MACHINA

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1 Management Summary

This document is deliverable O2-T3 "Trainer Handbook", as described in the MACHINA Application Form. The main precedents of this report are the deliverables O1-T4 "Definition of MACHINA learning outcomes", O2-T1 "Grouping of learning outcomes into MACHINA learning units", O2-T2 " Educational Resources" that includes the training exercises, case studies, lectures notes and slide sets components of the learning material and O3-T1 "Identification of suitable platforms to host VOOC infrastructure and content" that includes the learning content in the MOOC platform with testing, adaptation and presentation materials.

The main purpose of this report is to structure the results of O1-T4, O2-T1, O2-T2 and O3-T1, in material and guidelines for trainers which will help them achieve the training goals. This document includes the trainer's guidelines on how to use the training material (slides, videos, case studies and exercises) to maximize the learning outcomes achievement, a short methodology and instructions on how to facilitate the remote training making use of MOOC's supported tools.

2 Introductory notes

2.1 Rationale of MACHINA

Machine learning is an essential branch of Artificial Intelligence. This technique is adopted globally by many top-ranked companies. ML is all about creating algorithms and systems to analyze the process and learn from data. It is the fundamental science technology which processes more data and gives better results. Every business has data which they need to analyze, but the vast amount of data will be difficult to handle manually. Hence AI comes in the rescue, and its branch ML works in this direction.

The expansion of Machine Learning (ML) technologies across the major sectors of the EU economy has brought the need for up-skilling ICT professionals so that they are able to perceive and work on ML applications.
MACHINA is an Erasmus+ project that aims to address this challenge by delivering a modular curriculum and Open Educational Resources (OERs) on ML technology, to increase the relevance of VET provision for ICT professionals to match their competences with the latest ICT developments and promote their employability.

2.2 Duration of Course and Learning Units

The proposed duration of the course is 509 hours. Out of these, 83 hours are allocated to LU1: ML essentials for ICT Professionals; 80 hours – to LU2: Mathematical Foundations; 100 hours – to LU3: ML Algorithms, Programs and Protocols; 80 Hours to LU4: Deep Learning (Advanced); 83 hours to LU5 Communication. The remaining 83 hours are dedicated to LU6: Legislation, Ethics, Project Management related to ML.

The course will consist of theoretical lectures, practical work and individual assignment parts (including the reading material, preparing/solving tutorials, preparing for the course tests).

2.3 Recommended Learner's Background

Target groups of learners include (i) ICT professionals employed in companies building and offering Machine Learning technology, who have some experience in Machine Learning technology and wish to improve themselves by taking suggested course; (ii) I-VET students aspiring to get employed as ML application developers; (iii) project managers who need to understand the need for different blockchain applications and implications of blockchain technology in the key sectors of economy.

3 Trainer Handbook structure

This Handbook acts as an aid to all educators that perform training (in person or online) about ML technology. The Handbook addresses ML Learning Units only and does not extend to other topics of interest in the subject area. Its structure mirrors the MACHINA Curriculum and VOOC due to simplified navigation and why classroom training is pursued in the same setting.

This Handbook is divided in eight chapters, the first chapter is the Management Summary, the second one an introductory note and the third one presents the structure of the document and details the items of the lesson plans.

The fourth chapter describes the different MACHINA learning units with their learning objectives and the expected knowledge and skills to be achieved. Detailed lesson plans for classroom sessions and online use are proposed based on the multimedia content and exercises available; together with the prerequisites to attempt the session.

The fifth chapter presents additional case studies and exercises to maximize the learning outcomes achievement in class and MOOC learning units, according to the expected competences (knowledge and skills) to be achieved.

The sixth chapter offers a short methodology and instructions on how to facilitate the remote training making use of VOOC's supported tools.

The seventh chapter presents the MOOC platform functionalities and explains their use.

3.1 Items of lesson plans

Separate topics within the learning units of the MOOC module are described with specific lesson plan, if suitable.

Lesson plans consist of the following items.

Table 1: Items of lesson plans

ITEM	CONTENT
Setting	Online or in classroom or both.
Duration:	Estimated duration for classroom and online session, split into lecture and practice/individual work.
Lesson beginning:	What meaningful activity will learners complete as soon as they enter the classroom or when starting learning online?
Engage/motivation:	How could learners' interest be sparked? Is there a prior knowledge that should be tapped? Is there vocabulary that must be cleared? Is there brainstorming that students need to complete before the lesson begins?
Whole group instructions:	In classroom: Focus lessons (explicit teaching /modeling, strategy demonstration, shared reading, shared writing, discussion, writing process.
Evaluate understanding/assessment :	How will trainer know if learners have achieved lesson's objective?

Closing activities:	How will trainer tie up loose ends, reinforce/revisit the objective and connect the lesson to the learning unit?
Resources:	What does trainer need in order to teach the lesson? (Computer Lab, Equipment)

4 MACHINA Programme

The MACHINA course, consisting of six learning units, is described in this section.

The learning units are:

- **LU1** ML essentials for ICT professionals,
- **LU2** Mathematical Foundations,
- **LU3** ML Algorithms, Programs and Protocols,
- **LU4** Deep Learning Advances,
- **LU5** Communicating the merits, challenges and implications of Machine Learning technology,
- **LU6** Legislation, Ethics, Project Management related to Machine Learning

Each learning unit is composed of several lessons and each lesson includes 2 or more learning outcomes.

4.1 LU1: Machine Learning essentials for ICT professionals

The aim of this learning unit is to define the essential ML characteristics and addresses the fundamental features of ML applications. It provides a common theoretical background regarding the ML landscape.

The learning objectives of this learning unit are:

1. Giving an overview of the ML characteristics and its different algorithms,
2. Understand the concept behind ML and how to detect patterns from data,
3. Identify different types of applications that use the ML algorithms.

This learning Unit is composed of the following 4 Lessons:

- **Lesson 1** Introduction to ML
- **Lesson 2** Where to apply ML
- **Lesson 3** Machine Learning and Data Processing
- **Lesson 4** Example of ML applications

The lesson 1 has two learning outcomes:

- **LO1** Understand the theoretical principles of Machine Learning
- **LO2** Get a general over view of the different Machine Learning algorithms.

The lesson 2 has two learning outcomes:

- **LO3** Types of the problems that ML algorithms can solve nowadays
- **LO4** How to solve the problems using various Machine Learning techniques

The lesson 3 has one learning outcome:

- **LO5** Understand Data preprocessing and visualization methods

The lesson 4 has two learning outcomes

- **LO6** Understand the elements of ML in applications
- **LO7** Analyse some existing to a given context

After the completion of this unit, the learners should have the ability to explain basic ML concepts, such as Supervised ML, Unsupervised ML, and Reinforcement learning.

Also explain basic principles and applications of ML in education, industrial and finance fields.

4.1.1 Lesson 1: Introduction to ML

4.1.1.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Definition of Machine Learning • What is ML • ML terminologies Applications of Machine Learning in • Education • Finance • Industry Types of Machine Learning • Supervised ML • Unsupervised ML • Reinforcement learning	Capable to Identify Machine Learning methods suitable for the existing problem in the workflow	Identify ML characteristics in different applications. Critically evaluate ML features for an application (in Finance, Industry, Education)

4.1.1.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.

Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "Who knows about ML" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What"s the future of ML" or "Is ML the solution for anything?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like "What"s the future of ML" or "Is ML the solution for anything?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.

Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.1.1.3 Prerequisites

No particular knowledge or experience needed; however, a basic knowledge of ICT and Linear Algebra will help in better understanding the functioning of Machine Learning.

4.1.2 Lesson 2: Where to Apply ML

4.1.2.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Types of problems the Machine Learning algorithms can solve • Classification • Regression • Clustering • Reinforcement Learning Advantages Machine Learning algorithms	Capable to -Identify Machine Learning methods suitable for the existing problem in the workflow. -Solve the problems using various Machine Learning techniques. -Articulate how ML algorithms are fundamentally different from traditional programming algorithms.	Correctly Choose an ML Algorithm for a specific problem.

4.1.2.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Remind the group of learners of the definition of Machine Learning and what are the types of it by asking "What are the different types of ML?"
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "? Do you know what types of problems the ML algorithms can solve?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them.

	Initiate a debate around topics like "Do you know what types of problems the ML algorithms can solve? ".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.1.2.3 Prerequisites

The first lesson of learning unit 1, and a basic knowledge of ICT and Linear Algebra will help in better understanding the functioning of Machine Learning.

4.1.3 Lesson 3: Machine learning and Data processing

4.1.3.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
-Types of data processing techniques. - Data Visualizations technique. -Evaluation metrics for ML algorithms.	Capable to -Identify the different data preprocessing and visualization methods. - split data into training and test datasets.	Correctly evaluate the selected ML algorithm for a given problem.

4.1.3.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "Who knows about data pre-processing" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What"? What are the steps for processing the data of an ML project?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like " Can you name the steps for processing the data of an ML project?

Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.1.3.3 Prerequisites

The first and the second lesson of learning unit 1, and a basic knowledge of ICT and Linear Algebra will help in better understanding the functioning of Machine Learning.

