations for integrating AI into business operations
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI technology
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and Jupyter notebooks

Suggested materials:

- Christoph Molnar, Interpretable Machine Learning: A Guide for Making Black Box Models Explainable, 2024, online: https://christophm.github.io/interpretable-ml-book/
- Samek, W., Montavon, G., Vedaldi, A., Hansen, L. K., & Müller, K. R. (Eds.). (2019). Explainable AI: interpreting, explaining and visualizing deep learning (Vol. 11700). Springer Nature.

4.18. AI for Business

Description
ML Engineers need to be able to articulate their technological expertise into the language and needs of business to be truly effective. This learning unit looks in detail as to possibilities for ML exploitation in business. It will offer case studies for analysis so that learners are able to identify and communicate them clearly to clients. Topics include: (1) overview of ML successes and failures in business and what the critical factors are (2) common ML use cases (3) analysis of business processes for automation possibilities (4) making a business case for ML and communicating with business clients.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 4 - Machine Learning (EQF 6) 5 - Explainable AI (EQF 6) 7 - AI Awareness (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Identifies suitable applications for deep and shallow neural architectures • Adapts existing AI models to new contexts and problems • Demonstrates an ongoing commitment to advancing skills and knowledge • Assesses the ethical implications of machine learning projects • Evaluates the impact of explainable AI on model performance • Conveys the principles and benefits of explainable AI to stakeholders • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Knowledge of current trends in AI technology • Engages in continuous learning to keep pace with rapid advancements in AI technology • Collaborates within teams, contributing positively to group efforts • Solves problems creatively and efficiently • Delivers impactful presentations • Cultivates an innovative mindset, embracing and fostering creativity • Communicates effectively across a variety of platforms and media • Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)
Lectures either online or in-person, and/or case-study based seminars
Materials
Lecture Slides, example case-studies, resources document. Selected readings from business literature, for example HBR.

4.19. AI Ethics

Description
ML Engineers need to be aware of their professional responsibilities and this unit aims to deliver this in a manner accessible to technologists. Topics include: (1) The dark side of AI: what can go wrong (1) The legal framework in the EU (AI Act, GDPR, Digital Services Act), (2) Ethical Considerations: Fairness, Explainability and Robustness, (3) AI Governance and Regulation, (4) AI Ethics in Generative AI and Machine Learning (5) Compliance in practice and the responsibilities of an ML practitioner. Though this is a short learning unit, in the context of a larger first-cycle program it may be extended by additional related material as required by professional bodies.
Related Programme Learning Outcome(s)
2 - AI Technologies (EQF 6) 4 - Machine Learning (EQF 6) 6 - AI Ethics (EQF 6) 7 - AI Awareness (EQF 6) 9 - Generative AI (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Demonstrates an ongoing commitment to advancing skills and knowledge • Assesses the ethical implications of machine learning projects • Identifies ethical considerations and challenges in AI development and deployment • Develops ethical guidelines and frameworks for AI projects • Implements strategies to mitigate ethical risks in AI applications • Assesses AI projects for ethical implications • Knowledge of industry-specific laws (national and international) • Knowledge of current trends in AI technology • Engages in continuous learning to keep pace with rapid advancements in AI technology • Assesses the ethical implications of generative AI systems • Conveys the principles and potential of generative AI to a broad audience • Engages in continuous learning and professional development • Collaborates within teams, contributing positively to group efforts • Solves problems creatively and efficiently • Delivers impactful presentations • Cultivates an innovative mindset, embracing and fostering creativity • Communicates effectively across a variety of platforms and media • Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)
Lectures either online or in-person, and/or case-study based seminars
Materials
Lecture Slides, example case-studies, resources document. Suggested Readings: • AI Ethics, Michael Coeckelbergh; The Cambridge Handbook of Artificial Intelligence, chapter 15 (Nick Bostrom, Oxford University, Eliezer Yudkowsky); • EU Artificial Intelligence Act: The Essential Reference, Lex Press

4.20. Project and Thesis Work

Description
Aspiring ML Engineers benefit from an opportunity to exercise their acquired knowledge and skills in an extended piece of work. To this end, a synoptic capstone Project and Thesis Work learning unit may be offered. This unit supports both a traditional academic project typical of first-cycle studies, as well as a work-based or industrial project. It could also be used as a concluding unit in a microcredential-based scheme that leads to a larger award. The scheme should give clear guidance as to what constitutes a suitable project in the context of the final award as well as providing support in appropriate methodological issues (eg. referencing). The focus and the regulations of the awarding institutions and overall purpose of the study programme will determine the type and shape of the project. That said, a minimum of 5 ECTS is suggested to allow for an extended piece of work to be produced.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 6) 2 - AI Technologies (EQF 6) 4 - Machine Learning (EQF 6) 6 - AI Ethics (EQF 6) 7 - AI Awareness (EQF 6) 11 - Soft Skills (EQF 6)
Unit learning outcomes
• Analyzes the fundamental principles of neural networks • Identifies suitable applications for deep and shallow neural architectures • Designs deep learning models by selecting appropriate architectures • Implements deep learning models using relevant frameworks and libraries • Applies deep learning techniques to solve problems • Selects appropriate AI frameworks and libraries for specific project needs • Develops AI models using chosen frameworks and libraries • Analyses the performance and efficiency of AI models and technologies • Adapts existing AI models to new contexts and problems • Demonstrates an ongoing commitment to advancing skills and knowledge • Applies fundamental machine learning concepts and algorithms • Evaluates machine learning models using established metrics and validation techniques • Designs data pre-processing and feature engineering strategies • Assesses the ethical implications of machine learning projects • Assesses AI projects for ethical implications • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market

- Analyses the implications of AI on business processes
- Assesses the strategic considerations for integrating AI into business operations
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI technology
- Solves problems creatively and efficiently
- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

As this is self-directed, it could be supported in a number of ways: lectures, seminars and well as consultations with a project supervisor. These could be conducted either online or face-to-face.

Materials

Generic project guideline document, presentation of scheme/guidance, resources document.

Suggested Reading: Thesis Projects: A Guide for Students in Computer Science and Information Systems, Mikael Berndtsson, Jörgen Hansson, Björn Olsson, Björn Lundell

MACHINE LEARNING ENGINEER (EQF 7)

1. General information

Name	Machine Learning Engineer
EQF level	EQF 7
Goals	The intent of the EQF 7 Machine Learning (ML) Engineer curriculum is to provide a solid base in ML techniques, develop advanced machine learning and artificial intelligence (AI) skills, and ensure the ability to build and manage ethical and secure AI systems. Its aim is to produce graduates who are ready to lead and innovate as ML Engineers, capable of tackling complex problems and contributing to advancements in technology and society, as well as being capable of applying their knowledge to real-world problems.
Scope	The curriculum is aimed at people who intend to become ML Engineer practitioners. It can also be used to upskill or reskill individuals that already have a background in computer science and want to specialize in ML. It is also intended to both articulate how to instantiate for both microcredentials as well as conventional second-cycle courses, as both options are valid for aspiring ML Engineers (for example if they possess a master's degree already). It is also agnostic as regards platforms and APIs so to allow customisation to local requirements.
Entry requirements	As expected of a bachelor's degree in computer science or a related subject, specifically: • Python programming, basic data preprocessing, basic databases • Linear Algebra • Calculus • Probability theory Resources such as the following may be used for already competent programmers who wish to familiarise themselves with Python beforehand: • https://cs231n.github.io/python-numpy-tutorial/ • https://pandas.pydata.org/pandas-docs/stable/user_guide/10min.html

Programme learning outcomes (PLOs)	1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - ML Ops (EQF 7) 4 - Machine Learning (EQF 7) 5 - Explainable AI (EQF 7) 6 - Big Data & Data Analytics (EQF 7) 7 - Human-Centered AI (EQF 7) 8 - AI Ethics (EQF 6) 9 - AI Awareness (EQF 6) 10 - Cyber and Data Security (EQF 5) 11 - Generative AI (EQF 7) 12 - Change Management (EQF 6) 13 - Soft Skills (EQF 6) 14 - HPC and Cloud services (EQF 7)

2. Description of the structure

The two learning units Machine Learning Foundations, Deep Learning comprise a base that covers the key concepts that underpin the role.

Thereafter there are two sets of extension learning units. The first set deepens and broadens ML technical knowledge and skills in important areas (Data Science, Machine Learning Operations [MLOps], Large-Scale AI Solutions, Generative AI). An AI Applications learning unit has also been articulated to allow customisable delivery in specific application areas such as cybersecurity and NLP.

Following from this, the second set of learning units are aimed at developing aspiring ML Engineers to be effective deliverers of technological solutions to clients (Human-Centred AI and User Experience, AI for Business, AI Law and Ethics, AI Transformation and Project Management).

It is worth noting that it is assumed that soft skills will be developed through the curriculum.

Though 5 ECTS is assumed as a default to support conventional second-cycle studies, a range is given. For example, a microcredential aimed at upskilling established developers might require fewer ECTS as some of the outcomes could be deemed to have been already met to some degree.

There is a capstone Project and Thesis Work learning unit. This supports both a traditional academic project typical of second-cycle studies, as well as a work-based or industrial project. It could also be used as a concluding unit in a microcredential-based scheme that leads to a larger award. A minimum of 5 ECTS is suggested to allow for an extended piece of work to be produced.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Machine Learning Foundations	2-10 ECTS	EQF 6-7	Exam and/or Practical Assignment, Project work
Deep Learning	2-10 ECTS	EQF 6-7	Exam and/or Practical Assignment, Project work
Data Science	2-10 ECTS	EQF 6-7	Exam and/or Practical Assignment, Project work
Machine Learning Operations (MLOps)	2-5 ECTS	EQF 6-7	Exam and/or Practical Assignment, Project work
Large Scale AI Solutions (cloud/HPC)	2-5 ECTS	EQF 6-7	Exam and/or Practical Assignment, Project work
AI Applications (NLP, coding tools, CV, Speech, cybersecurity, etc.)	1-5 ECTS	EQF 5-6-7	Exam and/or Practical Assignment, Project work

Generative AI	2-5 ECTS	EQF 6-7	Exam and/or Practical Assignment, Project work
Human-Centred AI and UXUser Experience	1-5 ECTS	EQF 6-7	Exercises requiring the analysis, evaluation or UX design of AI systems (can be under exam conditions if required, also scope for groupwork)
AI for Business	1-5 ECTS	EQF 6-7	Exercises based on the analysis of case studies and/or realistic scenarios (can be under exam conditions if required, also scope for groupwork)
AI Law and Ethics	1-25 ECTS	EQF 6-7	Exercises based on the analysis of case studies and/or realistic scenarios (can be under exam conditions if required, also scope for groupwork)

AI Transformation and Project Management	1-5 ECTS	EQF 6-7	Exercises based on the analysis of case studies and/or realistic scenarios (can be under exam conditions if required, also scope for groupwork)
Project and Thesis Work	5+ ECTS	EQF 6-7	Project report, presentation/demonstration.

4. Details of Learning Units

4.1. Machine Learning Foundation

Description
The "Machine Learning foundations " learning unit is designed to provide students with a comprehensive understanding of both foundational and advanced machine learning techniques. Students will learn the fundamentals and practical use of predictive models for various classification, regression, and unsupervised learning tasks. The curriculum covers a wide range of topics, from classical algorithms to reinforcement learning methods. Modules: 1. Types of machine learning (e.g., supervised, unsupervised, self-supervised, reinforcement learning, semi-supervised learning, active learning) 2. Classical algorithms: k-NN, Linear and Logistic Regression, Decision Trees, Random Forest, XGBoost, and SVM 3. Advanced ensemble methods: Stacking, Boosting (AdaBoost, Gradient Boosting), and Bagging 4. Unsupervised learning: K-means, Hierarchical Clustering, DBSCAN, GMM, and Self-Organizing Maps (SOM) 5. Dimensionality Reduction and Feature Selection: PCA, t-SNE, UMAP, LDA, ICA, and Autoencoders 6. Probabilistic Graphical Models: Bayesian Networks, Markov Random Fields, and Hidden Markov Models 7. Deep Learning and backpropagation basics 8. Reinforcement Learning: Q-Learning and Deep Q-Networks (DQN) 9. Advanced Model Evaluation, Validation, and Interpretation
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - ML Ops (EQF 7) 4 - Machine Learning (EQF 7) 5 - Explainable AI (EQF 7) 6 - AI Awareness (EQF 6) 7 - Soft Skills (EQF 6)
Unit learning outcomes
• Critically evaluates and understands the theoretical underpinnings of deep learning • Designs innovative deep learning models • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Disseminates findings and developments in AI technologies

- Designs robust ML Ops architectures
- Independently develops robust machine learning models using advanced algorithms
- Understands the mathematics of ML algorithms
- Critically evaluates the performance of machine learning models
- Optimizes machine learning algorithms and systems for improved performance
- Designs AI systems with a focus on explainability
- Critically assesses AI models for biases and ethical implications
- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Assesses the strategic considerations for integrating AI into business operations
- Knowledge of current trends in AI technology
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and example practical exercises.

