

## **04-T1: Statement of support for the social recognition of MACHINA learning outcomes**





## PURPOSE

The purpose of this document is to motivate Machine Learning (ML) stakeholders, such as IT companies, sector representatives, policy actors, social partners, standardization organisations, national qualification agencies, VET and HE institutions, trainers/mentors, and field experts to:

- a) Support the recognition of the validity of the MACHINA project's learning outcomes in terms of addressing the skills, knowledge and competences required by ICT professionals to understand, develop and use of Machine Learning;
- b) Contribute to the advancement of the project's objectives to reinforce education in digital competences, based on the principles of common interest, reciprocity and complementarity.

## CONTEXT

The Statement of Support has been created in the context of the Erasmus+ KA2 project [MACHINA](#), which aims to tackle this ML skill deficit by increasing the relevance of Continuing & Initial VET provision in the sector, to assure that the existing & future ICT workforce will have the ML specific competences & transversal skills required to respond to modern workplace requirements and succeed in a competitive, fast-growing field.

This objective is in line with the priorities of the Digital Europe EU Program and the Digital Education Action Plan, to a) enhance digital competences for the digital transformation, b) support the upskilling of the ICT workforce and c) update the European Digital Competence Framework with AI and ML related skills requirements.

**Machine Learning (ML)** is a subset of Artificial Intelligence (AI) that has gained substantial prominence in diverse economic & social realities, has become the basis for a series of technological developments such as automated translation systems, medical image analysis, and virtual assistants. ML was born from pattern recognition but has evolved to refer to the use of data & learning algorithms to produce models, predict outcomes, and make decisions with minimum human intervention. The fast-paced expansion of ML, especially in data-driven industries (e.g. banking, retail), is rapidly pushing up the demand for skilled ICT workers in the EU. While the demand for ML expert workers is particularly high, the supply is severely lagging behind.

**Machine Learning (ML)** is profoundly transforming “traditional” business models & processes across sectors, by **optimizing the processing of massive data volumes and automating core tasks**. The fast-paced expansion of ML uses, especially in data-driven industries (financial services, health care, retail), is rapidly pushing forward the **demand for skilled ICT workers in the EU**. Whereas the demand for ML skills is steadily growing, employers are facing a shortfall of suitable candidates, which



is leaving thousands of positions unfilled (an estimated 769,000), threatening productivity, efficiency & future growth.

## LABOUR MARKET ANALYSIS

According to the evidences resulted from the research activities regarding the labour market demands in job vacancies as well as the education and training offers available for this sector, across the partner countries, it was found that Machine Learning is used more and more by companies from all sectors.

The results of the research and data gathering showed that

- 344% growth in ML relevant job postings since 2015
- the value of the European ML Market is projected - to increase from 750 million euros in 2019 to 3.5 billion euros
- the EU is facing a huge ML skills gap with 769,000 unfilled positions
- 2.3 million new working positions will be created the next 3 years due to the rise of automation and intelligent systems
- the most demanded job titles in the EU market are Machine Learning Engineer and Data scientist. AI/ML engineer: Best Tech job for 2020
- the ICT sector is found to be the larger employer for ML roles, accounting for over half of all job advertisements. Other ML intensive industries are engineering, telecommunications and consulting.
- Business and Transversal skills are often missing in ML educational and training programmes; relevant concepts and use cases are almost exclusively approached from a technical point of view.
- most ML training offerings types are offered at the highest level as specialization master degree programs, as well as short cycled introductory or subject specific online courses.

## VET CURRICULUM ON MACHINE LEARNING FOR ICT PROFESSIONALS

MACHINA developed a formal VET curriculum on Machine Learning for ICT professionals, to address current and emerging occupational needs, essentially improving the quality of sectoral formal and non-formal vocational training. The curriculum is referenced to the 5th EQF level and has a 2-semester duration. It comprises both theoretical & practical learning components, employing a modular structure to facilitate deployment in formal & informal C-VET environments.

The project will also make available transnational educational materials in the form of OERs, to ensure wide adoption and support VET provision in a cost-effective, flexible way.



## Learning outcomes

- Understand the theoretical principles of Machine Learning
- How to solve the problems using various Machine Learning techniques
- Understand Data pre-processing and visualization methods
- Understand the elements of ML in applications
- Learn definition of sets, functions, relations and their basic operations
- Learn definition of vector space, metric and the gradient of a function
- Calculate easy probabilities base on basic combinatorics
- Compute mean, median, variance, standard deviation of a population
- Write a simple algorithm as a flow chart
- Write a simple algorithm in a programming language (Python)
- Learn basic data structures (sets, lists, associative, arrays)
- Identify the different ML linear models' algorithms and implementation
- Identify the different algorithms of supervised, unsupervised and semi-supervised learning
- Obtain an overview of the different programming languages and frameworks available for ML.
- Understand best practices for building machine learning applications
- Understand when to use MLP, CNN and RNN models
- Implement, train, tuning and validate a MLP, CNN and RNN model using Keras API
- Learn definition of Autoencoders (AE) and Restricted Boltzmann machines (RBM)

## Curriculum outline

This course is made up of 6 Learning Units, which are further broken down into 27 lessons that step through the different topics and instances of the Machine Learning field.