4.1.4 Lesson 4: Example ML Applications

4.1.4.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
- Existing ML applications, related structures, and architectures. - *Examples of different ML applications in various sectors.*	Capable to -Analyze existing ML applications according to a given context	Give an account of the advantages and disadvantages of the features of a specific ML application

4.1.4.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h.

	Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "Who can identify an application that uses ML" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like What"s applications do you know from your everyday life uses ML? Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like "What" are the different areas that can apply ML to facilitate its work?
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.

Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.1.4.3 Prerequisites

The first lesson of learning unit 1, and a basic knowledge of ICT and Linear Algebra will help in better understanding the functioning of Machine Learning.

4.2 LU2: Mathematical foundations

The aim of this learning unit is to Defines the mathematical foundation required for writing programs and algorithms for ML and AI.

The learning objectives of this learning unit are:

1. To break down the difficult mathematical concepts into easier one to understand concepts.
2. To focus on mathematical concepts and algorithms to get full understanding of ML and AI techniques and methodologies.

This learning Unit is composed of the following 5 Lessons:

- **L1** Set, Functions, Relations
- **L2** Linear Algebra
- **L3** Probability Theory
- **L4** Statistics
- **L5** Computation theory

The lesson 1 has five learning outcomes:

-**LO1** To know the definition of sets and basic sets' operations

-**LO2** To know definition of function and basic functions' operations

-**LO3** To know definition of relation, equivalence relation, partition of a set

-**LO4** To know the concept of local minima and derivatives of a function

-**LO5** To be able to compute an approximation of derivative at a point using deltas

The lesson 2 has five learning outcomes:

-**LO6** To know the definition of vector space and basic vector operations

-**LO7** To know the definition of metric

-**LO8** To know the difference between scalar, vector, tensor

-**LO9** To know how calculate the Hadamard product

-**LO10** To know the definition of the gradient of a function

The lesson 3 has six learning outcomes:

-**LO11** To know the frequentist definition of probability of an event

-**LO12** To know the definition of probability as ratio between favourable outcomes on total outcomes

-**LO13** To be able to calculate easy probabilities base on basic combinatorics

-LO14 To know the definition of join probability

-**LO15** To know the definition of independent events

-LO16 to know the definition of conditional probability

-LO17 To know the Bayes Theorem

The lesson 4 has eight learning outcomes:

-LO17 To know the definition of population and sample

-LO18 To know the meaning and to be able to compute mean, median, variance, standard deviation of a population

-LO19 To know the meaning of covariance and correlation

-LO20 To know the meaning of maximum likelihood estimator

-LO21 To know the meaning of univariate and multi variate linear regression and how to compute the parameters

-LO22 To know the definition of correlation matrix

-LO23 To know the meaning of logistic regression

-LO24 To know the definition of precision, recall, confusion matrix

The lesson 5 has six learning outcomes:

-LO25 To know the concept of algorithm

-LO26 To be able to write a simple algorithm as a flow chart

-LO27 To know the basics of procedural programming language (operations, conditions, if-else, while, for)

-LO28 To be able write a simple algorithm in a programming language (Python)

-LO29 To know the basic data structures (sets, lists, associative, arrays)

-LO30 To know the concept of classes, instances, methods

After the completion of this unit the student should have reviewed all basic mathematical and computer science theory and language propaedeutic to ML study.

4.2.1 Lesson 1: Set, Functions, Relations

4.2.1.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Knows / Aware of formal definitions of sets, relations,	-Deciding if an element belongs to a set	Able to: -Describing, analyse and solving a mathematical input-output problem in formal terms

functions, derivatives	-Calculating basic operations on sets -Calculate the domain, range, codomain of a function -Calculate the partition induced by a equivalence relation	

4.2.1.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h Online : 6h Lecture: 3h Practice/Individual work: 3h
Lesson beginning	Assess the importance of set theory for a general formal approach to ML Checking the degree of classroom formal training and background
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples

	and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials
Closing activities	None
Resources	Paper, pencil, board.

4.2.1.3 Prerequisites

No knowledge or experience needed

4.2.2 Lesson 2: Linear Algebra

4.2.2.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Knows / Aware of informal definitions scalars, vectors, vector space, inner and outer products, metrics, linear independence, orthonormal bases, matrices, tensors	Calculate the basic linear algebra operations on matrices and vectors	Representing and manipulating data in tabular form

4.2.2.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h Online : 6h Lecture: 3h Practice/Individual work: 3h
Lesson beginning	Assess the importance of linear algebra to be operative in ML libraries active use
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials
Closing activities	None
Resources	Paper, pencil, board.

4.2.2.3 Prerequisites

No particular knowledge or experience needed

4.2.3 Lesson 3: Probability Theory

4.2.3.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Informal definition of probability of an event, conditional probabilities, Bayes theorem	Capable to calculate probabilities of simple events using combinatorics and conditional probabilities using Bayes' theorem	Estimating likeliness of an event without explicit probability calculation

4.2.3.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h Online: 6h Lecture: 3h Practice/Individual work: 3h
Lesson beginning	Assess the importance of probability theory to be aware its funding role of ML theory

Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials
Closing activities	None
Resources	Paper, pencil, board.

4.2.3.3 Prerequisites

No particular knowledge or experience needed

4.2.4 Lesson 4: Statistics

4.2.4.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Basic informal definitions as population, sample, frequencies, mean , variance, Percentiles,	-Calculate mean and variance of a distribution -using an estimator or a classifier to make predictions	Be able to correctly interpret output results of an algorithm calculating aggregations on a population by standard aggregation functions (min, max, avg, std, ...) - Be able to correctly interpret output results of an algorithm calculating aggregations on a population by standard aggregation functions (min, max, avg, std, ...) univariate and multivariate linear regression

linear regression, logistic regression, likelihood, estimator, classifier		-Reading and interpreting a confusion matrix a classifier -Interpreting the (mean) measure error of an estimator

4.2.4.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h Online : 6h Lecture: 3h Practice/Individual work: 3h
Lesson beginning	Assess the importance of statistics in data analysis and the importance of linear regression theory as starting point and benchmark for general ML algorithms
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials

Closing activities	None
Resources	Paper, pencil, board.

4.2.4.3 Prerequisites

No particular knowledge or experience needed

4.2.5 Lesson 5: Computation theory

4.2.5.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Definition of computational framework, coding language, algorithm	-Capable to read a diagram flux -Capable to describe an easy algorithm formally	-Coding an easy algorithm with some programming language -Using an existing class to implement object and using methods to solve some ML problem

4.2.5.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h Online : 6h Lecture: 3h Practice/Individual work: 3h

Lesson beginning	Introducing informally the python computational framework
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use a real computational framework as Ipython/Jupyter for concepts' exemplification.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials
Closing activities	Developing together with the teacher some IPython notebooks to solve easy data analysis problem on its own pc
Resources	Paper, pencil, board, computational framework

4.2.5.3 Prerequisites

No particular knowledge or experience needed

4.3 LU3: ML Algorithms, Programs and Protocols

The aim of this learning unit is to define the foundational machine learning models and understand how to select the suitable ML model for a given problem and how to implement it in one of the available programming languages.

The learning objectives of this learning unit are:

1. Foundational understanding of machine learning models.
2. Understand some of the essential machine learning algorithms and how to evaluate the performance of them.
3. Identify different programming languages and frameworks that support the implementation of machine learning algorithms.

This learning Unit is composed of the following 6 Lessons:

- **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.

The lesson 1 has two learning outcomes:

- **LO1** Get an overview of ML linear models.
- **LO2** Identify the different ML linear models' algorithms and implementation

The lesson 2 has two learning outcomes:

- **LO3** Get an overview of supervised learning and its utility.
- **LO4** To identify the different algorithms of supervised learning and implementation.

The lesson 3 has two learning outcome:

- **LO5** Get an overview of unsupervised learning and its utility.
- **LO6** Identify the different algorithms of unsupervised learning and implementation.

The lesson 4 has two learning outcomes

- **LO7** Get an overview of semi supervised learning and its utility.
- **LO8** Identify the different algorithms of semi supervised learning, and implementation.

The lesson 5 has one learning outcomes

- **LO9** Obtain an overview of the different programming languages and frameworks available for ML.

The lesson 6 has two learning outcomes

- **LO10** Understand best practices for building machine learning applications.
- **LO11** Identify Hyperparameter Tuning methods.

After the completion of this unit, the learners should have the ability to explain the different ML concepts, Supervised ML, Unsupervised ML, and semi-supervised learning and the different algorithms they have.

4.3.1 Lesson 1: Machine learning by linear models

4.3.1.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Definition of • Regression • Classification Understand of Linear Models	Capable of understanding the different linear models used for Regression and classification analysis	Use the learned Linear model to solve classification or regression ML tasks.

4.3.1.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "Who knows about regression or classification analysis" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like ""What"s mathematical models do you know can be used to solve an ML problem?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them.

	Initiate a debate around topics like " "How you can apply a linear model to solve one of the ML problems?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.3.1.3 Prerequisites

LU1 and LU2, Basic understanding of Linear Algebra, and probability theory.