Suggested materials:

- Bishop, C. M., & Nasrabadi, N. M. (2006). Pattern recognition and machine learning (Vol. 4, No. 4, p. 738). New York: Springer.
- Géron, A. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. " O'Reilly Media, Inc.".
- Stuart Russell, Peter Norvig (2021), Artificial Intelligence: A Modern Approach, 4th edition, Pearson

4.2. Deep Learning

Description
The "Deep Learning" learning unit is focused on advancing students to deep learning models, methods and applications. The learning unit also introduces the necessary hardware architecture and software tools, as well as model development and deployment methods, with practical examples. Topics: 1. CRISP-DM methodology, its application to deep learning 2. Hardware architecture (from small to large scale) 3. Deep learning frameworks (e.g. PyTorch, TensorFlow, Keras) and related software tools (e.g. SLURM, Docker, Singularity, Kubernetes, KubeFlow, MLFlow, TensorBoard) 4. General deep learning architectures (e.g. fully connected, recurrent, convolutional, transformer layers) 5. Complex architectures (e.g. residual, skip connections, highway and dense networks, sequence-to-sequence models) 6. Self-supervised learning (SSL) and its application to different domains (e.g. text, vision) 7. Hyperparameter optimization 8. Graph neural networks 9. Deep reinforcement learning 10. Uncertainty and explainability in deep learning
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - ML Ops (EQF 7) 4 - Machine Learning (EQF 7) 5 - Explainable AI (EQF 7) 6 - Big Data & Data Analytics (EQF 7) 7 - AI Awareness (EQF 6) 8 - Generative AI (EQF 7) 9 - Soft Skills (EQF 6) 10 - HPC and Cloud services (EQF 7)
Unit learning outcomes
• Critically evaluates and understands the theoretical underpinnings of deep learning • Designs innovative deep learning models • Develops advanced deep learning models using current frameworks and tools • Analyses complex datasets using deep learning models • Reflects on the ethical, legal, and social implications of deploying deep learning models • Manages the lifecycle of deep learning projects • Assesses the capabilities and limitations of different AI technologies

- Integrates AI technologies to create comprehensive systems that improve decision-making
- Implements AI solutions using best practices in software engineering and data management
- Disseminates findings and developments in AI technologies
- Designs robust ML Ops architectures
- Independently develops robust machine learning models using advanced algorithms
- Understands the mathematics of ML algorithms
- Critically evaluates the performance of machine learning models
- Optimizes machine learning algorithms and systems for improved performance
- Designs AI systems with a focus on explainability
- Implements xAI techniques for such as feature importance scores, model-agnostic methods, and visualization of AI decision paths
- Evaluates the effectiveness of explainable AI models
- Researches and applies the latest advancements in explainable AI
- Critically assesses AI models for biases and ethical implications
- Develops and applies sophisticated data analytics algorithms and models to big data sets
- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Assesses the strategic considerations for integrating AI into business operations
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI
- Design and implement advanced generative AI models
- Optimize generative models for efficiency and scalability
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Thinks critically, analysing situations, evaluating diverse perspectives
- Deploys complex applications on HPC and/or cloud platforms

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and example practical exercises.

Suggested materials:

- Chollet, Francois. Deep learning with Python. Simon and Schuster, 2021. Online: https://www.manning.com/books/deep-learning-with-python-second-edition
- Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, 2016, MIT Press, online: http://www.deeplearningbook.org
- Bishop, C. M., & Bishop, H. (2023). Deep learning: Foundations and concepts. Springer Nature.

4.3. Data Science

Description
The "Data Science" learning unit is designed to introduce students to the fundamental concepts, techniques, and tools used in data science. This unit covers the process of extracting insights and knowledge from structured and unstructured data, with a focus on statistical analysis, data visualization, and data-driven decision-making. Topics: 1. Introduction to Data Science: data science lifecycle, types of data, and the role of data science in organizations 2. Data Collection and Acquisition: data sources, web scraping, APIs, and survey design 3. Exploratory Data Analysis (EDA): uni-, bi-, and multivariate analysis, statistical summaries, and data visualization 4. Data Preprocessing: data cleaning, transformation, integration, and handling missing data 5. Feature Engineering: feature selection, extraction, and transformation techniques 6. Data Visualization: principles of effective data visualization, tools (e.g., Matplotlib, Seaborn, Plotly), 7. Statistical Inference: probability distributions, hypothesis testing, confidence intervals, and sampling techniques, 8. Machine and deep learning for data science, 9. Big Data Technologies: introduction to big data concepts, distributed computing, and software tools,
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - Machine Learning (EQF 7) 4 - Explainable AI (EQF 7) 6 - Big Data & Data Analytics (EQF 7) 7 - AI Awareness (EQF 6) 8 - Soft Skills (EQF 6)
Unit learning outcomes
• Critically evaluates and understands the theoretical underpinnings of deep learning • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Disseminates findings and developments in AI technologies • Independently develops robust machine learning models using advanced algorithms • Understands the mathematics of ML algorithms • Critically evaluates the performance of machine learning models • Designs AI systems with a focus on explainability • Implements xAI techniques for such as feature importance scores, model-agnostic methods, and visualization of AI decision paths

- Designs and implements robust big data infrastructures
- Develops and applies sophisticated data analytics algorithms and models to big data sets
- Manages the entire lifecycle of data analytics projects
- Evaluates the performance of big data systems and analytics approaches
- Advocates, advises and implements for responsible data usage
- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Analyses the implications of AI on business processes
- Assesses the strategic considerations for integrating AI into business operations
- Knowledge of current trends in AI technology
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and example practical exercises.

Suggested materials:

- *Joel Grus (2019). Data Science from Scratch: First Principles with Python. O'Reilly Media*
- *Wes McKinney (2023). Python for Data Analysis, 3rd Edition, online: https://wesmckinney.com/book/*

4.4. Machine Learning Operations (MLOps)

Description

The "MLOps" (Machine Learning Operations (MLOps) learning unit is designed to introduce students to the principles and practices of deploying, monitoring, and maintaining machine learning models in small-, medium- and large-scale production environments for students with prior experience in machine learning and software engineering. This unit covers the end-to-end lifecycle of machine learning projects, focusing on the operational aspects of ML systems. ModulesTopics:

1. Introduction to MLOps: ML lifecycle, challenges, and types of MLOps,
2. Scalable Data Engineering for ML: Data pipelines, feature stores, and data versioning, distributed feature engineering, real-time pipelines,
3. ML Model Development: automated model training and, hyperparameter tuning, and experiment tracking,
4. Model Evaluation and Validation: Performance metrics, cross-validation, and model selection, advanced testing techniques (e.g. A/B, metamorphic, property-based testing)
5. Model Deployment: Containerization, orchestration, and serving infrastructure,
6. Model Monitoring: Data drift, concept drift, and model performance monitoring
7. Model Maintenance: Model retraining, versioning, and continuous improvement,
8. ML Pipelines: Orchestrating end-to-end ML workflows,
9. ML Observability: Logging, tracing, and debugging ML systems,
10. CI/CD for ML: Continuous Integration and Continuous Deployment pipelines for ML
11. MLOps Governance and Best Practices: ML project management, team collaboration, and best practices for maintaining and evolving ML systems
12. MLOps Tools and Platforms: Overview of popular MLOps tools and platforms (e.g., MLflow, Kubeflow, TensorFlow Extended).

Related Programme Learning Outcome(s)

1 - Deep Learning (EQF 7)

2 - AI Technologies (EQF 7)

3 - ML Ops (EQF 7)

4 - Machine Learning (EQF 7)

5 - Big Data & Data Analytics (EQF 7)

6 - AI Awareness (EQF 6)

7 - Soft Skills (EQF 6)

Unit learning outcomes

- Critically evaluates and understands the theoretical underpinnings of deep learning
- Assesses the capabilities and limitations of different AI technologies
- Integrates AI technologies to create comprehensive systems that improve decision-making
- Implements AI solutions using best practices in software engineering and data management
- Designs robust ML Ops architectures
- Implements continuous integration and continuous delivery (CI/CD) pipelines

- Optimizes machine learning pipelines for performance and efficiency
- Evaluates the effectiveness and efficiency of ML Ops systems
- Understands the mathematics of ML algorithms
- Manages the entire lifecycle of data analytics projects
- Evaluates the performance of big data systems and analytics approaches
- Advocates and implements for responsible data usage
- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Analyses the implications of AI on business processes
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and example practical exercises.

Suggested materials:

- Mark Treveil et al., Introducing MLOps: How to Scale Machine Learning in the Enterprise, O'Reilly, 2021
- MLOps: Continuous delivery and automation pipelines in machine learning (2023), online: https://cloud.google.com/architecture/mlops-continuous-delivery-and-automation-pipelines-in-machine-learning
- Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann (2020). Introducing MLOps, O'Reilly Media, Inc.

4.5. Large Scale AI Solutions (cloud/HPC)

Description
The "Large Scale AI Solutions (cloud/HPC)" learning unit is designed to introduce students to develop, deploy, and manage large-scale AI solutions using cloud computing and High-Performance Computing (HPC) technologies and infrastructure. This unit covers the principles, architectures, and best practices for building scalable and efficient AI systems. Topics: 1. Introduction to Large Scale AI: Challenges, opportunities, and use cases, 2. Cloud Computing for AI: Cloud service models, providers, and AI platforms, 3. HPC for AI: HPC architectures, parallel computing, and accelerators (e.g., GPUs, TPUs), the EuroHPC framework. 4. Scalable Data Processing: Big data platforms, data lakes, and distributed data processing frameworks (e.g., Apache Spark, Dask), 5. Distributed Machine Learning: Data parallelism, model parallelism, and distributed training frameworks, 6. AI Workload Management: Resource allocation, scheduling, and orchestration in cloud and HPC environments, 7. Serverless computing, function-as-a-service (FaaS), 8. AI Infrastructure Optimization: Performance tuning, cost optimization, and efficiency best practices, 9. Scalable Model Serving: Model serving architectures, inference optimization, and scalable serving frameworks (e.g., TensorFlow Serving, NVIDIA Triton).
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - Machine Learning (EQF 7) 4 - Soft Skills (EQF 6) 5 - HPC and Cloud services (EQF 7)
Unit learning outcomes
• Critically evaluates and understands the theoretical underpinnings of deep learning • Designs innovative deep learning models • Develops advanced deep learning models using current frameworks and tools • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Disseminates findings and developments in AI technologies • Independently develops robust machine learning models using advanced algorithms • Collaborates within teams, contributing positively to group efforts • Solves problems creatively and efficiently • Delivers impactful presentations • Cultivates an innovative mindset, embracing and fostering creativity

- Thinks critically, analysing situations, evaluating diverse perspectives
- Architects scalable and/or secure HPC and cloud infrastructures
- Conduct detailed performance monitoring and tuning
- Deploys complex applications on HPC and/or cloud platforms
- Manages HPC and/or cloud environments
- Analyses the performance of HPC and/or cloud-based AI solutions systems
- Innovates with emerging technologies in HPC and/or cloud computing
- Evaluates new HPC and/or cloud technologies and services for potential adoption

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and Jupyter notebooks

Suggested materials:

- Robey, R., & Zamora, Y. (2021). Parallel and high performance computing. Simon and Schuster.
- Ted Hunter, Steven Porter, Legorie Rajan PS (2019). Build cost-effective and robust cloud solutions with Google Cloud Platform (GCP) using these simple and practical recipes, Packt Publishing Ltd,
- John Culkin, Mike Zazon (2022). AWS Cookbook: Recipes for Success on AWS 1st Edition. O'Reilly Media, Inc.

4.6. AI Applications (NLP, coding tools, CV, Speech, cybersecurity, etc.)

Description

This learning unit has been articulated to allow customisable delivery in specific AI application areas and upskill to current state-of-the-art. The broad aim of the learning unit is to showcase engender a deep appreciation of how AI is transforming products and services. The narrower aim of the learning unit is to introduce immerse students to in the latest AI solutions, mainly based on advanced deep learning models, and to give them practice in developing project-based AI solutions. Application areas within this learning unit may include

- conversational AI applications,
- natural language processing (NLP) aided applications and coding tools,
- computer vision-based applications,
- speech and audio processing,
- cybersecurity,
- anomaly detection.