### Learning Unit 1: ML essentials for ICT professionals

- Lesson 1: Introduction to ML
- Lesson 2: Where to apply ML
- Lesson 3: Machine Learning and Data processing
- Lesson 4: Example ML applications

### Learning Unit 2: Mathematical Foundations

- Lesson 1: Set, Functions, Relations
- Lesson 2: Linear Algebra
- Lesson 3: Probability Theory

- Lesson 4: Statistics
- Lesson 5: Computation theory

### **Learning Unit 3: ML Algorithms, Programs, and Protocols**

- Lesson 1: Machine Learning by linear models
- Lesson 2: Supervised learning
- Lesson 3: Unsupervised learning
- Lesson 4: Semi-supervised learning
- Lesson 5: Programming languages and frameworks for Machine Learning algorithms
- Lesson 6: Best practices for ML

### **Learning Unit 4: Deep Learning (Advanced)**

- Lesson 1: Multilayer Perception (MLP)
- Lesson 2: Convolutional Neural Networks (CNN)
- Lesson 3: Recurrent Neural Networks (RNN)
- Lesson 4: Autoencoders (AE), Restricted Boltzmann Machines (RBM)

### **Learning Unit 5: Communicating the merits, challenges, and implications of Machine Learning technology to customers and within own organization**

- Lesson 1: Introduction to communication and ML involvement
- Lesson 2: Types, levels, components of effective communication and ways for using Machine Learning in Communications
- Lesson 3: The future of communication in accordance with artificial intelligence
- Lesson 4: The effects of artificial intelligence in communication

### **Learning Unit 6: Legislation, Ethics, Project Management related to ML**

- Lesson 1: EU guidelines on ethics in artificial intelligence
- Lesson 2: Data Value/Costs Model
- Lesson 3: Bias in Machine Learning
- Lesson 4: Software engineering for AI applications

### **Massive Open Online Course**

The MACHINA VOOC, hosted on “OpenLearning” platform, acts as a wide access delivery method for the MACHINA curriculum. The MACHINA VOOC is a flexible, self-guided e-learning scheme that reflects the structure of the developed curriculum on Machine Learning for ICT professionals and comprises



versatile training and assessment materials (in an online form), including presentation files, video lectures, infographics, practical exercises, case studies, and multiple-choice questionnaires.

Link: <https://www.openlearning.com/courses/machine-learning-skills-for-ict-professionals>

## SCOPE

I, the undersigned, hereby declare to support the efforts of the MACHINA project, recognizing the added value of the following project results:

- Evidence-based, measurable and assessable learning outcomes for VET provision in ML methods and applications, (O1).
- Formal VET learning units on ML for ICT workers and VET integration guidelines (O2).
- Open Education Resources (OERs) - for training delivery and learning in ML methods and use cases (O2).
- MACHINA Vocational Open Online Course (VOOC) infrastructures and content in 6 EU languages (O3).
- A statement of support for the (social) recognition of ML learning outcomes (O4)
- The outline and specifications of an EU-wide professional qualification in ML (O4)
- A Blueprint for the integration of ML skills requirements into sectoral competence frameworks and EU/national certification and standardisation schemes (O4).
- Five (5) national information days in France, Germany, Greece, Italy and Romania to share and disseminate MACHINA results (E1-5).

and committing to support, within our capacities and available resources, their wide update and mainstreaming by engaging in the following non-binding activities:

- Widespread dissemination of training materials aimed at enhancing the skills of ICT workers.
- Vocal advocacy vis-à-vis political actors at all levels for a better support of the upskilling of ICT professionals in the ML field.
- Promoting the incorporation of ML skills requirements into the European e-Competence Framework
- Raising awareness on the societal and economic benefits emanating from the development and uptake of Machine Learning (ML) applications and the need of better skilled and qualified ICT professionals.



- Mutual exchange of information and knowledge on public and private initiatives aimed at increasing the quality and supply of skills development opportunities for ICT professionals, VET programmes and apprenticeships schemes.
- Further fostering the recognition of ML related occupational requirements for ICT professionals by economic and social stakeholders.
- Supporting the introduction of a new specialty for “AI/ML specialists” through consultation with national qualification/accreditation authorities

## LEGAL NATURE

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