4.3.2 Lesson 2: Supervised learning

4.3.2.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Definition of • *Supervised Learning* *Supervised Learning Algorithms* • *Support Vector Machines.* • *Decision Trees.*	-Capable of understanding the different supervised ML algorithms -Understand the strengths and weaknesses of Supervised Learning Algorithms	Evaluate and compare the different results of the Supervised Learning Algorithms.

• *Random Forest.* • *Neural Network.*		

4.3.2.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "Who knows about Decision Trees" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What"s *Supervised Learning*?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting

	the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like "What"s classification?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.3.2.3 Prerequisites

LU1 and LU2, Basic understanding of Linear Algebra, and probability theory.

4.3.3 Lesson 3: Unsupervised learning

4.3.3.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Definition of • Unsupervised Learning Unsupervised Learning Algorithms	-Capable of understanding the different unsupervised ML algorithms	Evaluate and compare the different results of the unsupervised Learning Algorithms.

• Clustering. • Dimensionality reduction. • Associative rules analysis.	-Understand the strengths and weaknesses of unsupervised Learning Algorithms	

4.3.3.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "Who knows about K-means clustering" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What"s Un*supervised Learning*?".

	Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like like "What"s clustering?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.3.3.3 Prerequisites

LU1 and LU2, Basic understanding of Linear Algebra, and probability theory.

4.3.4 Lesson 4: Semi supervised learning

4.3.4.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Definition of • *Semi-supervised Learning* *Semi-supervised Learning Algorithms(SSL)* • *SSL-Algorithms* • *Self-training* • *Co-training* • *S3VM* • *Graph-based algorithm*	-Capable of understanding the different semi-supervised ML algorithms -Understand the strengths and weaknesses of semi-supervised Learning Algorithms	Evaluate and compare the different results of the semi-supervised Learning Algorithms.

4.3.4.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.

Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "Who knows about semi-supervised" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What"s semi-*Supervised Learning*?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like "What"s semi-*Supervised Learning*?". .
Closing activities	Summarize the main key elements learned and provide common feedback based on learner

	inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.3.4.3 Prerequisites

LU1 and LU2, Basic understanding of Linear Algebra, and probability theory.

4.3.5 Lesson 5: Programming languages and frameworks for Machine learning algorithms

4.3.5.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Machine learning programming languages for solving problems (Python, Matlab, R,...)	Understand the strengths and weaknesses of many popular machine learning frameworks.	Be able to choose a suitable programming language for your ML project

4.3.5.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "what programming languages do you know for ML" questions.

Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like " What are the top programming languages used in ML projects?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like can you guess the top 3 programming languages used in ML projects?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.3.5.3 Prerequisites

LU1 and LU2

4.3.6 Lesson 6: Best practices for ML

4.3.6.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Define the best practices for building machine learning applications.	Identify the strength and weaknesses of the ML algorithms that can be applied to a specific problem.	Be able to choose the correct ML algorithm for any problem and dataset

4.3.6.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "what programming languages do you know for ML" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.

Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like ""What's the best way to choose an ML algorithm parameter??". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like ""What's the best way to choose an ML algorithm parameter?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.3.6.3 Prerequisites

LU1 and LU2, LU3, L1,2,3,4,5.

4.4 LU4: Deep Learning (Advanced)

The aim of this learning unit is to is a general treatment of basic concepts relating most common neural networks models used in real application, i.e.: Multilayer Perceptron, Convolutional Networks, Recurrent Networks, Restricted Boltzmann Machines

The learning objectives of this learning unit are:

- To understand the important details about deep neural networks and get to know of different deep neural network architecture.
- To identify the potential of deep learning in different applications such as natural language processing, computer vision, or recommendation systems.

This learning Unit is composed of the following 4 Lessons:

- **L1** Multilayer Perceptron (MLP)
- **L2** Convolutional Neural Networks (CNN)
- **L3** Recurrent Neural Networks (RNN)
- **L4** Autoencoders (AE), Restricted Boltzmann Machines (RBM)

The lesson 1 has eight learning outcomes:

-**LO1** To know the definition of MLP
-**LO2** To know when to use MLP model
-**LO3** To know definition of different activation functions
-**LO4** To know basic cost functions' definition
-**LO5** To know common gradient descent techniques to minimize cost functions
-**LO6** To know general principles of back propagation algorithm
-**LO7** To know how to tune model fitting

-**LO8** To be able to implement, train, tuning and validate a MLP model using Keras API

The lesson 2 has six learning outcomes:

-**LO9** To know basic CNN filters

-**LO10** To know when to use CNN model

-**LO11** To know basic CNN architectures

-**LO12** To know basic concepts about transfer learning, end-to-end learning, multi-task learning

-**LO13** To be able to implement, train, tuning and validate a CNN model using Keras API

-**LO14** To be able to import a pre-trained CNN to solve specific problem

The lesson 3 has six learning outcomes:

-**LO15** To know the definition of RNN

-**LO16** To know what a sequence model is

-**LO17** To know when to use RNN model

-**LO18** To know basic RNN architectures and modules (GRU, LSTM)

-**LO19** To know word2vec and word-embedding techniques

-**LO20** To be able to implement, train, tuning and validate a RNN model using Keras API

The lesson 4 has four learning outcomes:

-**LO21** To know the definition of AE

-**LO22** To know the definition of RBM

-**LO23** To be able to implement, train, tuning and validate a AE model using Keras API

-**LO24** To be able to implement, train, tuning and validate a RBM model using Keras API

After the completion of this unit the student should have a general knowledge and survey of all main technologies used in production that are under the name of "Deep Learning"

4.4.1 Lesson 1: Multilayer Perceptron (MLP)

4.4.1.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
-Perceptron - Activation functions - Cost functions - Learning -Gradient descent -Multi-layer perceptron and its universality - Parameters and hyper-parameters	To use a framework to implement, train and validate a MLP machine learning model	-To understand which class of problems could be solved with (and only with) a deep learning approach -To design and develop a deep learning model to solve those problems -To optimize the used technology for best performances (using scalable technologies, fine tuning parameters and hyper-parameters)

4.4.1.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h

	Online : 6h Lecture: 3h Practice/Individual work: 3h
Lesson beginning	Introduce the single perceptron model by analogy with linear regression and logistic regression, stressing the same underlying input linear structure and different output nonlinear activation
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials – Lab activity
Closing activities	None
Resources	Paper, pencil, board. Computational framework

4.4.1.3 Prerequisites

LU1, LU2, LU3

4.4.2 Lesson 2: Convolutional Neural Networks (CNN)

4.4.2.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Convolutional neural networks - Convolution filters - Edge detection - Padding -Stride convolution transfer learning, end-to-end learning, multi-task learning	To use a framework to implement, train and validate a CNN machine learning model	-To understand which class of problems could be solved with (and only with) a CNN deep learning approach -To design and develop a CNN deep learning model to solve those problems -To optimize the used technology for best performances (using scalable technologies, fine tuning parameters, and hyper-parameters)

4.4.2.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h Online: 6h Lecture: 3h Practice/Individual work: 3h
Lesson beginning	Introduce the CNN with the problem of input dimensionality reduction

Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials – Lab activity
Closing activities	None
Resources	Paper, pencil, board. Computational framework

4.4.2.3 Prerequisites

LU1, LU2, LU3, LU4-lesson1

4.4.3 Lesson 3: Recurrent Neural Networks (RNN)

4.4.3.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Recurrent neural networks - Sequence models-Long-short term memories - Gated Recurrent Unit-	To use a framework to implement, train and validate a RNN machine learning model	-To understand which class of problems could be solved with (and only with) a RNN deep learning approach -To design and develop a RNN deep learning model to solve those problems -To optimize the used technology for best performances (using scalable technologies, fine tuning parameters, and hyper-parameters)

word2vec-word-embedding		

4.4.3.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h Online : 6h Lecture: 3h Practice/Individual work: 3h
Lesson beginning	Introduce the RNN with the problem of unknow input and output sequence length and the utility of having units with memory capacities
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials – Lab activity

Closing activities	None
Resources	Paper, pencil, board. Computational framework

4.4.3.3 Prerequisites

LU1, LU2, LU3, LU4-lesson1

4.4.4 Lesson 4: Autoencoders (AE), Restricted Boltzmann Machines (RBM)

4.4.4.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
-Auto-encoders - Restricted Boltzmann machines	To use a framework to implement, train and validate a AE-RBM machine learning model	-To understand which class of problems could be solved with (and only with) a AE-RBM deep learning approach -To design and develop a AE-RBM deep learning model to solve those problems -To optimize the used technology for best performances (using scalable technologies, fine tuning parameters, and hyper-parameters)

4.4.4.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture: 6h Practice/Individual work: 4h

	Online: 6h Lecture: 3h Practice/Individual work: 3h
Lesson beginning	Introduce the AE and RBM in the context of self-supervised and unsupervised learning using NN architectures
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes
Evaluate understanding/assessment	Checking the results of individual assignments provided in the learning materials – Lab activity
Closing activities	None
Resources	Paper, pencil, board. Computational framework

4.4.4.3 Prerequisites

LU1, LU2, LU3, LU4-lesson1

4.5 LU5 Communicating the merits, challenges and implications of ML technology to customers and within own organization

The aim of this learning unit is to address the fundamental communication principles and personal communication strengths and weaknesses as well as define the various technologies and approaches to accomplish communicative goals.