Related Programme Learning Outcome(s)

1 - Deep Learning (EQF 7)

2 - AI Technologies (EQF 7)

3 - Machine Learning (EQF 7)

4 - Human-Centered AI (EQF 7)

5 - AI Awareness (EQF 6)

6 - Cyber and Data Security (EQF 5)

7 - Generative AI (EQF 7)

8 - Soft Skills (EQF 6)

Unit learning outcomes

- Critically evaluates and understands the theoretical underpinnings of deep learning
- Designs innovative deep learning models
- Manages the lifecycle of deep learning projects
- Assesses the capabilities and limitations of different AI technologies
- Integrates AI technologies to create comprehensive systems that improve decision-making
- Implements AI solutions using best practices in software engineering and data management
- Disseminates findings and developments in AI technologies
- Understands the mathematics of ML algorithms
- Evaluates AI systems from a human-centered perspective
- Critically assesses societal impacts of AI
- Understands the basic concepts and technologies underlying artificial intelligence
- Identifies key AI applications in the programming application market
- Analyses the implications of AI on business processes
- Assesses the strategic considerations for integrating AI into business operations

- Collaborates with technical and non-technical teams to explore AI opportunities
- Knowledge of current trends in AI technology
- Engages in continuous learning to keep pace with rapid advancements in AI
- Analyses the landscape of cyber threats and vulnerabilities
- Implements advanced security measures, such as encryption, firewalls, and intrusion detection systems
- Develops and tests robust cybersecurity policies and procedures
- Manages incident response and recovery operations
- Evaluates the effectiveness of security protocols through regular audits and updates
- Design and implement advanced generative AI models
- Apply generative AI in novel applications
- Stay abreast of technological advancements in the field of generative AI
- Advocate for responsible use of generative AI technologies
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Lecture Slides, example practical exercises, resources document.

4.7. Generative AI

Description
The "Generative AI" learning unit focuses on creating new data instances that resemble training data or that interacts with the user. This area includes techniques that allow models to generate novel images, texts, music, and other forms of media, simulating human-like creativity. the principles, techniques, and applications of generative artificial intelligence models. This unit covers the fundamentals of generative models, their architectures, and their use cases in various domains. Modules: 1. Introduction to Generative AI 2. Autoregressive Models: Autoregressive model architectures, training, and generation processes (e.g., PixelRNN, WaveNet), 3. Autoencoders (AEs) and Variational Autoencoders (VAEs), latent space representation, 4. Generative Adversarial Networks (GANs): Generator-discriminator architecture, adversarial training, and GAN variants (e.g., DCGAN, CycleGAN, StyleGAN), 5. Diffusion Models: Denoising diffusion probabilistic models, reverse diffusion process, 6. Transformer-based Generative Models: Attention mechanism, self-attention, and transformer architectures for generative tasks (e.g., GPT, BERT), 7. Evaluation Metrics for Generative Models: Inception Score, Fréchet Inception Distance (FID), and Kernel Inception Distance (KID), 8. Applications of Generative AI: Image and video synthesis, text, speech, music generation, and data augmentation. 9. Deep learning for generative AI: a. Generative Adversarial Networks b. Variational Autoencoders c. Diffusion 10. Natural language and code generation 11. Image and vdeo generation 12. Audio generation.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - Human-Centered AI (EQF 7) 4 - Generative AI (EQF 7) 5 - Soft Skills (EQF 6)
Unit learning outcomes
• Critically evaluates and understands the theoretical underpinnings of deep learning • Designs innovative deep learning models • Manages the lifecycle of deep learning projects • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management

- Disseminates findings and developments in AI technologies
- Designs AI solutions that incorporate human-centered design principles
- Implements interactive AI systems that facilitate effective human-AI collaboration
- Evaluates AI systems from a human-centered perspective
- Design and implement advanced generative AI models
- Evaluate the effectiveness and safety of generative AI models
- Optimize generative models for efficiency and scalability
- Knowledge in fine tuning and customizing generative models and use of transfer learning
- Apply generative AI in novel applications
- Stay abreast of technological advancements in the field of generative AI
- Advocate for responsible use of generative AI technologies
- Collaborates within teams, contributing positively to group efforts
- Solves problems creatively and efficiently
- Delivers impactful presentations
- Cultivates an innovative mindset, embracing and fostering creativity
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

In-class / Blended learning

Materials

Learning materials: presentation slides and Jupyter notebooks

Suggested materials:

- David Foster (2019). Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, O'Reilly Media, Inc.
- Chris Fregly, Antje Barth, Shelbee Eigenbrode (2023). Generative AI on AWS: Building Context-Aware Multimodal Reasoning Applications 1st Edition, O'Reilly Media, Inc.

4.8. Human-Centred AI and User Experience

Description
This learning unit focuses on the integration of human-centred principles into the design, development, and deployment of artificial intelligence systems. This unit explores how AI can be developed to be more supportive of human needs. Skills developed will be around designing and evaluating AI systems that are not only technically proficient but also aligned with human goals. Topics include: (1) Introduction to Human-Centred AI, (2) Design for User Experience: Inclusivity and accessibility (3) Evaluation of AI systems for UX and human-centredness.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - Human-Centered AI (EQF 7) 4 - AI Awareness (EQF 6) 5 - Soft Skills (EQF 6)
Unit learning outcomes
• Critically evaluates and understands the theoretical underpinnings of deep learning • Designs innovative deep learning models • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Disseminates findings and developments in AI technologies • Designs AI solutions that incorporate human-centered design principles • Implements interactive AI systems that facilitate effective human-AI collaboration • Evaluates AI systems from a human-centered perspective • Innovates by applying the latest research in psychology, cognitive science, and user experience design to AI development • Critically assesses societal impacts of AI • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Collaborates with technical and non-technical teams to explore AI opportunities • Knowledge of current trends in AI technology • Engages in continuous learning to keep pace with rapid advancements in AI • Collaborates within teams, contributing positively to group efforts • Solves problems creatively and efficiently • Delivers impactful presentations • Cultivates an innovative mindset, embracing and fostering creativity

- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

Lectures either online or in-person, and/or case-study based seminars

Materials

Lecture Slides, example case-studies, resources document.

Suggested Reading:

- *Human-Centered AI, Ben Shneiderman*
- *Converging Minds: The Creative Potential of Collaborative AI, Aleksandra Przegalinska, Tamilla Triantoro*

4.9. AI for Business

Description
ML Engineers need to be able to articulate their technological expertise into the language and needs of business to be truly effective. This learning unit looks in detail as to possibilities for ML exploitation in business. It will offer case studies for analysis so that learners are able to identify and communicate them clearly to clients. Topics include: (1) overview of ML successes and failures in business and what the critical factors are (2) common ML use cases (3) analysis of business processes for automation possibilities (4) making a business case for ML and communicating with business clients.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 7) 2 - Machine Learning (EQF 7) 3 - Explainable AI (EQF 7) 4 - AI Awareness (EQF 6) 5 - Change Management (EQF 6) 6 - Soft Skills (EQF 6)
Unit learning outcomes
• Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Disseminates findings and developments in AI technologies • Critically evaluates the performance of machine learning models • Designs AI systems with a focus on explainability • Critically assesses AI models for biases and ethical implications • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Collaborates with technical and non-technical teams to explore AI opportunities • Knowledge of current trends in AI technology • Understands the principles and theories of change management • Assesses organizational readiness for change • Collaborates within teams, contributing positively to group efforts • Leads (interdisciplinary) teams and projects • Solves problems creatively and efficiently • Delivers impactful presentations • Cultivates an innovative mindset, embracing and fostering creativity • Communicates effectively across a variety of platforms and media

- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)
Lectures either online or in-person, and/or case-study based seminars
Materials
Lecture Slides, example case-studies, resources document. *Selected readings from business literature, for example HBR.*

4.10. AI Law and Ethics

Description
ML Engineers need to be aware of their legal and professional responsibilities and this unit aims to deliver this in a manner accessible to technologists. Topics include: (1) The dark side of AI: what can go wrong (1) The legal framework in the EU (AI Act, GDPR, Digital Services Act), (2) Ethical Considerations: Fairness, Explainability and Robustness, (3) AI Governance and Regulation, (4) AI Ethics in Generative AI and Machine Learning (5) Compliance in practice and the responsibilities of an ML practitioner. Though this is a short learning unit, in the context of a larger second-cycle program it may be extended by additional related material as required by professional bodies.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 7) 2 - AI Ethics (EQF 6) 3 - AI Awareness (EQF 6) 4 - Soft Skills (EQF 6)
Unit learning outcomes
• Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Identifies ethical considerations and challenges in AI development and deployment • Develops ethical guidelines and frameworks for AI projects • Implements strategies to mitigate ethical risks in AI applications • Assesses AI projects for ethical implications • Knowledge of industry-specific laws (national and international) • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Knowledge of current trends in AI technology • Collaborates within teams, contributing positively to group efforts • Communicates effectively across a variety of platforms and media • Thinks critically, analysing situations, evaluating diverse perspectives
Delivery method(s)
Lectures either online or in-person, and/or case-study based seminars
Materials
Lecture Slides, example case-studies, resources document.

Suggested Readings:

- *AI Ethics, Michael Coeckelbergh; The Cambridge Handbook of Artificial Intelligence, chapter 15 (Nick Bostrom, Oxford University, Eliezer Yudkowsky)*
- *EU Artificial Intelligence Act: The Essential Reference, Lex Press.*

4.11. AI Transformation and Project Management

Description
In practice, ML projects are often also business change projects. This learning unit sets out how ML Engineers can interface with other stakeholders to ensure that their technical interventions are properly executed and achieve the desired impact on the organisation. It will examine and evaluate what methods and tools are available to ML practitioners, as well as what kinds of interventions work in practice and how the odds can be stacked in favour of success.
Related Programme Learning Outcome(s)
1 - AI Technologies (EQF 7) 2 - Machine Learning (EQF 7) 3 - Explainable AI (EQF 7) 4 - AI Awareness (EQF 6) 5 - Change Management (EQF 6) 6 - Soft Skills (EQF 6)
Unit learning outcomes
• Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Disseminates findings and developments in AI technologies • Critically evaluates the performance of machine learning models • Designs AI systems with a focus on explainability • Critically assesses AI models for biases and ethical implications • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Understands the principles and theories of change management • Assesses organizational readiness for change • Designs change management strategies • Communicates change effectively, using clear, persuasive messaging • Engages stakeholders throughout the change process • Implements change management plans • Manages resistance to change • Evaluates the effectiveness of change management efforts • Cultivates resilience and adaptability in teams • Collaborates within teams, contributing positively to group efforts • Communicates effectively across a variety of platforms and media • Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)
Lectures either online or in-person, and/or case-study based seminars
Materials
Lecture Slides, example case-studies, resources document. *Suggested Reading: Artificial Intelligence and Business Transformation, Alba Yela Aránega, Domingo Ribeiro-Soriano, María Teresa Del Val Núñez (Eds).*

4.12. Project and Thesis Work

Description
Aspiring ML Engineers benefit from an opportunity to exercise their acquired knowledge and skills in an extended piece of work. To this end, a synoptic capstone Project and Thesis Work learning unit may be offered. This unit supports both a traditional academic project typical of second-cycle studies, as well as a work-based or industrial project. It could also be used as a concluding unit in a microcredential-based scheme that leads to a larger award. The scheme should give clear guidance as to what constitutes a suitable project in the context of the final award as well as providing support in appropriate methodological issues (eg. referencing). The focus and the regulations of the awarding institutions and overall purpose of the study programme will determine the type and shape of the project. That said, a minimum of 5 ECTS is suggested to allow for an extended piece of work to be produced.
Related Programme Learning Outcome(s)
1 - Deep Learning (EQF 7) 2 - AI Technologies (EQF 7) 3 - Machine Learning (EQF 7) 4 - AI Awareness (EQF 6) 5 - Soft Skills (EQF 6)
Unit learning outcomes
• Critically evaluates and understands the theoretical underpinnings of deep learning • Designs innovative deep learning models • Assesses the capabilities and limitations of different AI technologies • Integrates AI technologies to create comprehensive systems that improve decision-making • Implements AI solutions using best practices in software engineering and data management • Disseminates findings and developments in AI technologies • Independently develops robust machine learning models using advanced algorithms • Understands the mathematics of ML algorithms • Critically evaluates the performance of machine learning models • Optimizes machine learning algorithms and systems for improved performance • Understands the basic concepts and technologies underlying artificial intelligence • Identifies key AI applications in the programming application market • Analyses the implications of AI on business processes • Assesses the strategic considerations for integrating AI into business operations • Knowledge of current trends in AI technology • Engages in continuous learning to keep pace with rapid advancements in AI • Solves problems creatively and efficiently • Delivers impactful presentations

- Cultivates an innovative mindset, embracing and fostering creativity
- Communicates effectively across a variety of platforms and media
- Thinks critically, analysing situations, evaluating diverse perspectives

Delivery method(s)

As this is self-directed, it could be supported in a number of ways: lectures, seminars and well as consultations with a project supervisor. These could be conducted either online or face-to-face.

