

**2020-1-HR01-KA226-HE-094713**

**O3 - Distance learning curricula in Machine Learning**

**Curricula description**

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**CODEIN**

Cloud cOmputing for Digital Education INnovation

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**Identification Sheet**

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| **Project Code** | **2020-1-HR01-KA226-HE-094713** |
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## INTRODUCTION

**Name of the Curriculum:** Machine Learning

**Duration of the program:** 150 hrs

The emergence of distance teaching and learning, also due to the recent COVID-19 pandemic, calls for a transformation in how we think about learning. To participate and thrive in a distance learning framework, it is widely believed that students must be right at the center of the learning process and become power learners. This entails developing multifaceted skills that enable them to properly cope with complexity and embrace dynamicity, thus becoming real learners.

The Machine Learning course will allow students to learn and practice machine learning concepts within artificial intelligence. They will be introduced to the terminology, syntax, and steps required to create a machine-learning solution using hands-on, engaging activities.

## INTEGRATED COMPETENCIES (LEARNING OUTCOMES)

1. Learn the fundamentals of machine learning – regression, classification, clustering, and deep learning.
2. Build and optimize (linear, non-linear) data representation models—model performance and comparison.
3. Learn to implement machine learning algorithms in software modules/programs.
4. Select, design and apply machine learning algorithms in practical problems of different natures.
5. Define the problems in machine learning terminology and framework and choose the most relevant approach.
6. Learn to work as a team, improve writing skills (written reports) and speaking skills (project presentation)

## SURVEY ON INDUSTRY PARTNERS (EMPLOYERS)

A survey [1] was conducted among twelve (12) Oracle industry partners to gather feedback on the Machine Learning curriculum. The survey aimed to determine the relevance and necessity of various curriculum components in the context of technology and labor market trends. The processed questionnaire results provided insightful feedback. Here's a summary of the results:

**Geographical representation**: The responses came primarily from Poland, Croatia and Slovenia.

**Company size**: The majority of respondents work in large companies with more than 250 employees and an annual turnover of more than EUR 50 million.

**Respondents' positions:** The respondents held various positions, including Product Manager, Project Manager, and Executive Board Member, providing diverse perspectives from different managerial and executive levels within the companies.

**Work experience:** The work experience with the current employer ranged from 1 to 8 years, while the total work experience in the field varied from 12 to 23 years, demonstrating a mix of mid to senior-level professionals.

**Qualification levels**: The most common qualification level for jobs incorporating curriculum knowledge was Level 6 (undergraduate studies) followed by Level 7.1 (professional/graduate studies).

**Appropriateness of qualification level:** According to the survey results, most of the respondents think that the current level of qualification that covers the curriculum knowledge is suitable for employment in their respective companies. However, it is acknowledged that certain job roles may require a higher level of qualification for better performance.

**Curriculum components evaluation:**

* The fundamentals of machine learning (regression, classification, clustering, deep learning) were considered necessary by a significant majority, highlighting the importance of foundational machine learning knowledge.
* Building and optimizing data representation models was also seen as necessary, with a slight preference towards it being needed in full or for the most part.
* Implementing machine learning algorithms in software was deemed needed for the most part, suggesting a practical application of machine learning skills is highly valued.
* The ability to select, design, and apply machine learning algorithms in practical problems received mixed responses but leaned towards being necessary.
* Defining problems in machine learning terminology and choosing relevant approaches was considered needed for the most part, emphasizing the importance of problem-solving skills in machine learning.
* Teamwork, writing, and speaking skills were recognized as important, with responses indicating these soft skills are needed for the most part or in whole.

## COURSE DURATION AND IMPLEMENTATION

This course comprises 30 hours of lectures, 30 hours of practical exercises and assessments, and 90 hours of independent learning. This course can be elective and worth 4 ECTS points. This curriculum is not copyrighted. It has open access and is available for use by any educational institution or individual interested in independent learning (its open access quarantines transferability).

## PREREQUISITES

**Required**

* Fundamental knowledge of statistics, object-oriented concepts and programming, data structures and recursion

**Suggested**

* Previous experience with programming fundamentals

## TARGET AUDIENCES

**Educators**

* Universities that teach computer science, information communications technology (ICT), data science, business, or a related subject

**Students**

* Students who wish to learn the concepts of machine learning

## LESSON-BY-LESSON TOPICS

### What is Artificial Intelligence?

* Video
* What is Artificial Intelligence (AI)?
* Historical Overview of AI
* Impact of AI in Today's World

### Introduction to Machine Learning

* Video
* Why Now?
* Data vs Information
* Machine Learning Workflow
* Hands-On Lab

### Main categories of Machine Learning

* Video
* Supervised Learning
* Unsupervised Learning
* Structured and Unstructured Data
* Hands-On Lab

### Classification and its applications

* Video
* Logistic Regression
* Naive Bayes
* Decision Trees
* k-Nearest Neighbors (k-NN)
* Hands-On Lab

### Regression and its applications

* Video
* Linear Regression
* Polynomial Regression
* Ridge Regression
* Hands-On Lab

### Clustering and its applications

* Video
* K-Means
* Hierarchical Clustering
* DBSCAN
* Hands-On Lab

### Introduction to Deep Learning

* Video
* Neural Networks
* Simple neuron - Linear Unit
* Single-layer network – Perceptron
* Activation functions
* Hands-On Lab

### Evaluation of Machine Learning Models

* Video
* Importance of evaluation in machine learning
* Evaluation Metrics for Classification
* Evaluation Metrics in Regression Models
* Evaluation Metrics for Clustering
* Hands-On Lab

### Optimization of Machine Learning Models

* Video
* Hyperparameter Tuning
* Regularization Techniques
* Performance Optimization
* Optimization for Resource Constraints
* Hands-On Lab

### Ethics in Machine Learning

* Video
* Bias in Machine Learning
* Privacy and Data Protection
* Transparency and Explainability
* Accountability and Responsibility
* Social Impact and Job Displacement

## REFERENCES

[1] Europian Union, Europass, *The European Qualifications Framework*, Accessed: 18.09.2022. [Online]. Available: https://europa.eu/europass/en/europass-tools/european-qualifications-framework