The learning objectives of this learning unit are:

1. Giving an overview of the basic communication principles and practices,
2. Understand the components of effective communication and ways for using Machine Learning in Communications,
3. Identify different types of application of ML in communication environments (eg. at the workplace).

This learning Unit is composed of the following 4 Lessons:

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

The lesson 1 has 5 learning outcomes:

- **LO1** Fundamental communication principles and practices
- **LO2** Select creative and appropriate modalities and technologies to accomplish communicative goals
- **LO3** To know the importance of communication in the 21st Century
- **LO4** To know the different methods of effective business communication in brief
- **LO5** To know about the ML involvement in communication and organisations

The lesson 2 has 4 learning outcomes:

- **LO1** Differentiate between various approaches of communicating issues
- **LO2** To know the components of communication
- **LO3** Present messages in multiple communication

- **LO4** To understand how machine learning and artificial intelligence can help organizations and communications

The lesson 3 has 3 learning outcomes:

- **LO1** To understand the positive communication
- **LO2** To understand the role of AI and Machine Learning
- **LO3** To understand the relation between new media and communication

The lesson 4 has 3 learning outcomes:

- **LO1** Identify contexts, situations and barriers that impede communication self-efficacy
- **LU2** Adapt messages to the diverse needs of individuals, groups and contexts
- **LU3** Differentiate between various approaches of communicating issues

After the completion of this unit, the learners should have the ability to explain basic concepts of communication and ML concepts, such as New media, to understand the importance of Communication in Business, and explain basic principles and applications of ML in communication and in organisations, to know the characteristics and methods of effective communication and understand the ways in which business organizations can take advantage of the fast development of technology.

1.1.1 Lesson 1: Introduction to communication and ML involvement

1.1.1.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Applications of Machine Learning • Communication in ML • Interpersonal Skills • Methods of Effective Business Communication • ML involvement	Capable to understand the basic concepts of communication: what is communication, what are the characteristics of communication, methods of effective business communication and ML involvement in communication.	Identify the role of communication in society and business from the perspective of communication characteristics. Analyse and understand the ways in which business organizations can take advantage of the fast development of technology. Identify and understand the effective business communication methods and some of the benefits of effective communication in an organization.

1.1.1.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 21h Lecture: 10h; practice/individual work 11h. Online: 21h Lecture: 8h; practice/individual work 13h.

Setting	Online or in classroom
Lesson beginning	Assess the awareness of the group of learners (Machine Learning, …) using "Who knows about…" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood. Online: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment and present on their findings for the class. Open a live online debate about topics like "What"s the future of ML" or "Is ML the solution for anything?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them.

Setting	Online or in classroom
	Initiate a debate around topics like "What"s the future of ML" or "Is ML the solution for anything?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises. More online resources and possible topics for discussion: • *The Role of Communication in Society* - https://www.youtube.com/watch?v=y15zc6meS4o • *Role and Importance of Communication* - https://www.youtube.com/watch?v=qNrwhyz-nzs • *Effective Communication: Why is it Important in Management?* - https://www.youtube.com/watch?v=nIQhHEWpdWs • *5 Ways To Develop Effective Business Communication* - https://www.youtube.com/watch?v=yfneUJ4W6Lo • *Characteristics of Effective Communication* - https://www.youtube.com/watch?v=LrjlW00kkws • *EFFECTIVE COMMUNICATION IN THE WORKPLACE* -

Setting	Online or in classroom
	https://www.youtube.com/watch?v=1-RuWoE_Mmw • *Methods of Communication in Business* - https://www.youtube.com/watch?v=w_oQ5JLSZGE • *The Advantages & Disadvantages of Technology* - *https://www.youtube.com/watch?v=5r4NzvO9Cg4* • *What are Interpersonal Skills* - *https://www.youtube.com/watch?v=VoUkP63O4Ik*

1.1.1.3 Prerequisites

No particular knowledge or experience needed, however a basic knowledge of communication will help.

1.1.2 Lesson 2: Types, levels, components of effective communication and ways for using Machine Learning in Communication

1.1.2.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Applications of Machine Learning • Types of Communication • Levels of Communication • Ways for using Machine Learning in organisation and communications • Artificial intelligence and business today	Capable to understand and know about types, levels, and components of effective communication, as well as the use of Machine Learning in Communication.	Identify the types of communication and understand their characteristics. Analyse the levels of communication and discover what are the impact of machine learning on this. Identify the ways that machine learning and artificial intelligence can help organisations and Communications.

1.1.2.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 25h Lecture: 12h; practice/individual work 13h. Online: 25h Lecture: 10h; practice/individual work 15h.

Setting	Online or in classroom
Lesson beginning	Assess the awareness of the group of learners (Machine Learning, …) using "Who knows about…" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes. Use exercises like: **Design a machine learning system sketch to suggest a set of keywords for a long text that synthetizes the text content using a recurrent neural network model.**
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What"s the future of ML" or "Is ML the solution for anything?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them. *Study case – chat bot*

Setting	Online or in classroom
	https://towardsdatascience.com/how-to-create-a-chatbot-with-python-deep-learning-in-less-than-an-hour-56a063bdfc44 Initiate a debate around topics like "What"s the future of ML" or "Is ML the solution for anything?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises. • More resources for exercise https://stanford.edu/~shervine/teaching/cs-230/cheatsheet-recurrent-neural-networks • Verbal Vs Non-verbal Communication: Difference between them with examples & comparison chart - https://www.youtube.com/watch?v=akfatVK5h3Y • Process and Levels of Communication - https://www.youtube.com/watch?v=SYINeVtPn-c • Communication Skills For Workplace Success- https://www.youtube.com/watch?v=_ywNxbf4JyM • 10 Barriers to Effective Communication - https://www.youtube.com/watch?v=slq1nAhZuqE

Setting	Online or in classroom
	• How can Artificial Intelligence be used in businesses? - https://www.youtube.com/watch?v=hLSDcAxmPJg • What is Artificial Intelligence| How does it help in communication - https://www.youtube.com/watch?v=Z1eOPpTcyy0 • How Artificial Intelligence is Transforming Business - https://www.youtube.com/watch?v=mz4eyl0mC7A • Top 10 Artificial Intelligence Technologies In 2021 - https://www.youtube.com/watch?v=by-WC6gJ1yM

1.1.2.3 Prerequisites

No particular knowledge or experience needed, however a basic knowledge of communication and AI basics will help.

1.1.3 Lesson 3: The future of communication in accordance with artificial intelligence

1.1.3.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Applications of Machine Learning • AI in Communication • New Media	Capable to • understand the positive communication • Identify contexts, situations and barriers that impede communicating	Identify ML characteristics in a given setting for communication. Analyse existing ML applications according to a given context – for communication purposes

1.1.3.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 22h Lecture: 10h; practice/individual work 12h. Online: 22h Lecture: 6h; practice/individual work 16h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning, …) using "Who knows about…" questions.
Engage/motivation	Classroom: Make sure the fundamental elements are understood, use practical examples and ask open

Setting	Online or in classroom
	questions to ensure the basics and the vocabulary are understood. Online: Make sure the fundamental elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes. Use exercises such as: **Using Python: design, implement and validate a machine learning system to classify if a sentence is polite/unpolite/neutral**
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the examples of ML application and comment on their findings. Start a new topic in a forum with open questions like "Is ML the solution for better communication?", "Are there any risks involved?". Classroom: Initiate a debate around topics like "Is ML the solution for better communication?", "Are there any risks involved?"
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of MLin communication.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

Setting	Online or in classroom
	https://scikit-learn.org/stable/modules/feature_extraction.html#text-feature-extraction More online resources and possible topics for discussion • Prof Andrea Goldsmith: Can machine learning trump theory in communication system design? https://www.youtube.com/watch?v=7L4PHaYP6O4 • Configuring MIMO Communication Links with Machine Learning https://www.youtube.com/watch?v=98cQb1B2sks • Machine Learning for Wireless [Wireless Future Podcast] https://www.youtube.com/watch?v=Mx-z6KQPJJc • Introduction to New Media https://www.youtube.com/watch?v=XzCTAHM81hc • Artificial intelligence & interpersonal communication (Lecture 6 INTRO COURSE AI in COMMUNICATION) https://www.youtube.com/watch?v=t_fduq7SY7I • Artificial intelligence & the future of communication (Lecture 7 INTRO COURSE AI in COMMUNICATION)

Setting	Online or in classroom
	https://www.youtube.com/watch?v=3tIW6oO8dl8 • Artificial intelligence and the media (Lecture 4 INTRO COURSE on AI IN COMMUNICATION) https://www.youtube.com/watch?v=fRTaZz_EuzM • How does artificial intelligence influence communication? (Lecture 3 INTRO COURSE AI/COMMUNICATION) https://www.youtube.com/watch?v=ZoFnkcmYtvs • The Role of Deep Learning in Communication Systems - https://www.youtube.com/watch?v=vG2oyXECG-8

1.1.3.3 Prerequisites

No particular knowledge or experience needed, however a basic knowledge of communication (including online technology) will help.