Materials

Generic project guideline document, presentation of scheme/guidance, resources document.

Suggested Reading: Thesis Projects: A Guide for Students in Computer Science and Information Systems, Mikael Berndtsson, Jörgen Hansson, Björn Olsson, Björn Lundell

AI Managers

DECISION MAKERS EQF 7

1. General information

Name	Decision Makers
EQF level	EQF 7
Goals	The curriculum aims to provide participants with insights into the regulatory landscape, strategic planning, and hands-on experience with AI technologies, thereby supporting informed decision-making and driving innovation in their organisations. **Goals1-** Understand the various risks associated with implementing AI solutions within organisations. **Goals 2-** Develop the ability to critically analyze and discuss risk assessments related to AI applications. **Goals 3-** Understand the strategic role of AI in supporting business objectives. **Goal 4-** Gain knowledge of authoritative publications and regulations governing AI. **Goal 5-** Provide practical skills in implementing AI solutions within a business context.
Scope	The curriculum has been designed for mid-career professionals with the objective of providing learners with a comprehensive education on the integration of AI within organisational contexts. The primary target group for this curriculum are professionals who are involved in or responsible for decision-making, strategic planning, or innovation within their organisations. This includes, but is not limited to: • Business Executives • Managers • Legal and Compliance Officers
Entry requirements	*None*

Programme learning outcomes (PLOs)	2 - Organisational decision-making on AI (EQF 7)

2. Description of the structure

The curriculum presents 3 Learning Units:

1-The Risks of AI

2- Developing an Organizational AI Strategy

3- Implementing AI Solutions in Business

Each learning unit will be delivered over a period of 8 hours, totaling 24 hours for the entire curriculum. The curriculum will be delivered through a blend of lectures, interactive discussions, practical workshops, and case studies.

Participants will engage in both individual and group activities to reinforce learning outcomes.

The programme objective is to provide mid-career professionals with a comprehensive understanding of the potential and risks associated with AI, the strategic implementation of AI within organisations, and the practical skills required to develop and deploy AI solutions effectively.

Participants will gain insights into the regulatory landscape, strategic planning, and hands-on experience with AI technologies, which will support informed decision-making and drive innovation in their organisations.

The assessments will encompass a range of methodologies, including participation, case study analyses, group activities, workshop outputs, and final evaluations. This approach will ensure a comprehensive understanding and practical application of the topics covered.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
1- The opportunities of AI	8 hours	EQF 7	Participation (20%) Discussion and project/plan Presentation (80%)
2- The risks of AI	8 hours	EQF 7	Participation (20%) Discussion and project/plan Presentation (80%)

3- Developing an organizational AI strategy	8 hours	EQF 7	Participation (20%) Discussion and project/plan Presentation (80%)

4. Details of Learning Units

4.1. 1- The opportunities of AI

Description
This structured, short-duration unit aims to provide decision-makers with a comprehensive understanding of AI's potential within their organizations, enabling them to critically assess AI proposals and strategically integrate AI solutions. Through this unit, learners will gain the ability to make informed decisions about integrating AI technologies into business operations, ensuring that they can effectively navigate the complexities and opportunities AI presents.
Related Programme Learning Outcome(s)
2 - Organisational decision-making on AI (EQF 7)
Unit learning outcomes
• Indicates the potential impact of implementing an AI solution in terms of organisation (e.g., structure, processes, governance), technology (e.g., infrastructure, data), and people (e.g., know-how, roles, functions) • Critically discusses and evaluates proposals (plans, recommendations, etc.) on the application of AI in a specific business.
Delivery method(s)
Combination of lectures, case studies, interactive discussions, and practical activities
Materials
Materials developed from Textbook, case studies and articles like: • Industry reports from *McKinsey & Company* available under Creative Commons licenses • Articles from *AI Magazine* and *The Journal of Artificial Intelligence Research* with Creative Commons licenses • Open Access books such as *"Introduction to Artificial Intelligence"* by Wolfgang Ertel (available under Creative Commons license)

4.2. 2- The risks of AI

Description of [learning unit title]
This unit aims to equip mid-career decision-makers with the skills to identify, assess, and manage risks associated with implementing AI solutions within their organizations. Participants will learn to interpret risk analyses, evaluate AI implementation proposals critically, and develop strategies to mitigate potential risks. By the end of this unit, learners will be proficient in making informed decisions regarding AI adoption while considering potential risks and their impact on the organization.
Related Programme Learning Outcome(s)
2 - Organisational decision-making on AI (EQF 7)
Unit learning outcomes
• Interprets a risk analysis of implementing an AI solution. • Critically discusses and evaluates proposals (plans, recommendations, etc.) on the application of AI in a specific business.
Delivery method(s)
Combination of lectures, case studies, interactive discussions, and practical activities
Materials
Materials developed from Textbook, case studies, online courses like: • *The Malicious Use of Artificial Intelligence: Forecasting, Prevention, and Mitigation"* (arXiv, Creative Commons licensed) *"Ethics of Artificial Intelligence and Robotics"* by Vincent C. Müller (available on PhilPapers, Creative Commons licensed) • Coursera: *AI for Everyone* by Andrew Ng (auditable for free) • edX: *Artificial Intelligence: Implications for Business Strategy* by MIT (auditable for free)

4.3. 3- Developing an organizational AI strategy

Description of [learning unit title]
This 8-hour learning unit aims to equip mid-career professionals with the knowledge and skills necessary to develop and implement a comprehensive AI strategy within their organizations. Participants will gain a deep understanding of authoritative AI publications, relevant laws and regulations, and the strategic application of AI to support corporate objectives. Through case studies and practical exercises, learners will explore best practices and critically evaluate AI proposals, ensuring a well-governed and transparent AI adoption process.
Related Programme Learning Outcome(s)
2 - Organisational decision-making on AI (EQF 7)
Unit learning outcomes
• Lists the main authoritative EU and global publications and sources on AI, such as those of the European Council and the European Commission, the OECD and UNESCO • Distinguishes current and emerging laws and regulations related to AI, such as the EU AI Act, data protection laws, sectoral regulatory frameworks, intellectual property (IP) laws, anti-trust/competition laws, consumer protection laws, cyber and information security laws. • Describes the relation between AI and business strategy and the way AI can support corporate objectives (AI vision), e.g., by explaining how AI can be used to create value and be a source of competitive advantage to a business. • Discusses main building blocks and best practices (case studies) of AI and data strategies in a range of businesses and industries. • Critically discusses and evaluates proposals (plans, recommendations, etc.) on the application of AI in a specific business. • Recognises the importance of a well-governed, transparent, and structured AI adoption and implementation process.
Delivery method(s)
Lectures, case studies, interactive discussions, and practical workshops
Materials
Materials will be developep starting from Articles, reports , case studies • *"AI Policy and Governance: A Global Perspective"* by the OECD (available on the OECD iLibrary, Creative Commons licensed) • *"The EU AI Act: A Comprehensive Overview"* by the European Commission • GDPR guidelines • *"AI in Business: Case Studies"* available from OER Commons or MERLOT

AI ADVISOR-CONSULTANT EQF 6/7

1. General information

Name	AI Advisor-Consultant
EQF level	EQF 6/7
Goals	The programme aims to provide learners with a deeper understanding of what is involved in developing and implementing an AI strategy in an organisation. The participant will get tools to be able to advise organisations on this.
Scope	It is intended for professionals already working in or are very familiar with the ICT field, who want to gain insight about what the development and implementation of an AI strategy in organisations entails, so that they can advise on this within their own organisation or advise others. These professionals have an undergraduate (Bachelors) degree and/or at least five years of working experience as a business or IT consultant.
Entry requirements	The minimum entry requirement is a Bachelors degree, preferably in a field related to IT and/or management/ business. Additionally, it is also strongly recommended to have at least five years of working experience as a business or IT consultant. Generally, participants need to be familiar with organisation processes, business practices, management fields and IT related terminology and work practices. Specifically, in relation to digital transformation, risk management and management of change. All participants must have competence in spoken and written English (level B2).
Programme learning outcomes (PLOs)	1 - AI fundamentals (EQF 6) 2 - AI Strategy (EQF 7) 3 - AI implementation (EQF 7) 4 - AI Ethics advanced (EQF 7) 5 - Impact of AI (EQF 7)

2. Description of the structure

The programme is composed of four compact learning units and gradually moves from a general overview of the AI landscape to the more specific implementation issues in a business context.

Firstly, the learner will gain a general understanding of AI; next the impact AI has on the way companies and customers interact and do business is addressed; as well as ethical considerations and governance; and finally, learners will explore the ways that AI can be leveraged.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
AI Fundamentals [for Decision and Policymakers]	25 h / 1 ECTS	EQF 6	Quizzes
Understanding the AI Landscape	3 ECTS	EQF 6/7	Exam
Enhancing work with AI	3 ECTS	EQF 7	Exam
AI Guardrails & Governance	1 ECTS	EQF 6/7	Practical assignment
AI Strategy, Transformation & Implementation	6 ECTS	EQF 6/7	Practical assignment

4. Details of Learning Units

4.1. AI Fundamentals for Decision and Policymakers

Description of [learning unit title]
The learning unit AI Fundamentals for Decision and Policymakers covers common technical terms and concepts, including supervised and unsupervised machine learning, generative models, and the distinction between narrow and broad AI. Trainees learn about data representation, data clustering, dimensionality reduction, classification, evaluation of machine learning models, and intuitively understand a transition to more complex machine learning models such as deep neural networks. The utility of deep neural networks is illustrated on the analysis of images and text. No prior knowledge of statistics or computer science is required to take this course.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6)
Unit learning outcomes
• Explains common technical terms and concepts (supervised and unsupervised machine learning, generative models, narrow and broad AI). • Explains methods for evaluating the performance and impact of AI models. • Explains generative AI. • Explains the need for development and use of foundation models.
Delivery method(s)
• On-site lectures with practical demonstrations of methods, tools, and cases • Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges • On-line discussion and quizzes • On-line forum, discussions and assistance on Discord channel
Materials
• Lecture notes with practical examples, cases, and demonstrations with the data mining tool Orange, delivered electronically to in-class participants • Quizzes and interactive lecture notes in a mini-MOOC environment • A set of short educational videos • Rescha S (2024): Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters) • Kneusel RT (2023): How AI Works, No Starch Press (optional reading, selected chapters)

4.2. Understanding the AI Landscape

Description of Understanding the AI Landscape
In this course, the learner will explore the full definition of AI; how it works, and when it can be used, focusing on informative use cases; identify the types of data, as well as the tools and technologies AI uses to operate.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - AI Strategy (EQF 7)
Unit learning outcomes
• Explains common technical terms and concepts (supervised and unsupervised machine learning, generative models, narrow and broad AI). • Explains generative AI. • Describes general concerns, opportunities, risks, and pitfalls commonly associated with AI. • Highlights the importance of data quality and data governance in AI projects. • Identifies and prioritizes AI use cases/ scenarios to determine when and what AI solutions are best applicable in a specific situation.
Delivery method(s)
Online lectures, videos
Materials
Course materials Workbook

4.3. Enhancing work with AI

Description of [learning unit title]
AI's capabilities are transforming the way companies and customers interact and do business. This course explores the challenges and opportunities that this new technology brings.
Related Programme Learning Outcome(s)
2 - AI Strategy (EQF 7)
Unit learning outcomes
• Explains how AI can be used to create value and be a source of competitive advantage to a business by using structured methods and analysis techniques.
Delivery method(s)
Online lectures, videos
Materials
Course materials Workbook

4.4. AI Guardrails & Governance

Description of [learning unit title]
In this course, the learner will gain a foundational understanding of ethical guardrails and governance as these apply to the application and use of generative AI technologies in an everyday business context
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 4 - AI Ethics advanced (EQF 7) 5 - Impact of AI (EQF 7)
Unit learning outcomes
• Describes general concerns, opportunities, risks, and pitfalls commonly associated with AI. • Explains ethical issues such as fairness, bias, transparency, and accountability raised by AI. • Highlights the importance of data quality and data governance in AI projects. • Provides guidelines for ethical leadership and decision-making in AI. • Identifies and describes the concepts of bias, trust, fairness, transparency, equality, accountability, and empowerment in the context of artificial intelligence. • Analyses and assesses algorithmic rules against ethical criteria and policy. • Applies technical and non-technical methods to monitor and evaluate the development, deployment and use of the AI system and its learning processes. • Explains the abilities of AI-based technology and its possible applications to be misused in general, such as privacy violations, algorithmic bias, socio-economic inequalities, misinformation and deep fake technologies, lack of transparency and explainability and social surveillance.
Delivery method(s)
Online lectures, videos
Materials
Course materials Workbook

