



D4.2 Specific Curriculum



DATA SCIENTIST EQF 6



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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 abbreviations

AI	Artificial Intelligence
ARISA	Artificial Intelligence Skills Alliance
EQF	European Qualification Framework
EU	European Union

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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	<ul style="list-style-type: none"> • Fundamental Programming Skills: <ul style="list-style-type: none"> ○ Python (or R) • Database Fundamentals: <ul style="list-style-type: none"> ○ SQL • Computer Science Fundamentals: <ul style="list-style-type: none"> ○ Data Structures and Algorithms ○ Software Engineering Principles ○ Database Systems
Programme learning outcomes (PLOs)	<p>1 - Deep Learning (EQF 6)</p> <p>2 - AI Technologies (EQF 6)</p> <p>3 - Machine Learning (EQF 6)</p> <p>4 - Explainable AI (EQF 6)</p> <p>6 - Big Data & Data Analytics (EQF 6)</p> <p>7 - Human-Centered AI (EQF 6)</p> <p>8 - AI Ethics (EQF 6)</p> <p>9 - AI Futures and Innovation (EQF 6)</p> <p>10 - Business Intelligence (EQF 6)</p> <p>11 - AI Awareness (EQF 6)</p> <p>12 - Cyber and Data Security (EQF 6)</p> <p>13 - Generative AI (EQF 6)</p>

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
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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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Lectures • Case studies
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p> <p>Student readings suggested:</p>

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
<ul style="list-style-type: none"> 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)
<ul style="list-style-type: none"> Workshop Lectures
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p> <p>Student readings suggested: Burkov, A. (2019). The hundred-page machine learning book (Vol. 1, p. 32). Quebec City, QC, Canada: Andriy Burkov.</p>

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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Workshop • Lectures
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p>

4.4. Neural Networks

Description of [learning unit title]
Covers the basics of Neural Networks.
Related Programme Learning Outcome(s)
<p>1 - Deep Learning (EQF 6)</p> <p>2 - AI Technologies (EQF 6)</p> <p>6 - Big Data & Data Analytics (EQF 6)</p> <p>9 - AI Futures and Innovation (EQF 6)</p>
Unit learning outcomes
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Workshop • Lectures
Materials
<p>Lecturer Materials:</p> <p>Tutorial Materials (Slide and Presentations)</p>

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)
<p>1 - Deep Learning (EQF 6)</p> <p>2 - AI Technologies (EQF 6)</p> <p>6 - Big Data & Data Analytics (EQF 6)</p> <p>9 - AI Futures and Innovation (EQF 6)</p>
Unit learning outcomes
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Workshop • Lectures • Project Work
Materials
<p>Lecturer Materials:</p> <p>Tutorial Materials (Slide and Presentations)</p> <p>Student readings suggested:</p> <p>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.</p>

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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Workshop • Lectures
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p>

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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Workshop • Lectures
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p> <p>Student readings suggested: Foster, D. (2022). Generative deep learning. " O'Reilly Media, Inc."</p>

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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Workshop • Lectures
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p>

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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Lectures
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p>

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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Workshop • Lectures
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p>

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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Workshop • Lectures
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p> <p>Student readings suggested: Denning, D. E., & Denning, P. J. (1979). Data security. ACM computing surveys (CSUR), 11(3), 227-249.</p>

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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Lectures • Case Studies
Materials
<p>Lecturer Materials: Tutorial Materials (Slide and Presentations)</p> <p>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. <i>Frontiers in Psychology</i>, 9, 320628.</p>



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