1.1.4 Lesson 4: The effects of artificial intelligence in communication

1.1.4.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Applications of Machine Learning • AI in communication at the workplace	Capable to: • Apply communication principles and practices	Identify ML characteristics used for effective communication at the workplace. Evaluate the risks of using AI features in communication at the workplace.

1.1.4.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 15h Lecture: 6h; practice/individual work 9h. Online: 15h Lecture: 4h; practice/individual work 11h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning, …) using "Who knows about…" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood. Online: Make sure the fundamental technical elements are understood, use practical examples and ask open

Setting	Online or in classroom
	questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Start online debate on topics like "How does ML influence the workplace?" or "Is ML the solution for anything?". Classroom: Initiate a debate around topics like "How does ML influence the workplace" or "Is ML the solution for anything?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises. More online resources and possible discussion topics: • "Artificial Intelligence and the Future of Work" | Andy Chan | TEDxStLawrenceU https://www.youtube.com/watch?v=bScAMuegX7Y • AI & The Future of Work | Volker Hirsch | TEDxManchester https://www.youtube.com/watch?v=dRw4d2Si8LA • What Are The Negative Impacts Of Artificial Intelligence (AI)? -

Setting	Online or in classroom
	https://www.youtube.com/watch?v=P6vwNM_ecFk • The future of AI: risks and challenges - https://www.youtube.com/watch?v=peGV0aNaTfg

1.1.4.3 Prerequisites

No particular knowledge or experience needed, however a basic knowledge of communication (including online technology) will help.

4.6 LU6 Legislation

The aim of this learning unit is to introduce the Legislation and EU law and regulations for AI and ML applications. Understand the life cycle and cost/benefits for a machine learning project.

The learning objectives of this learning unit are:

1. Understand the EU law and regulations for AI and ML applications.
2. Identify the different types of bias in AI and their consequences.
3. Know the project management requirement and lifecycle for AI applications.
4. Identify Data value and cost models.

This learning Unit is composed of the following 4 Lessons:

- **Lesson 1** EU guidelines on ethics in artificial intelligence.
- **Lesson 2** Bias in Machine learning.

- **Lesson 3** Software engineering for AI applications.
- **Lesson 4** Data value and cost models /Project Management.

The lesson 1 has 4 learning outcomes:

- **LO1** Get an overview of the EU ethics for AI and ML applications.
- **LO2** Identify the AI Regulation for AI applications.
- **LO3** Get an overview of the data market.
- **LO4** Identify regulations on data source models.

The lesson 2 has two learning outcomes:

- **LO5** Get a look at the bias in ML.
- **LO6** Identify the different types of machine learning bias.

The lesson 3 has two learning outcomes:

- **LO7** Understand the project Lifecycle for an AI application.
- **LO8** Get an overview of the software architecture used for an AI application.

The lesson 4 has two learning outcomes :

- **LO9** Get an overview of project management
- **LO10** Define a data collection project.

After completing this unit, the learners should have the ability to identify the EU law and regulations for AI and ML applications and understand the different types of ML biases. Moreover, learners should determine the project management requirement and lifecycle for AI applications.

4.6.1 Lesson 1: EU guidelines on ethics in artificial intelligence

4.6.1.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Identify • *The EU ethics for AI and ML applications.* • *The EU Regulation for AI applications*	Capable of understanding the different EU ethics and regulations for AI and ML applications	Define Terms and conditions for an AI application.

4.6.1.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "What EU regulations do you know for AI applications" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.

Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What"s EU guidelines do you know about ML applications?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them.
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.6.1.3 Prerequisites

No particular knowledge or experience needed.

4.6.2 Lesson 2: Bias in Machine learning

4.6.2.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
Identify - the different types of machine learning bias.	Capable of defining the bias in the application and mitigating it.	Capable of avoiding data bias in ML application

4.6.2.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "What you know about bias in ML" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online:

	Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What"s the bias in ML". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like "What"s the databias".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.6.2.3 Prerequisites

LU1

4.6.3 Lesson 3: Software engineering for AI applications

4.6.3.1 Targeted Knowledges and Skills

Knowledge	Skills	Competency
-The definition of Software engineering and AI. -Identify the Main types of the software architecture: Layered architecture. Tiered architecture. Service-oriented architecture. Microservice architecture.	Characterize a system / Identify software-based requirements	Analyze a system Build a decision support system using data analysis and machine learning

4.6.3.2 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "What you know about bias in ML" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings.

	Start a new topic in a forum with open questions like "What"s the ML project lifecycle". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a debate around topics like "why it is important to have an ML project lifecycle?".
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.6.3.3 Prerequisites

LU1

4.6.4 Lesson 4: Data Value and Cost Models / Project management

4.6.5 *Targeted Knowledges and Skills*

Knowledge	Skills	Competency
Identify • *Data value models* • *Different data sources* • *Impact of the E regulation on data sources*	Capable of understanding the constraints (costs / term of service…) associated to different data sources	Define a strategy to get the proper data for ML and adjust the Terms of service

4.6.5.1 Lesson plans

Setting	Online or in classroom
Duration:	Classroom: 10h Lecture:4h; practice/individual work 6h. Online: 10h.
Lesson beginning	Assess the awareness of the group of learners (Machine Learning) using "What do you consider while selecting a data source" / "What is a data pricing" questions.
Engage/motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples

	and ask open questions to ensure the basics and the vocabulary are understood.
Whole group instructions	Yes.
Evaluate understanding/assessment	Online: Individual task: Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What kind of data source do you know, what are the associated costs / constraints". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them.
Closing activities	Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of ML technology.
Resources	Paper, pencil, board. If possible computer classroom for individual exercises.

4.6.6 *Prerequisites*

LU6 lesson 1

5 Case studies and Exercises

Each of the four learning units includes one or more case studies, multiple choice questions, exercises, and FAQs when needed.

5.1 Case studies

A case study brings to life real business scenarios by addressing an organisation dilemma. Case studies are a proven and well-stablished technique. They enable students to apply theoretical concepts in real world situations.

Cases come in numerous formats - from a simple "What would you do in this situation?" question to a detailed description of a situation with accompanying data to analyse.

By studying case study examples students will be actively engaged in figuring out the solutions; developing their skills in:

- Problem solving
- Using analytical tools, both quantitative and qualitative
- Decision making in complex situations
- Coping with ambiguities
- Learning how to apply optimal solutions in similar situations

The available case studies are in Annex 1 to this document; we also encourage teachers to develop their own case studies or adapt the existing ones in order to better address their students' needs.

5.2 Exercises

Each learning unit contains one or more theoretical or practical exercises. The different kinds of exercises are:

- Multiple-choice questions
- Short answer questions
- Time categorization exercises
- Essay questions

One of the advantages of multiple-choice questions is that the actual answer is visible. In many cases a student may very well know the answer to a question but is unable to recall it due to issues with memory or feeling pressurised in an exam situation. Seeing the answer could well trigger the memory to enable a correct answer to be given. Multiple-choice questions are short and sharp which means that more of them can be posed in a test situation to give a student a more thorough examination of how much they understand about a given subject.

Short answer questions are open-ended questions that require learners to create a concise answer to the question. They are commonly used in examinations to assess the basic knowledge and understanding of a topic before more in-depth assessment questions.

In timed categorization exercises the learner has a limited amount of time (seconds or minutes) to identify items that belong to a particular group or theme. This type of question apart from specialized field knowledge also requires speed and logic.

Essay exercise enable a student to demonstrate his depth of understanding about a given subject. Answers can vary in length but students know they need to know a lot about subjects to be able to respond creatively, usually with an essay which gives a

discussion-style response. As there is no way of bluffing through this type of questioning by guessing the correct answer, it could be argued that it provides a thorough and rigorous test of knowledge.

The available exercises are in Annex 2 to this document; like for the case studies, we also encourage teachers to develop their own exercises or adapt the existing ones in order to better address their students' needs.

6 Organization of teaching using the MACHINA VOOC

The incorporation of VOOCs as a way of teaching/learning in the environment of connectivism involves not only the overcrowding of students but also the emergence of new professional roles, trying to somehow mitigate the absence of existing custom tutorial attention in traditional distance learning courses and somehow achieve greater empathy with the students so that you are not alone "institutionally".

These new figures can highlight emerging among others, two in particular: curators (MOOC content developers) and facilitators (learning MOOC's supporters). In this guide we'll try to help you become excellent "facilitators".
The primary means of communication in a MOOC may be:

- A learning management system such as Moodle or Blackboard
- Online groups such as Yahoo or Google groups
- An aggregation of various distributed platforms, such as blogs and Twitter.

Learners who are new to MOOCs, and who are not familiar with self-directed learning, often struggle to find their place within a MOOC.

In this chapter, we offer a few recommendations that will help teachers and, consequently, learners to make the most of a MOOC experience.

6.1 Before a MOOC starts

When someone is thinking about participating in a MOOC, the first question they should ask themselves is this: "Is this the right MOOC for me?".
The MOOCs may have prerequisites, the content may be too basic, or it may not be of interest to the individual.