4.5. AI Strategy, Transformation & Implementation

Description of [learning unit title]
This course addresses strategies to effectively lead organizations through the transformational impact of AI. It explores how AI can be leveraged, how to plan an AI implementation and the issues surrounding it.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - AI Strategy (EQF 7) 3 - AI implementation (EQF 7)
Unit learning outcomes
• Encourages collaboration between technical and non-technical teams. • Guides the process of identifying customer needs. • Proposes and evaluates creative ideas on the application of AI technologies, by applying idea generation and evaluation techniques. • Identifies and prioritizes AI use cases/ scenarios to determine when and what AI solutions are best applicable in a specific situation. • Formulates an AI strategy (or a digital strategy that incorporates AI) in a in a coherent, clear, convincing, well-argued manner, aligned with the organisation strategy, compliant with relevant laws and regulations and while considering opportunities, risks, and ethical considerations. • Performs a risk analysis with identification and assessment of risks of possible AI solutions, considering corporate and societal values and interests. • Explains methods and techniques to manage change and reach consensus and commitment. • Determines enabling factors for implementing an AI solution in terms of organisation (e.g., structure, processes, governance), technology (e.g., infrastructure, data), and people (e.g., know-how, roles, functions) • Explains the dependence upon data and how to acquire, prepare, manage, and provide and scale data for AI applications.
Delivery method(s)
Online lectures, videos
Materials
Course materials Workbook

ORGANIZATION DECISION MAKERS (EQF 6/7)

1. General information

Name	Decision Makers
EQF level	EQF 6-7
Goals	Equip organizational decision-makers with necessary knowledge of key AI concepts, including machine learning, generative models, and various AI applications such as predictive analytics, computer vision, and natural language processing. This foundational understanding will enable participants to grasp the potential and limitations of AI technologies. Develop participants' skills in evaluating the performance and impact of AI models using appropriate metrics and techniques. The course will also guide participants through the lifecycle of AI projects, from data collection and model training to deployment and maintenance, emphasizing the importance of data quality, governance, and collaboration between technical and non-technical teams to ensure successful AI implementation. Ensure that participants can critically assess and address the ethical implications of AI, including fairness, bias, transparency, and accountability. Additionally, the course aims to provide frameworks and best practices for integrating AI into organizational strategies, aligning AI initiatives with corporate objectives, and leveraging AI for competitive advantage while maintaining ethical standards.
Scope	This course is designed to equip organizational decision-makers, including managers and executives, with a comprehensive understanding of artificial intelligence (AI) and its applications within a business context. The course covers a range of topics, from fundamental AI concepts and machine learning techniques to practical applications in predictive analytics, computer vision, and natural language processing. Additionally, it addresses critical ethical considerations, such as fairness, bias, transparency, and accountability, as well as the current regulatory landscape. Participants will learn methods for evaluating AI model performance, strategies for integrating AI into business operations, and best practices for data governance and project lifecycle management. By blending lectures and case-based learning, the course aims to provide participants with the knowledge and skills needed to effectively and ethically implement and manage AI technologies in their organizations, ultimately leveraging AI for competitive advantage and strategic growth.

Entry requirements	A bachelor's degree in business administration and/or management, or equivalent experiences working in organizations in decision making roles.
Programme learning outcomes (PLOs)	1 - AI fundamentals (EQF 6) 2 - Organisational decision-making on AI (EQF 7)

2. Description of the structure

The course has a duration of 10 weeks. Weeks one, two and three are instruction weeks. Week four serves as a recap and consultation week. Weeks five, six and seven are instruction week. Week 8 is final consultation week. The preliminary plan is participants would submit their final assignment towards the end of week 9 and by the end of week 10, the submitted assignments have been assessed and feedback provided. The course is designed to be a 5-EC course with 140 hours of total study load.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Overview of AI fundamentals	1 ECTS	EQF 6	Project portfolio
Fields of AI application	1 ECTS	EQF 6	Project portfolio
AI performance evaluation and explainability	1 ECTS	EQF 6	Project portfolio
Ethics of AI	1 ECTS	EQF 6	Project portfolio
Regulatory landscape	1 ECTS	EQF 6-7	Project portfolio
AI and business strategy	1 ECTS	EQF 6-7	Project portfolio
Data quality and data management	1 ECTS	EQF 6	Project portfolio

AI project lifecycle and management	1 ECTS	EQF 6	Project portfolio
Collaboration between teams	1 ECTS	EQF 6	Project portfolio
Risk management and leadership	1 ECTS	EQF 7	Project portfolio
Economic and social impact of AI	1 ECTS	EQF 6-7	Project portfolio
Future trends and frameworks	1 ECTS	EQF 6-7	Project portfolio

4. Details of Learning Units

4.1. Overview of AI fundamentals

Description
This session serves as a comprehensive introduction to the fundamentals of artificial intelligence. Participants will gain an understanding of AI's history and evolution, tracing its development from its early days to contemporary advancements. Key technical terms and concepts will be clearly explained, including machine learning, generative models, and the distinction between narrow and broad AI. The session will lay the foundation for understanding how these concepts fit into the broader AI landscape and prepare participants for more detailed explorations of AI applications and strategies in subsequent sessions.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6)
Unit learning outcomes
• Explains common technical terms and concepts (supervised and unsupervised machine learning, generative models, narrow and broad AI).
Delivery method(s)
As this is the first session of the course, an interactive lecture is an optimal delivery method, allowing for clear dissemination of information as well as accommodating questions from participants. IN addition to the key learning outcome, this session would also serve to introduce the course and assignment to participants.
Materials
To ensure a clear introduction to AI fundamentals, the following materials are essential: presentation slides covering AI history, key concepts, and technical terms; reading materials including articles, research papers, and foundational texts; and multimedia resources such as video tutorials, short documentaries, and interactive online modules for self-paced learning. Deck of session 1.1 from AI & Creativity may be adapted, which already includes some videos links.

4.2. Fields of AI application

Description
This session explores the diverse applications of AI in real-world scenarios, focusing on key areas such as computer vision, natural language processing, autonomous systems, and predictive analytics. Through real-world case studies, participants will see practical examples of AI in action, understanding the benefits and challenges of each application. By the end of this session, participants will grasp the breadth of AI applications and their potential impact on various industries. The specific industry context can be further defined depending on the type of participants and/or the institute where the course will be piloted.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6)
Unit learning outcomes
• Explains common fields of machine learning and AI applications (such as exploratory data analysis, predictive analytics, decision support, computer vision, natural language processing, autonomous systems). • Explains the need for development and use of foundation models. • Discusses the economic and social impact of AI.
Delivery method(s)
Lecture and in-class case-based learning. For this session, a combination of lecturing and case-based learning (CBL) will be highly effective. The session will begin with a lecture that introduces the various fields of AI application. Following the lecture, participants will be divided into small groups to analyze real-world cases that showcase AI applications in different industries. Each group will examine the AI technologies used, discuss the benefits and challenges, and present their findings to the class. This approach not only provides a thorough understanding of AI applications but also fosters practical decision-making skills and peer learning.
Materials
The most essential materials for this session would be the PowerPoint deck for the lecturing segment of the session and a number of relevant and interesting cases for the CBL portion of the session. Cases may include Tesla (automated driving), McDonald's (customer order taking in drive through), UPS (route optimization), Walmart (AI in employee scheduling and performance management). More cases would be sought and developed for tailor the type of participants and/or the institute where the course will be piloted.

4.3. AI performance evaluation and explainability

Description
This session focuses on the critical aspects of evaluating AI models' performance and ensuring their explainability and interpretability. Participants will learn about AI model performance metrics and standards such as accuracy, precision, recall, F1 score, and ROC-AUC. The session will then delve into the principles of explainability and interpretability, emphasizing the importance of transparency in AI systems.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6)
Unit learning outcomes
• Explains methods for evaluating the performance and impact of AI models. • Explains the principles of explainability and interpretability in AI models. • Explains generative AI.
Delivery method(s)
Similar to the previous session, a combination of lecturing and case-based learning would be applied. The session will start with a lecturing that covers essential performance metrics and evaluation methods, such as accuracy, precision, recall, F1 score, and ROC-AUC. This foundational knowledge will be enriched with detailed explanations of explainability techniques like LIME and SHAP. Following the lecture, participants will engage in case-based learning, where they will analyze real-world case studies of AI implementations. These case studies will illustrate how the discussed metrics and techniques are applied in practice, allowing participants to critically evaluate AI models and understand their decision-making processes. This blended approach ensures that participants not only grasp theoretical concepts but also gain hands-on experience in applying these principles to real-world scenarios.
Materials
The most essential materials for this session would be the PowerPoint deck for the lecturing segment of the session and a number of relevant and interesting cases for the CBL portion of the session. Some of the cases used in the previous session would also function well as case materials in this session. The case-based discussion of this session would focus, instead of application, on performance and quality standards of the use of AI in these organizations.

4.4. Ethics of AI

Description
This session focuses on the ethical considerations and challenges associated with AI, zooming in on issues such as fairness, bias, transparency, and accountability. Participants will explore how ethical dilemmas arise in the development and deployment of AI systems and the potential societal impacts of these technologies. The session will cover frameworks and guidelines for ethical AI practices, ensuring that AI implementations are aligned with ethical principles and regulatory requirements.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6)
Unit learning outcomes
• Explains ethical issues such as fairness, bias, transparency, and accountability raised by AI. • Provides guidelines for ethical leadership and decision-making in AI.
Delivery method(s)
A combination of lecturing and case-based learning will be employed to effectively address the complex ethical issues surrounding AI. The session will begin with a lecture that introduces key ethical concepts such as fairness, bias, transparency, and accountability, supported by relevant frameworks and guidelines. This foundational knowledge will be enriched with real-world cases that highlight ethical dilemmas in AI applications. The discussion of the case materials will also implicate how leaders and leadership behaviors and strategies can contribute to the ethical application of AI in organizations.
Materials
For this session, course materials from the course mapping, specifically, AI and ethics from AI and creativity, my boss is an algorithm from digital economy can be used as the basis for developing the lecturing deck for this session. For the case-based learning section of this session, case materials still need to be developed. Examples of cases could include facial recognition and privacy concerns (Clearview AI), potential biases in hiring and selection (Amazon's AI recruitment tool), and social media content moderation and recommendation (Facebook).

4.5. Regulatory landscape

Description
This lecture will provide an overview of the current regulatory landscape for artificial intelligence (AI) and data privacy laws. Participants will learn about existing and emerging regulations such as the EU AI Act, data protection laws, sectoral regulatory frameworks, intellectual property (IP) laws, anti-trust/competition laws, consumer protection laws, and cyber and information security laws. By the end of the session, decision-makers will be able to explain these regulatory frameworks and distinguish between them, equipping them with the knowledge to navigate AI compliance effectively. This understanding is crucial for ensuring that AI initiatives within their organizations adhere to relevant legal standards.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - Organisational decision-making on AI (EQF 7)
Unit learning outcomes
• Explains the current regulatory landscape for AI and data privacy laws. • Distinguishes current and emerging laws and regulations related to AI, such as the EU AI Act, data protection laws, sectoral regulatory frameworks, intellectual property (IP) laws, anti-trust/competition laws, consumer protection laws, cyber and information security laws.
Delivery method(s)
The session will be delivered through a combination of lecture content and interactive case studies. The instructor will present the regulatory frameworks, supplemented by real-world examples of organizations that have navigated these regulations successfully or faced challenges. This method allows participants to contextualize the information and see practical applications, enhancing their understanding of the material.
Materials
Regulatory Framework Comparison Chart: A comprehensive chart comparing different AI and data privacy regulations, highlighting key provisions, scope, and implications for organizations. This visual aid will help participants quickly reference and differentiate between various laws and their requirements. **Case Study Compendium:** A collection of detailed case studies showcasing how different organizations have approached AI regulation compliance. Each case study will include background information, the regulatory challenges faced, strategies implemented, and outcomes. This compendium will serve as a practical guide for decision-makers.

