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D4.2 Specific Curriculum

NLP ENGINEER 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	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.

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