-Before a learner decides to join the MOOC, the Facilitator MOOC should always suggest to see carefully the MOOC's website. The MOOC website contains the prerequisites, participation guidelines, information on the course structure, the topics, and course resources. Review these prior to starting the course in order to get a better idea of how the MOOC is structured and to figure out how much time to spend. If a learner doesn't meet all prerequisites, shouldn't discourage them; there are Facilitator MOOC and subject matter experts participating who help to learning and they can give answers and explanations.

6.1.1 Consider time

In addition to prerequisites, it is important suggest to the learners to consider the time requirements. If someone doesn't have the time, perhaps attending every week of the MOOC isn't what that learner should focus on. In MOOCs, like in other experiences in life, what someone learns is based on how much effort they put into it. Individuals will have a richer experience if they can contribute throughout the course and if they interact with other participants; however, if even if someone is too busy, then they can still have a worthwhile MOOC experience by selecting the specific topics where are of most interest to them. Those who try to do everything, and who don't have enough time, are apt to only engage with the content and fellow

participants in a peripheral way. If you wish to have a deeper learning experience, then choose the topics of greatest interest and set aside the time to investigate and contribute.

6.1.2 Format and technology MOOC

Before the MOOC starts, the facilitator MOOC recommends the interested person to take some time to become familiar with the technology they will use. This will allow the participant to focus his or her MOOC time on the content and on interacting with other participants, rather than fiddling with the delivery technologies the course uses.

6.2 During the MOOC

Once a participant has registered for the MOOC, it's time to learn. What to do first?

6.2.1 Participation

To get the most out of a MOOC, the facilitator must solicit the person to participate to the discussion forum. The more someone participates, the more that person is likely to make meaningful connections with other participants, which in turn helps deepen the learning experience.

There is a benefit in reading the materials for all and participating as much as possible. Remember, it's not just about the materials, but rather it's about the materials and the learning community— and every participant is part of that learning community. By participating constant, learners can gain both a better understanding and an expanded understanding through the contributions of their peers.

How does one participate in a MOOC? The first step is to read what the facilitators have posted as resources for the topics. This material acts as an initiation into the topic, and quite often it functions to seed discussion. After reading the material, a

participant can choose to investigate the topic further by finding their own readings or they can post their reflections on the resources.

When creating a post about the readings, participants should try to link the course content to their life experiences, as these reflections are valuable to them and to others who read the posts. It is important to take some time to read other participant's reflections, as they are likely to share insights and help deepen understanding of the topic. If a participant finds a particularly useful additional resource, they should share it with the larger community. When participants find that a post was particularly meaningful to them, they often take a moment or two to reply to it, and perhaps share their own insight. This dialogue encourages participation and helps to foster deeper meaning through connections and conversations.

6.2.2 Formal and informal facilitation

MOOCs are facilitated, they are not taught. MOOC facilitators are individuals passionate about the topic they are facilitating, and they have come to share their passion with the participants. There is no single person that checks to see that people are participating or to encourage further participation. Each participant shares the responsibility for keeping the community alive and active. The facilitators are not likely to answer everyone's questions, as they rely heavily on the community to support the conversations. In the end it's through peer learning and peer-to-peer connections that learning occurs in MOOCs, so it's critical for each participant to reach out and connect with someone.

6.2.3 Questions

If a participant has questions, they must feel free to ask the facilitators! Asking questions means not only closing open gaps in knowledge, it also gives everyone an opportunity to discover other potential gaps—things that they didn't know that they

don't know—and thus gives them an opportunity to fill those gaps as well. In the same vein, if a participant knows the answer to a question that someone else has posted (or has an opinion about the answer), they should feel free to post a reply. It is through these conversations that meaningful learning occurs.

6.2.4 Dealing with mass

MOOCs are massive; after all, that is what the "M" in MOOC stands for. They are massive in terms of the number of participants, and are generally massive in the number of conversations that occur. To avoid the feeling of information overload, or the feeling of being overwhelmed, participants must give themselves permission to not read everything. In a regular course, the teacher filters information to avoid this overload. In a MOOC, this is facilitator's and each participant's job. Because it is often not possible to read everything, individuals must filter for topics that they want to read, and then read and respond to only those. If a blog post and discussions are interesting but it's not possible to read the details right away, participants can bookmark them. This way, when there is a spare moment—for example, on the train going home—a learner can return to those readings. The nice thing about MOOCs is that even though the MOOC itself is time-bound, the content is not. Everyone can always go back to MOOC content (and participant blogs and discussions) long after the MOOC is over—it's not necessary to process all the information immediately.

6.2.5 Etiquette

Before we finish this section, we'd like to discuss MOOC etiquette. To help reduce information overload, before sharing resources or posting a question, the facilitator should be advised participants to search to see if someone has already posted about it. If someone has, the best approach is to reply within that thread rather than create a new one. For example, if there is an introductions thread, participants should post

their introductions within that thread. In addition, when replying to a message, it's not necessary to quote the entire message within the reply. The best practice is to edit the quoted text to only include the portions that are relevant to the reply. Finally, spelling does matter. Proofreading posts and checking them for spelling mistakes and typos makes it easier for others to read. This is especially important when MOOC participants do not speak English very well and may rely on some automated translation tools for language assistance.

6.3 Post-MOOC: stay connected!

Even when the MOOC is over, the learning doesn't have to stop! The Facilitators must always suggest to people who introduced themselves probably shared with the group their blog, Twitter, and LinkedIn addresses to continue contact. Chances are that they are still thinking about the topics and materials discussed in the MOOC. They may even be posting their reflections on the completion of the MOOC. Others may have already connected with these individuals on Twitter, LinkedIn, and their blogs while the MOOC was in session, so keeping up with what they write, and commenting back on those posts, isn't going to be much of an issue. It is good to connect while everyone's contributions to the MOOC are still familiar. Thus, any new developments and news on the topic of the MOOC will be available to everyone in their network through the magic that is RSS. Since participants commonly blog for some time about the MOOC discussion topics, and chances are high that other participants are following their blogs, they are also contributing to the knowledge creation of a large group as well!

Finally, now that the MOOC is over, participants likely have more free time for collaboration. They can reach out to some fellow MOOC participants who have similar ideas to theirs. An ad-hoc working group would be simple to organize to explore topics of mutual interest. These topics may be research-based or practice-based. The

point is that there are probably professionals out there who are thinking of things to work on based on their MOOC experiences, but it would be easier to accomplish with a small group of like-minded individuals than working on solving the problem on their own. Through extended practice and collaboration come greater opportunities.

7 The MACHINA Vocational Open Online Course (VOOC)

7.1 What is a MOOC/VOOC?

Massive Open Online Courses (MOOCs) are free online courses in different disciplines and fields of study, organised around an open, publicly-shared curriculum, available for anyone to enrol. MOOCs provide an affordable and flexible way to acquire new skills, foster personal development and career advancement though informal quality educational experiences at scale. Typically, MOOCs integrate social networking, accessible online resources, and are either self-paced or facilitated by experienced trainers in the field of study. MOOCs build on the engagement of learners who are at the centre of the learning process and self-organize their participation according to their own learning goals and skill development needs, prior knowledge and educational background, and available time and resources.

- **Course:** A MOOC/VOOC supports the attainment of learning outcomes after certain activities within in a given period of time. It comprises learning materials and some kind of formative evaluation method to assess the knowledge acquired by learners. It involves facilitators and learners, and enables the interaction among students and between students and facilitators.
- **Open:** On one hand, a MOOC should provide open and free access to educational resources and learning activities, which means that learners can

enrol and attend the course without paying (however it is a common practice that some features such as obtaining a certificate or the assessment of work assignments are provided with charge). On the other hand, a MOOC should be open to anyone without prerequisites such as country of origin, previous qualifications, or specific grades.

- **Online:** Course content is always available, over the internet, and through different devices. A MOOC does not require the physical attendance of learners at a classroom.
- **Massive:** A MOOC has no limitation on the number of participants, supporting the participation of thousands of learners from around the globe. Learners become part of the course by engaging with other people's work, and everybody learns from the work of the other participants.
- **Vocational:** A VOOC, as compared to MOOCs, has a vocational focus. It provides targeted, bit-size training opportunities to particular occupational groups that need to upgrade their skills and keep pace with the developments in their field (such as ICT professionals). VOOCs are designed to fill occupational skills needs/gaps with flexible, modular and interactive e-learning offerings that take into account VET teaching and learning particularities, and can be adapted to participants' individual needs and training priorities. The term "VOOC" was first coined by the European Commission within the call for sector skills alliances (Applicants' guidelines - 04/2017)

7.2 The MACHINA VOOC: Scope and structure

The MACHINA Vocational Open Online Course (VOOC) is a self-guided online course that acts as a wide access delivery method for the MACHINA curriculum. It has been designed to reflect the structure of the developed curriculum, as organized around learning units and lessons, and comprises the project's training and assessment materials, in an online form (text, presentations, multimedia files, interactive tools,

and exercises). The MACHINA VOOC primary relies on visual materials such as presentations, videos, info graphics, instructional mock-ups, and all textual descriptions are accompanied by visual aids to facilitate learners' understanding. The MACHINA VOOC integrates also additional pedagogical resources such as video units, info graphics, exercises that support auto-assessment, and collaboration mechanisms, aiming to provide an optimal learning experience with increased collaboration opportunities. The MACHINA online course is structured around 6 learning units, which are further broken down into 28 lessons.