4.6. AI and business strategy

Description
This lecture will explore how AI can be integrated into organizational strategy to drive corporate objectives and create competitive advantages. Participants will learn frameworks for aligning AI initiatives with business strategy, understand the role of AI in creating value, and gain insights into developing an AI vision for their organization. By the end of the session, decision-makers will be equipped with the knowledge to strategically implement AI, ensuring it supports and enhances their business goals. This understanding is crucial for leveraging AI as a transformative tool within their organizations.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - Organisational decision-making on AI (EQF 7)
Unit learning outcomes
• Provides frameworks for integrating AI into organizational strategy. • Describes the relation between AI and business strategy and the way AI can support corporate objectives (AI vision), e.g., by explaining how AI can be used to create value and be a source of competitive advantage to a business.
Delivery method(s)
An expert in AI and business strategy will lead the lecture, presenting key frameworks and concepts for integrating AI into business strategy. The session will include detailed examples and case studies from various industries, demonstrating how companies have successfully leveraged AI for strategic advantage. Next, the lecture will include a workshop where participants will work in groups to develop strategic plans for integrating AI into their organizations. Using provided frameworks, they will identify areas where AI can create value, align AI initiatives with corporate objectives, and outline steps for implementation. This interactive approach will enable participants to apply theoretical knowledge to practical scenarios, fostering a deeper understanding of AI's strategic role.
Materials
AI Strategy Framework Guide: A comprehensive guide outlining various frameworks for integrating AI into business strategy. This document will include step-by-step instructions, key considerations, and best practices, serving as a valuable reference for participants as they develop their own AI strategies.

4.7. Data quality and data management

Description
This lecture will emphasize the critical role of data quality and data governance in the success of AI projects. Participants will learn about the principles of data management, the importance of high-quality data, and best practices for establishing robust data governance frameworks. By the end of the session, decision-makers will understand how to ensure data integrity and compliance, which are essential for reliable and ethical AI implementations. This knowledge is fundamental for leveraging data as a strategic asset in AI-driven initiatives.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6)
Unit learning outcomes
• Highlights the importance of data quality and data governance in AI projects.
Delivery method(s)
Expert Presentation with Real-World Examples: An expert in data management and AI will deliver a presentation highlighting key concepts and strategies for ensuring data quality and governance. The presentation will include real-world examples and case studies of organizations that have successfully managed their data for AI projects. **Interactive Workshop on Data Governance:** Next, the session will feature an interactive workshop where participants will engage in hands-on activities to develop data governance policies and procedures. Through group exercises, discussions, and role-playing scenarios, participants will learn how to assess data quality, establish governance frameworks, and implement data management best practices. This method will provide practical experience and foster a collaborative learning environment.
Materials
Data Governance Framework Guide: A detailed guide outlining the components of effective data governance frameworks. This resource will include templates, checklists, and best practices for establishing and maintaining data quality standards, ensuring participants have a practical reference for implementing governance in their organizations. **Data Quality Assessment Toolkit:** A toolkit designed to help organizations evaluate and improve their data quality. The toolkit will include assessment templates, quality metrics, and actionable recommendations, enabling participants to systematically identify and address data quality issues in their AI projects.

4.8. AI project lifecycle and management

Description
This lecture will delve into the lifecycle and management of AI projects, covering key stages such as data collection, model training, deployment, and ongoing maintenance. Participants will gain a comprehensive understanding of each phase, including best practices, challenges, and considerations for successful project execution. By the end of the session, decision-makers will be equipped with the knowledge to effectively plan, execute, and manage AI initiatives throughout their lifecycle, ensuring sustainable and impactful deployments within their organizations.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6)
Unit learning outcomes
• Explains the lifecycle of AI projects, including data collection, model training, deployment, and maintenance.
Delivery method(s)
Expert-Led Masterclass with Case Studies: An expert in AI project management will lead a masterclass session, providing in-depth insights into each phase of the AI project lifecycle. The session will include detailed case studies and examples from diverse industries, illustrating successful strategies and lessons learned. Participants will have the opportunity to interact with the expert, ask questions, and discuss real-world applications, enhancing their understanding of effective project management practices in AI.
Materials
Interactive Decision-Making Module: A module that simulates decision-making scenarios at each phase of an AI project. Participants will navigate through challenges related to data collection, model development, deployment strategies, and maintenance.

4.9. Collaboration between teams

Description
The student communicates, takes direction, reflects and/or collaborates for effective communication, project management, self-reflection, collaboration and co-creation with various stakeholders using visualization and storytelling techniques, planning and prioritization, feedback mechanisms and coordination processes with stakeholders and applies this in various situations and environments, adapted to different target groups, cultures and interests, with the aim of convincing, learning and achieving shared goals. The student will also work on the practicalities of multi-stakeholder collaboration, and we get into what it entails to set up such a partnership: logic of change and value statement development
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6)
Unit learning outcomes
• Encourages collaboration between technical and non-technical teams.
Delivery method(s)
Face to face – master class and activities (apply the concepts their own project idea and receive feedback)
Materials
For the master class - power point on topics such as building value within your parternship Readings: for instance: United Nations report: A Time for Transformative Partnerships Russel Reynolds Associates (2015) Sustainable Leadership Talent requirements for sustainable enterprises Spitz, van Kranenburg & Korzilius (2021), Motives Matter: the relation between motives and inter-partner involvement in nonprofit-business partnerships

4.10. Risk management and leadership

Description
This module focuses on the critical role of risk management and leadership in AI implementation. Students will learn to identify, assess, and mitigate potential risks associated with AI, such as ethical considerations and data privacy issues. They will also explore how effective leadership can drive successful, responsible AI adoption within an organization.
Related Programme Learning Outcome(s)
2 - Organisational decision-making on AI (EQF 7)
Unit learning outcomes
• Recognises the importance of a well-governed, transparent, and structured AI adoption and implementation process.
Delivery method(s)
Face to face – master class and activities (apply the concepts their own project idea and receive feedback)
Materials
1. Case Studies: Real-world examples of AI implementation, highlighting both successful and unsuccessful cases. 2. Research Articles: Academic papers on AI, risk management, and leadership can provide students with a theoretical foundation and the latest research in the field. 3. Regulatory Guidelines: Documents from regulatory bodies on AI ethics, data privacy, and governance can help students understand the legal and ethical landscape of AI implementation. 4. In class Exercises: risk assessment exercise or leadership role-play: students could role-play as leaders managing an ai project, dealing with challenges such as ethical dilemmas, team conflicts, and project setbacks.

4.11. Economic and social impact of AI

Description
This unit aims to provide students with a comprehensive understanding of the economic and social implications of AI. It explores how AI technologies are transforming industries, creating new opportunities, and posing challenges for society. Students will learn about the economic impact of AI, including job creation and displacement, economic inequality, and changes in productivity and efficiency. The unit will also examine the social consequences of AI, such as privacy concerns, ethical considerations, and effects on social structures and relationships.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - Organisational decision-making on AI (EQF 7)
Unit learning outcomes
• Discusses the economic and social impact of AI. • Describes general concerns, opportunities, risks, and pitfalls commonly associated with AI. • Interprets a risk analysis of implementing an AI solution. • Critically discusses and evaluates proposals (plans, recommendations, etc.) on the application of AI in a specific business.
Delivery method(s)
Face to face – master class and activities (apply the concepts their own project idea and receive feedback)
Materials
• Power point for the master classes • Research Papers: Academic articles discussing the economic and social impacts of AI. • Reports: Reports from reputable organizations like the World Economic Forum, McKinsey, or PwC on the impact of AI on various industries. • Case Studies: Real-world examples of how AI has economically and socially impacted specific industries or societies.

4.12. Future trends and frameworks

Description
This unit aims to provide students with an understanding of the future trends in AI and the frameworks that guide its development and use. It will cover the evolution of AI, the emerging trends in the field, and the importance of foundation models. The unit will also delve into the main building blocks and best practices of AI and data strategies across various businesses and industries. Students will gain insights into the potential impact of implementing an AI solution on an organization's structure, processes, governance, technology infrastructure, data, and roles.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - Organisational decision-making on AI (EQF 7)
Unit learning outcomes
• Explains the need for development and use of foundation models. • Lists the main authoritative EU and global publications and sources on AI, such as those of the European Council and the European Commission, the OECD and UNESCO • Discusses main building blocks and best practices (case studies) of AI and data strategies in a range of businesses and industries. • Indicates the potential impact of implementing an AI solution in terms of organisation (e.g., structure, processes, governance), technology (e.g., infrastructure, data), and people (e.g., know-how, roles, functions)
Delivery method(s)
Face to face – master class and activities (apply the concepts their own project idea and receive feedback)
Materials
• Master class power point • AI Publications: Official documents from the European Council, the European Commission, the OECD, and UNESCO on AI. • Research Papers: Academic articles discussing future trends in AI and the development and use of foundation models. • Case Studies: Examples of AI and data strategies in various businesses and industries.

ADVISOR-CONSULTANT (EQF 6/7)

1. General information

Name	Policy Maker AI Advisor-Consultant
EQF level	(EQF 6/7)
Goals	- Basic technical knowledge on the functioning of AI systems - Insight into the broader context in which AI systems will be embedded in the public domain - Gain the ability to have a critical conversation about the design and development of AI systems in the public domain - The student investigates, analyses, evaluates and/or identifies the challenges and opportunities of public values, (privacy) legislation, ethical dilemmas that play a role in digital transformation within government services - Student investigates and/or analyses the possibility of using AI models and algorithms (hereinafter referred to as algorithms) with government data. - Student is able to develop new implementations of algorithms for government services, using reliable and transparent methodologies with an emphasis on improving processes, working methods, culture and citizen experience.
Scope	The scope is to introduce public policy makers with the technical basics of AI and about the ethical + legal considerations that arise when implementing AI systems in the public domain. Learning programmes developed in the context of the Minor digital innovations for Society & Government
Entry requirements	No major requirement. Basic knowledge about the functioning of the public domain
Programme learning outcomes (PLOs)	1 - AI fundamentals (EQF 6) 2 - AI and policy (EQF 7) 2 - AI Strategy (EQF 7) 3 - AI implementation (EQF 7) 4 - AI Ethics advanced (EQF 7) 5 - Impact of AI (EQF 7)

2. Description of the structure

Structure

We start with an introductory week in which students get to know each other and the learning programmes. In the following three weeks students will receive workshops with theoretical fundamentals. The students then choose a project at a government organization in a project market, on which they work with a team three full days a week during the entire learning programme. One day a week all students come together again for in-depth workshops of your choice, exchange of experiences and guidance.

Day structure

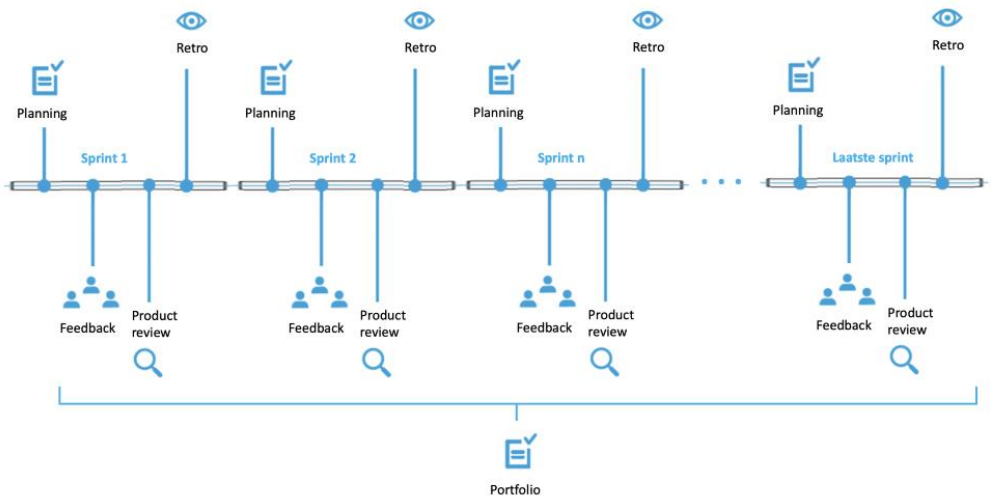
Morning: In the morning, we start the day with recognized experts 'masters'. They will take the students on a journey where theory and practice go hand in hand. The students build up their knowledge step by step, while at the same time refining their skills with targeted exercises. It is an interactive session, with room for questions, discussion and active participation. Afterwards students will be given a challenging assignment to work on in groups.

Parallel to Master Class: In addition to the Master class, there is also a Lab for other themes in the morning. An expert is present in the Lab to help you with the required knowledge and skills for the co-maker's assignment.

Afternoon: The afternoon starts with a consultation with your (team) supervisor to coordinate preparation, planning, reflection, collaboration, goals, assessments, reviews and the educational program aimed at the co-maker. This will be followed by work sessions in the afternoon for professional skills, targeted personal development, team building, entrepreneurship, planning, research, vision & mission and how to make an impact.

Assessment

The assessment is based on building an individual and joint portfolio, in which knowledge, skills, processed feedback and interim assessments are presented. These will be assessed in an assessment at the end of the course.



3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
Fundamentals of AI (and machine learning)	3 days	EQF 6/7	Project portfolio and pitch
De AI, government and regulatory environment (AI act, WOO - Open Government Act, etc.)	1 day	EQF 6/7	Project portfolio and pitch
Fairness in AI	1 day	EQF 6/7	Project portfolio and pitch
Privacy by design	1 day	EQF 6/7	Project portfolio and pitch
Value Sensitive Design – designing and taking into account ethical values	1 day	EQF 6/7	Project portfolio and pitch

4. Details of Learning Units

4.1. Fundamentals of AI (and machine learning)

Description of [learning unit title]
This learning unit takes the participant into various different levels of AI systems. It starts with introducing the basic concepts involved in machine learning and gradually explains more advanced models. Here the goal is to let the participants understand the functioning of AI systems on a conceptual level and get hands on experience with training their own AI model. By doing so, they gain a better understanding of what they are talking about
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 3 - AI implementation (EQF 7) 5 - Impact of AI (EQF 7)
Unit learning outcomes
• Explains common technical terms and concepts (supervised and unsupervised machine learning, generative models, narrow and broad AI). • Explains common fields of machine learning and AI applications (such as exploratory data analysis, predictive analytics, decision support, computer vision, natural language processing, autonomous systems). • Explains methods for evaluating the performance and impact of AI models. • Explains the principles of explainability and interpretability in AI models. • Explains the need for development and use of foundation models. • Provides frameworks for integrating AI into organizational strategy. • Highlights the importance of data quality and data governance in AI projects. • Explains the lifecycle of AI projects, including data collection, model training, deployment, and maintenance. • Explains practices, principles, methods, tools, and techniques related to risk management. • Explains the abilities of AI-based technology and its possible applications to be misused in general, such as privacy violations, algorithmic bias, socio-economic inequalities, misinformation and deep fake technologies, lack of transparency and explainability and social surveillance.
Delivery method(s)
Face to face This learning unit has 3 sessions which are all divided into two parts

Part 1 = A more in-depth lecture on the theory

Part 2 = A hackathon to implement the theory into practice

The three sessions are structured as follows:

1. Machine Learning 101
2. Machine learning 102
3. Neural Networks

Materials

- Machine learning 101 lecture powerpoint
- Machine learning 101 hackathon code notebook (case + dataset)
- Machine learning 102 lecture powerpoint
- Machine learning 102 hackathon code notebook (case + dataset)
- Neural Networks lecture powerpoint
- Neural Networks hackathon code notebook (case + dataset)

4.2. De AI act, government and regulatory environment (AI act, WOO - Open Government Act, etc.)

Description of [learning unit title]
What are these laws and what do they mean for me?
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - AI and policy (EQF 7) 2 - AI Strategy (EQF 7) 4 - AI Ethics advanced (EQF 7) 5 - Impact of AI (EQF 7)
Unit learning outcomes
• Explains the current regulatory landscape for AI and data privacy laws. • Lists the main authoritative EU and global publications and sources on AI, such as those of the European Council and the European Commission, the OECD and UNESCO • Distinguishes current and emerging laws and regulations related to AI, such as the EU AI Act, data protection laws, sectoral regulatory frameworks, intellectual property (IP) laws, anti-trust/competition laws, consumer protection laws, cyber and information security laws. • Recognises the balance and interaction between regulation and innovation • Indicates the impact of AI on human rights, economic well-being, and its implications on economic, social, medical, security, and environmental developments. • Discusses main building blocks and best practices (case studies) of national AI and data strategies • Recognises the importance of a well-governed, transparent, and structured AI policy development and assessment process. • Distinguishes current and emerging laws and regulations related to AI, such as the EU AI Act, data protection laws, sectoral regulatory frameworks, intellectual property (IP) laws, anti-trust/competition laws, consumer protection laws, cyber and information security laws. • Describes the regulatory and policy landscape for AI, including in the EU, e.g. AI Act, and in supra-national bodies like the IEEE and OECD. • Defines an AI ethics policy. • Names initiatives, organisations and communities of interest related to AI ethics, such as the OECD AI Policy Observatory. • Describes the political implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as the potential to affect the democratic process and elections in a

negative way, but also improve the policy-making process and the alignment between citizens and politicians.

- Describes the societal implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as facilitating individual services and improving customer satisfaction, but also its ability to undermine as well as to support human autonomy, well-being, and safety.
- Performs an overall AI impact assessment for an AI project or a specific AI application in a certain context by applying an impact assessment model or tool, such as the AI Impact Assessment of the Dutch government, the Microsoft Responsible AI Impact Assessment Guide or OECD's Algorithmic Impact Assessment (AIA)

Delivery method(s)

Face to face

This session has two parts

- The participant will gain insight into the origins of the AI act, how it will be rolled out in the Netherlands and the implications for the use and development of AI systems.
- The participants gain insight into the background and impact of the WOO. The participants can see how the rules impact the implementation of the application

Materials

- Lecture powerpoint
  In class exercise (case study where the participants examine it based on the laws)
  Hand-out with recourses on where to find information for each law

4.3. Fairness in AI (and Machine learning)

Description of [learning unit title]
Participants gain insight into the ethical considerations when determining 'fairness'. They are introduced to different ways to reduce bias in systems and how a discussion can be held about this
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 4 - AI Ethics advanced (EQF 7) 5 - Impact of AI (EQF 7)
Unit learning outcomes
• Describes general concerns, opportunities, risks, and pitfalls commonly associated with AI. • Explains ethical issues such as fairness, bias, transparency, and accountability raised by AI. • Provides frameworks for integrating AI into organizational strategy. • Explains the nature and the field of ethics, its importance and main theories, concepts, and principles. • Recognises ethical dilemmas. • Identifies and describes the concepts of bias, trust, fairness, transparency, equality, accountability, and empowerment in the context of artificial intelligence. • Explains criteria for trustworthy AI, such as lawful, ethical, and robust. • Explains main recommendations, codes and frameworks related to the ethics of AI, such as the framework for achieving Trustworthy AI of the High-Level Expert Group on Artificial Intelligence and the values-based principles of the OECD. • Explains methods to implement ethical work practices regarding AI, such as the AI Ethics maturity model. • Analyses and assesses algorithmic rules against ethical criteria and policy. • Defines an AI ethical policy. • Describes the societal implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as facilitating individual services and improving customer satisfaction, but also its ability to undermine as well as to support human autonomy, well-being, and safety.
Delivery method(s)
Face to face This learning unit is divided into two parts Part 1 = A more in-depth lecture on the theory

Part 2 = A hackathon to implement the theory into practice
Materials
• Lecture material • Hackathon code notebook (case + dataset) • Handout about various types of fairness

4.4. Privacy by design

Description of [learning unit title]
Providing insight into how privacy can be taken into account when developing applications.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - AI Strategy (EQF 7) 3 - AI implementation (EQF 7) 4 - AI Ethics advanced (EQF 7) 5 - Impact of AI (EQF 7)
Unit learning outcomes
• Describes general concerns, opportunities, risks, and pitfalls commonly associated with AI. • Explains ethical issues such as fairness, bias, transparency, and accountability raised by AI. • Provides frameworks for integrating AI into organizational strategy. • Explains the lifecycle of AI projects, including data collection, model training, deployment, and maintenance. • Encourages collaboration between technical and non-technical teams. • Provides guidelines for ethical leadership and decision-making in AI. • Explains related concepts such as digital transformation and digital strategy and • Guides the process of identifying customer needs. • Proposes and evaluates creative ideas on the application of AI technologies, by applying idea generation and evaluation techniques. • Identifies and prioritizes AI use cases/ scenarios to determine when and what AI solutions are best applicable in a specific situation. • Provides advice about the possibilities, advantages, and limitations of existing and emerging AI applications in general. • Explains practices, principles, methods, tools, and techniques related to risk management. • Performs a risk analysis with identification and assessment of risks of possible AI solutions, considering corporate and societal values and interests. • Proposes appropriate actions to handle risks and formulates an AI risk management plan, including governance mechanisms. • Explains methods and techniques to manage change and reach consensus and commitment.

- Determines enabling factors for implementing an AI solution in terms of organisation (e.g., structure, processes, governance), technology (e.g., infrastructure, data), and people (e.g., know-how, roles, functions)
- Explains the nature and the field of ethics, its importance and main theories, concepts, and principles.
- Recognises ethical dilemmas.
- Explains main recommendations, codes and frameworks related to the ethics of AI, such as the framework for achieving Trustworthy AI of the High-Level Expert Group on Artificial Intelligence and the values-based principles of the OECD.
- Explains methods to implement ethical work practices regarding AI, such as the AI Ethics maturity model.
- Analyses and assesses algorithmic rules against ethical criteria and policy.
- Applies technical and non-technical methods to monitor and evaluate the development, deployment and use of the AI system and its learning processes.
- Describes the political implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as the potential to affect the democratic process and elections in a negative way, but also improve the policy-making process and the alignment between citizens and politicians.
- Describes the societal implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as facilitating individual services and improving customer satisfaction, but also its ability to undermine as well as to support human autonomy, well-being, and safety.
- Describes the economic implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as automation-spurred job loss, but also the creation of new jobs, the automation of routine and time-consuming tasks and optimisation of workflows.
- Performs an overall AI impact assessment for an AI project or a specific AI application in a certain context by applying an impact assessment model or tool, such as the AI Impact Assessment of the Dutch government, the Microsoft Responsible AI Impact Assessment Guide or OECD's Algorithmic Impact Assessment (AIA)

Delivery method(s)

Face to face

This learning unit is divided into two parts

- Part 1 = A more in-depth lecture on the theory
- Part 2 = A case study to implement the theory into practice

Materials

- Lecture material
- Hackathon code notebook (case + dataset)
- Handout about various techniques that can be used

4.5. Value Sensitive Design - designing and taking into account ethical values

Description of [learning unit title]
Participants gain insight into how ethical values in technology can be measured and how they can be taken into account when designing a system.
Related Programme Learning Outcome(s)
1 - AI fundamentals (EQF 6) 2 - AI Strategy (EQF 7) 3 - AI implementation (EQF 7) 4 - AI Ethics advanced (EQF 7) 5 - Impact of AI (EQF 7)
Unit learning outcomes
• Describes general concerns, opportunities, risks, and pitfalls commonly associated with AI. • Explains ethical issues such as fairness, bias, transparency, and accountability raised by AI. • Provides frameworks for integrating AI into organizational strategy. • Explains the lifecycle of AI projects, including data collection, model training, deployment, and maintenance. • Encourages collaboration between technical and non-technical teams. • Provides guidelines for ethical leadership and decision-making in AI. • Explains related concepts such as digital transformation and digital strategy and • Guides the process of identifying customer needs. • Proposes and evaluates creative ideas on the application of AI technologies, by applying idea generation and evaluation techniques. • Explains how AI can be used to create value and be a source of competitive advantage to a business by using structured methods and analysis techniques. • Identifies and prioritizes AI use cases/ scenarios to determine when and what AI solutions are best applicable in a specific situation. • Provides advice about the possibilities, advantages, and limitations of existing and emerging AI applications in general. • Explains practices, principles, methods, tools, and techniques related to risk management. • Performs a risk analysis with identification and assessment of risks of possible AI solutions, considering corporate and societal values and interests.

- Proposes appropriate actions to handle risks and formulates an AI risk management plan, including governance mechanisms.
- Explains methods and techniques to manage change and reach consensus and commitment.
- Determines enabling factors for implementing an AI solution in terms of organisation (e.g., structure, processes, governance), technology (e.g., infrastructure, data), and people (e.g., know-how, roles, functions)
- Explains the dependence upon data and how to acquire, prepare, manage, and provide and scale data for AI applications.
- Performs a costs and benefits analysis of possible AI solutions.
- Provides advice on appropriate AI solutions based upon benefits, risks, and overall impact for a specific situation.
- Formulates an AI implementation plan.
- Formulates an AI project plan by applying relevant project management methods and tools, e.g., CRISP-DM and agile methodologies.
- Explains the evaluation of AI solutions.
- Communicates and presents advice on an AI implementation in a coherent, clear, convincing, well-argued, and inspiring way
- Describes the essence and key concepts of fundamental human rights and human values.
- Explains the nature and the field of ethics, its importance and main theories, concepts, and principles.
- Recognises ethical dilemmas.
- Explains main recommendations, codes and frameworks related to the ethics of AI, such as the framework for achieving Trustworthy AI of the High-Level Expert Group on Artificial Intelligence and the values-based principles of the OECD.
- Explains methods to implement ethical work practices regarding AI, such as the AI Ethics maturity model.
- Analyses and assesses algorithmic rules against ethical criteria and policy.
- Applies technical and non-technical methods to monitor and evaluate the development, deployment and use of the AI system and its learning processes.
- Defines an AI ethics policy.
- Explains the abilities of AI-based technology and its possible applications to be misused in general, such as privacy violations, algorithmic bias, socio-economic inequalities, misinformation and deep fake technologies, lack of transparency and explainability and social surveillance.
- Explains the abilities of AI-based technology and its possible applications to be used for good in general, such as solving complex problems in fields like climate science, drug discovery and engineering, the amplification of people's abilities e.g. by improving accessibility and self-expression.