Learning Unit 1: ML essentials for ICT professionals

- L1.1: Introduction to ML
- L1.2: Where to apply ML
- L1.3: Machine learning and Data processing
- L1.4: Examples of ML applications

Learning Unit 2: Mathematical Foundations

- L2.1: Set, Functions, Relations
- L2.2: Linear Algebra
- L2.3: Probability Theory
- L2.4: Statistics
- L2.5: Computational Theory

Learning Unit 3: ML Algorithms, Programs and Protocols

- L3.1: Machine learning by linear models
- L3.2: Supervised Learning
- L3.3: Unsupervised Learning
- L3.4: Semi-supervised Learning
- L3.5: Programming languages and frameworks for Machine learning algorithms
- L3.6: Best practices for ML

Learning Unit 4: Deep Learning

- L4.1: Multilayer Perceptron (MLP)
- L4.2: Convolutional Neural Networks (CNN)
- L4.3: Recurrent Neural Networks (RNN)
- L4.4: Autoencoders (AE), Restricted Boltzmann Machines (RBM)

Learning Unit 5: Communication

- L5.1: Introduction to communication and ML involvement
- L5.2: Types, levels, components of effective communication and ways for using Machine Learning in Communications
- L5.3: The future of communication in accordance with artificial intelligence
- L5.4: The effects of artificial intelligence in communication

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

- L6.1: EU guidelines on ethics in artificial intelligence
- L6.2: Bias in Machine learning
- L6.3: Software engineering for AI applications
- L6.4: Project Management

7.3 The MACHINA VOOC: Pedagogical Principles

The MACHINA Vocational Open Online Course is founded on the following **pedagogical principles**:

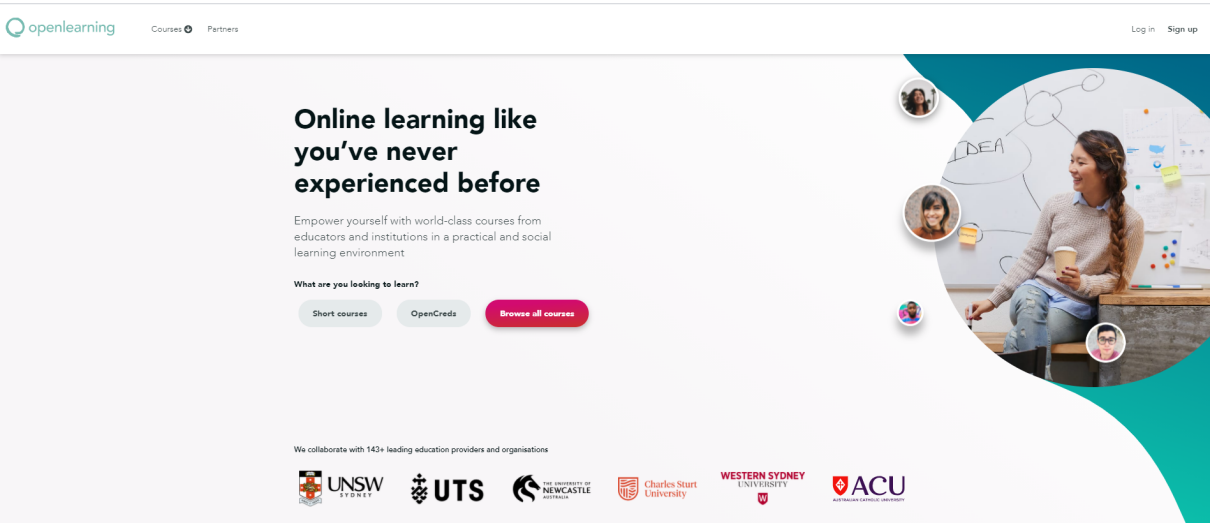
- **Learner-centeredness**: Learners are at the heart of the learning process, being able to establish individuals learning goals and a personal learning path based on available content and materials.
- **Flexibility**: Learners are able to arrange their own learning schedule according to their resources within the lifecycle of the course and decide their level of engagement.

- **Interactivity**: The MACHINA VOOC makes explicit mention on the value of interactivity and the multiplying effects it has on learning and capacity building. Learners are encouraged throughout the course to discuss with their peers, provide feedback on each other's work, and participate in joint activities, where possible.
- **Ubiquitous learning**: Learners are able to experience learning activities and content in any context and situation 24 hours 7 days per week through mobile devices such as laptops, tablets and smart phones.
- **Teacher as facilitator**: In MOOCs, trainers should abandon their traditional role which is to convey information to learners and now act as facilitators, motivating learners to engage in course activities and providing feedback and assistance with their tasks.
- **Blended evaluation scheme**: One of the greatest challenges for a Massive Open Online Course is to establish an assessment model that works at a much larger scale, with potentially thousands of learners participating in the course. To respond to this challenge, the MACHINA VOOC has employed a blended evaluation scheme that incorporates different methods & tools to evaluate learners' performance, including: a) auto-assessment, b) peer feedback, and c) self-checks.

8 How to access and Use the MACHINA VOOC

8.1 OPENLEARNING

The "MACHINA" online course is hosted on OPENLEARNING (www.openlearning.com); an online learning platform that allows individual educators (e.g., individual trainers, universities, colleges, consortia and public institutions) to create and deliver Massive Open Online Courses (MOOCs) in a wide range of disciplines and subjects. OPENLEARNING gives anyone the opportunity to offer truly interactive instruction without the need to write any code. Learning activities are combined with social mechanisms and facilitation/monitoring tools that allows to create engaging online learning experiences. The platform is designed to provide a community-based learning environment in which learners are actively involved in learning process and feel empowered, passionate communities of practice flourish, and deep learning experiences are fostered through carefully designed and interactive courses.



OPENLEARNING provides a wide range of authoring tools to make the process of learning easier and more entertaining (e.g., auto-assessment, blog, discussion forum). Courses are structured into (individual) learning modules that are populated with text, images, videos, presentations, info graphics, and exercises that essentially enhance the learning process and enable students to evaluate their knowledge and skill acquisition. OPENLEARNING employs a social media workflow with built-in galleries, announcements, wikis, blog pages, and discussion spaces to encourage commenting and liking throughout students' learning journey. These tools aim to

support interaction with peers and facilitators and ultimately foster a community of collaborative learners. The platform also supports content in different languages. Finally, to support flexible and ubiquitous learning, all courses are compatible with mobile devices such as laptops, smart phones and tablets.

OPENLEARNING forms a **global educational community** with (as of October 2021):

- 2.93 million learners
- 278 Higher Education (accredited) courses
- 184 institutions
- 4,260 private courses

Features, functionalities and tools

- ✓ No limitation on who can publish
- ✓ No restriction on language to use
- ✓ Content under open license
- ✓ Self-paced learning
- ✓ Modular learning
- ✓ Learning activities that can be sequenced
- ✓ 24/7 access to material and course content
- ✓ Versatile interactive tools (widgets)
- ✓ Automated assessment
- ✓ Self-assessment
- ✓ Notifications
- ✓ Comments thread on each page
- ✓ Discussion forum Blog
- ✓ Online chat
- ✓ Social media connections
- ✓ Groups of learners
- ✓ Badges
- ✓ Certification
- ✓ Progress monitoring
- ✓ Learning Analytics

MACHINA VOOC landing page

Machine Learning skills for ICT professionals

Credential type
Certificate of completion

Start date
Start any time

Duration
Flexible

Cost
Free

JOINED

Artificial Intelligence, Machine Learning, Mathematical Foundations, Algorithms, Neural Networks, Programming languages, Data value

MACHINA is an Erasmus+ KA2 project, which aims to tackle Machine Learning skill deficit by increasing the relevance of continuing & Initial VET provision in the sector and to assure that the existing & future ICT workforce will have the ML specific competences & transversal skills required.

Time involved in the course

This course is taught entirely online. There is no set time frame, you can study and do the activities when they suit you best. The duration of the course will last 3-4 months, considering 2 hours per day of learning activities.

Do you have other questions?

Send us email at parisa.ghodous-shariat-torbaghan@univ-lyon1.fr and solomos@exelia.gr

You can use your social media to share the course:

8.2 Minimum system requirements

This section presents the minimum system requirements for using OPENLEARNING (as of October 2021). These requirements may change over time, following future programming improvements or amendments.

Operating systems

Currently, authoring is only available on desktops. Learning is supported on desktops and mobile devices running Android and iOS. It is recommended to use the newest version of any software, when possible.