- Describes the political implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as the potential to affect the democratic process and elections in a negative way, but also improve the policy-making process and the alignment between citizens and politicians.
- Describes the societal implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as facilitating individual services and improving customer satisfaction, but also its ability to undermine as well as to support human autonomy, well-being, and safety.
- Describes the economic implications of AI by distinguishing the main issues, concerns, advantages, and disadvantages, such as automation-spurred job loss, but also the creation of new jobs, the automation of routine and time-consuming tasks and optimisation of workflows.
- Describes the implications of AI in specific areas, such as the automatization of weapons in defence, algorithmic trading in financial markets, AI-powered recruiting in HR and use of AI-driven robotic devices in healthcare.
- Performs an overall AI impact assessment for an AI project or a specific AI application in a certain context by applying an impact assessment model or tool, such as the AI Impact Assessment of the Dutch government, the Microsoft Responsible AI Impact Assessment Guide or OECD's Algorithmic Impact Assessment (AIA)
- Explains how to perform impact assessments of AI projects or applications from different perspectives, such as a Data Protection Impact Assessment, an Environmental Impact Assessment, a Health Impact Assessment, a Human rights impact assessment, a Racial equity impact assessment and a Gender impact assessment.

Delivery method(s)

- Face to face
- This learning unit is divided into two parts
    - Part 1 = A more in-depth lecture on the theory
    - Part 2 = A case study to implement the theory into practice

Materials

- Lecture material
- Hackathon code notebook (case + dataset)
- Handout about various techniques that can be used

DECISIONMAKER AND POLICYMAKER- AI FUNDAMENTALS (EQF 6)

1. General information

Name	Decisionmaker and Policymaker - AI Fundamentals
EQF level	EQF 6
Goals	1. **Comprehend AI Fundamentals:** Equip learners with a solid understanding of common AI technical terms and concepts, including key machine learning methodologies and the differences between narrow and broad AI. 2. **Evaluate AI Applications and Performance:** Enable learners to identify and assess the impact and effectiveness of AI applications across various fields, including data analysis, predictive analytics, and decision support. 3. **Understand AI Explainability, Interpretability, and Ethics:** Foster a solid understanding of the principles of AI explainability, ethical considerations, and the regulatory landscape governing AI and data privacy. 4. **Analyse Economic and Social Impacts of AI:** Develop the ability to critically evaluate the economic and social implications of AI technologies, recognizing potential risks and the importance of robust data governance. 5. **Integrate AI Strategically and Lead Ethically:** Provide learners with the skills to integrate AI into organizational strategies effectively, promote collaboration between technical and non-technical teams, and lead AI initiatives with a strong ethical foundation.
Scope	**Scope of the Curriculum:** The curriculum provides a comprehensive and practical education in AI for decision and policy makers, covering a broad range of topics from foundational AI concepts to the strategic integration of AI into organisational frameworks. It encompasses technical terms and concepts, applications and evaluation methods, principles of explainability and ethics, economic and social impacts, and guidelines for ethical leadership in AI. Designed for non-technical professionals, the training employs advanced pedagogical techniques and modern tools to facilitate rapid and effective learning. **Target Groups:** The curriculum is tailored for decision makers, policy makers, and senior management in both the industry and public sector who aim to understand and leverage AI technologies in their strategic initiatives. It is ideal for leaders seeking to enhance their knowledge of AI applications, ethical considerations, and integration strategies to make informed decisions and foster ethical AI practices within their organizations and in society. The

	curriculum ensures that learners can quickly grasp complex concepts using advanced training techniques and state-of-the-art tools, enabling them to achieve competency efficiently and effectively.
Entry requirements	No prior knowledge of mathematics, statistics, computer science, or programming is required.
Programme learning outcomes (PLOs)	1 - AI Fundamentals (EQF 6)

2. Description of the structure

The curriculum is organized into separate but interconnected learning units, each focusing on a specific aspect of AI and emphasizing a modular approach for comprehensive understanding.

The AI Fundamentals for Decision Makers unit establishes a foundation for understanding common technical terms and concepts, such as supervised and unsupervised machine learning, generative models, and the distinction between narrow and broad AI. This unit ensures that learners grasp AI's essential principles and terminology, forming the basis for more advanced topics.

Complementing this is the AI Applications and Evaluation unit, which explores various fields of AI applications like data analysis, predictive analytics, decision support, computer vision, and NLP. It also includes methods for evaluating the performance and impact of AI models, offering a detailed study of practical AI applications and the metrics used to assess their effectiveness and outcomes.

The Explainability, Interpretability, and Ethics unit extends knowledge to AI explainability and interpretability principles, ethical issues such as fairness, bias, transparency, and accountability, and the current regulatory landscape for AI and data privacy laws. This unit emphasizes understanding and addressing the ethical dimensions of AI, ensuring learners can deploy AI responsibly and transparently.

While the first three units emphasize an intuitive and practical understanding of AI concepts and applications, the Economic, Social Impact, and Governance unit discusses AI's broader economic and social impacts, concerns, risks, and pitfalls associated with AI. It highlights the importance of data quality and governance in AI projects, providing a comprehensive view of the implications of AI technologies on society and the economy.

The curriculum concludes with the unit AI Integration and Ethical Leadership, which offers frameworks for integrating AI into organizational strategy, encourages collaboration between technical and non-technical teams, and provides ethical leadership and decision-making guidelines in AI projects. This unit ensures participants are equipped to lead AI initiatives within their organizations, fostering an environment of ethical AI practice and strategic alignment.

Each unit in the curriculum builds on the previous units, ensuring a smooth transition from foundational to advanced topics while emphasizing the practical connections and applications of the concepts learned. The training includes examples, case studies, and hands-on work, ensuring learners can apply their knowledge effectively and responsibly in real-world scenarios.

3. Overview of Learning Units

Learning unit title	Hours/ECTS	EQF level	Assessment(s)
AI Fundamentals for Decision and Policymakers	25 h / 1 ECTS	EQF 6	Quizzes
AI Applications and Evaluation	25 h / 1 ECTS	EQF 6	Quizzes
Explainability, Interpretability, and Ethics	25 h / 1 ECTS	EQF 6	Quizzes
Economic, Social Impact, and Governance	25 h / 1 ECTS	EQF 6	Quizzes
AI Integration and Ethical Leadership	25 h / 1 ECTS	EQF 6	Quizzes

4. Details of Learning Units

4.1. AI Fundamentals for Decision and Policymakers

Description
The learning unit AI Fundamentals for Decision and Policymakers covers common technical terms and concepts, including supervised and unsupervised machine learning, generative models, and the distinction between narrow and broad AI. Trainees learn about data representation, data clustering, dimensionality reduction, classification, evaluation of machine learning models, and intuitively understand a transition to more complex machine learning models such as deep neural networks. The utility of deep neural networks is illustrated on the analysis of images and text. No prior knowledge of statistics or computer science is required to take this course.
Related Programme Learning Outcome(s)
1 - AI Fundamentals (EQF 6)
Unit learning outcomes
• Explains common technical terms and concepts (supervised and unsupervised machine learning, generative models, narrow and broad AI). • Explains generative AI. • Explains the need for development and use of foundation models.
Delivery method(s)
• On-site lectures with practical demonstrations of methods, tools, and cases • Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges • On-line discussion and quizzes • On-line forum, discussions and assistance on Discord channel
Materials
• Lecture notes with practical examples, cases, and demonstrations with the data mining tool Orange, delivered electronically to in-class participants • Quizzes and interactive lecture notes in a mini-MOOC environment • A set of short educational videos • Rescha S (2024): Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters) • Kneusel RT (2023): How AI Works, No Starch Press (optional reading, selected chapters)

4.2. AI Applications and Evaluation

Description
The learning unit AI Applications and Evaluation explores various fields of AI applications such as data analysis, predictive analytics, decision support, and recommender systems. It provides intuitive introduction to image analysis and natural language processing. The unit also introduces the concepts of accuracy and discusses the effects of overfitting or lack of training data. No prior knowledge of statistics or computer science is required to take this course. However, completion of the learning unit "AI Fundamentals for Decision Makers" unit is strongly recommended.
Related Programme Learning Outcome(s)
1 - AI Fundamentals (EQF 6)
Unit learning outcomes
• Explains common fields of machine learning and AI applications (such as exploratory data analysis, predictive analytics, decision support, computer vision, natural language processing, autonomous systems). • Explains methods for evaluating the performance and impact of AI models.
Delivery method(s)
• On-site lectures with practical demonstrations of methods, tools, and cases • Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges • On-line discussion of quizzes • On-line forum, discussions and assistance on Discord channel
Materials
• Lecture notes with practical examples, cases, and demonstrations with the data mining tool Orange, delivered electronically to in-class participants • Quizzes and interactive lecture notes in a mini-MOOC environment • A set of short educational videos • Rescha S (2024): Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters) • Kneusel RT (2023): How AI Works, No Starch Press (optional reading, selected chapters)

4.3. Explainability, Interpretability, and Ethics

Description
The learning unit Explainability, Interpretability, and Ethics focuses on the principles of AI explainability and interpretability, ethical issues like fairness, bias, transparency, and accountability, and the current regulatory landscape for AI and data privacy laws. No prior knowledge of statistics or computer science is required to take this course. Completion of the learning units "AI Fundamentals for Decision Makers" and "AI Applications and Evaluation" are strongly advised prior to enrolling in this course.
Related Programme Learning Outcome(s)
1 - AI Fundamentals (EQF 6)
Unit learning outcomes
• Explains the principles of explainability and interpretability in AI models. • Explains ethical issues such as fairness, bias, transparency, and accountability raised by AI. • Explains the current regulatory landscape for AI and data privacy laws.
Delivery method(s)
• On-site lectures with practical demonstrations of methods, tools, and cases • Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges • On-line discussion of quizzes • On-line forum, discussions and assistance on Discord channel
Materials
• Lecture notes with practical examples, cases, and demonstrations with the data mining tool Orange, delivered electronically to in-class participants • Quizzes and interactive lecture notes in a mini-MOOC environment • A set of short educational videos • Rescha S (2024): Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters) • Kneusel RT (2023): How AI Works, No Starch Press (optional reading, selected chapters)

4.4. Economic, Social Impact, and Governance

Description
The learning unit Economic, Social Impact, and Governance discusses the economic and social impacts of AI, concerns, risks, and pitfalls associated with AI, and highlights the importance of data quality and governance in AI projects. No prior knowledge of statistics or computer science is required to take this course.
Related Programme Learning Outcome(s)
1 - AI Fundamentals (EQF 6)
Unit learning outcomes
• Discusses the economic and social impact of AI. • Describes general concerns, opportunities, risks, and pitfalls commonly associated with AI. • Highlights the importance of data quality and data governance in AI projects.
Delivery method(s)
• On-site lectures with practical demonstrations of methods, tools, and cases • Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges • On-line discussion of quizzes • On-line forum, discussions and assistance on Discord channel
Materials
• Lecture notes with practical examples and cases delivered electronically to in-class participants • Quizzes and interactive lecture notes in a mini-MOOC environment • A set of short educational videos • Rescha S (2024): Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters) • Kneusel RT (2023): How AI Works, No Starch Press (optional reading, selected chapters)

4.5. AI Integration and Ethical Leadership

Description
The learning unit AI Integration and Ethical Leadership provides frameworks for integrating AI into organizational strategy, proposes the means of collaboration between technical and non-technical teams, and offers guidelines for ethical leadership and decision-making in AI projects. No prior knowledge of statistics or computer science is required to take this course.
Related Programme Learning Outcome(s)
1 - AI Fundamentals (EQF 6)
Unit learning outcomes
• Provides frameworks for integrating AI into organizational strategy. • Explains the lifecycle of AI projects, including data collection, model training, deployment, and maintenance. • Encourages collaboration between technical and non-technical teams. • Provides guidelines for ethical leadership and decision-making in AI.
Delivery method(s)
• On-site lectures with practical demonstrations of methods, tools, and cases • Self-study assisted with pre-recorded video material and interactive lecture notes with quizzes and challenges • On-line discussion of quizzes • On-line forum, discussions and assistance on Discord channel
Materials
• Lecture notes with practical examples and cases delivered electronically to in-class participants • Quizzes and interactive lecture notes in a mini-MOOC environment • A set of short educational videos • Rescha S (2024): Machine Learning Q & AI: 30 Essential Questions and Answers on Machine Learning and AI, No Starch Press (optional reading, selected chapters) • Kneusel RT (2023): How AI Works, No Starch Press (optional reading, selected chapters)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