- Desktop: Windows 10, MacOS Mojave and above
- Mobile devices (via OpenLearning application): Android 4.1 and above, iOS 9 and above

Internet browsers

OpenLearning runs on the following browsers:

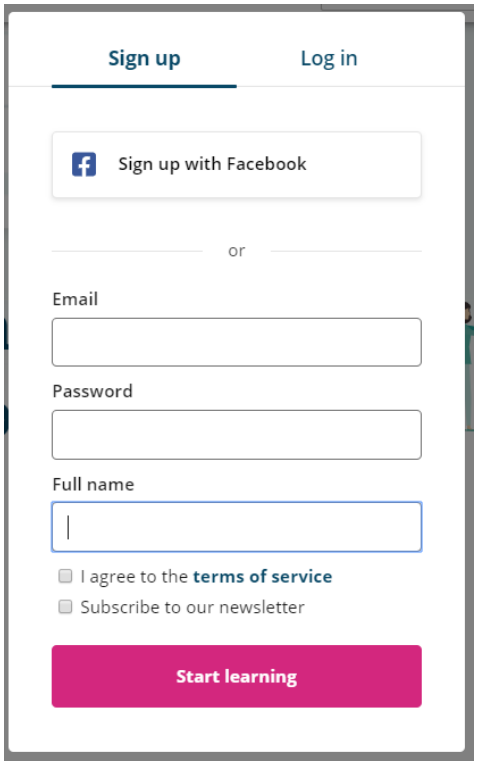
- Chrome (recommended)
- 32bit version of Chrome v80 and above
- Firefox Mozilla v54 and above
- Microsoft Edge 86 and above
- Safari v13 and above
- MS Internet Explorer is not recommended

Internet requirements

At minimum a broadband connection (256 Kbit/sec or faster—this buffering will allow you to view videos and online presentations), USB wireless modem, ADSL, T1/T2, fibre optic or cable. For more information on minimum system requirements, please visit: https://help.openlearning.com/t/y7grg4/minimum-system-requirements-for-maximising-your-openlearning-experience

8.3 Creating an account on OPENLEARNING

All users (both educators and learners) on OPENLEARNING need to create a user profile so as to get access to available courses and authoring tools. To create a new profile account, users have to enter their full name, a valid e-mail address to use as the login and a profile name. The latter will be the name displayed on the platform. There is also the option for users to sign up using their Facebook profile.
To sign up, an account password is also required. It is recommended that users should create a strong password that will include a mix of uppercase letters, lowercase letters, numbers, and symbols to prevent unauthorised access and keep their profile secure.



To create a user profile:

1. Go to www.openlearning.com and click on the “Sign up” link next to the “Log in” button.
2. The sign up form must be filled in with all the required information.
3. Enter your full name, your profile name and a valid e-mail address to use as the login for OpenLearning.
4. Create a user password. The user password must contain at least six characters.
5. Click on “Create my account”.
6. To get started, you need to verify your email address by clicking on the relevant link in the email you will receive upon submitting the sign-up form.

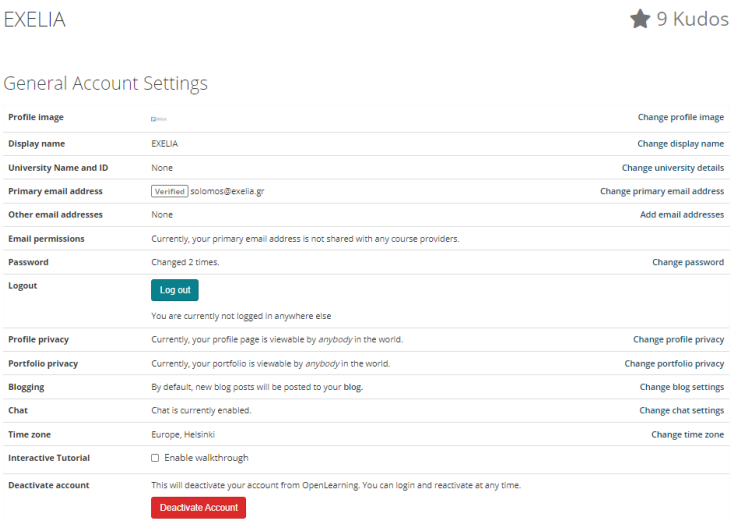
8.4 How to customise your profile

Users can easily customise their profile on the platform by selecting unique profile images, changing their display name and primary email address, adding location and time zone, as well as additional email addresses, and by providing biographical/personal information in the "About" section.

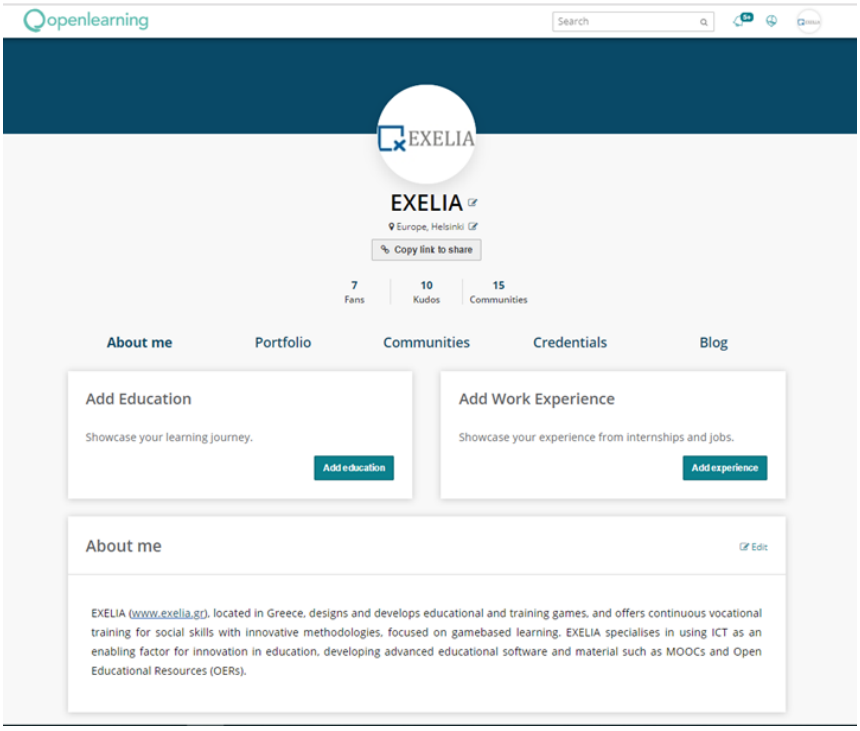
How to edit your profile

1. Select "Account Settings" from the drop-down menu to access your profile summary.

2. You will be able to edit your profile image, display name, primary email address, time zone and other personal features. Click into any of these areas and make your changes. You can easily change your email address and reset your password.

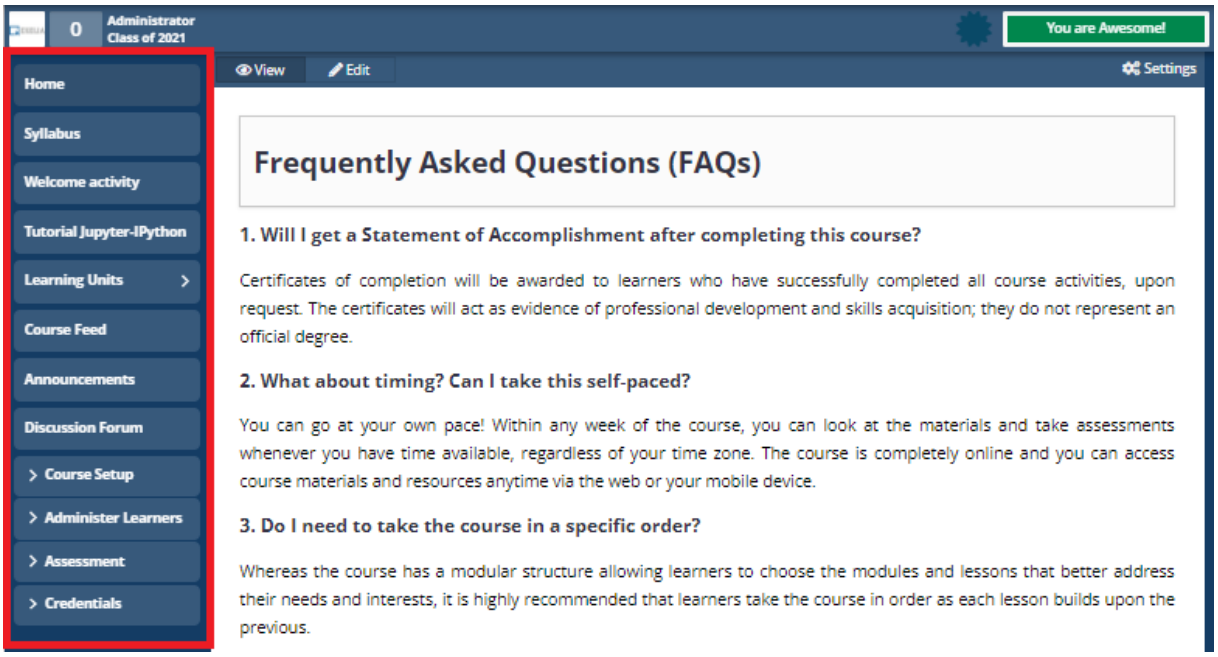


3. To edit your biographical information, you need to go to the “My profile” section from the drop-down menu to access your profile summary and write a small paragraph about yourself. Keep in mind that when you create courses, some of your biographical information will automatically display on the course summary page.



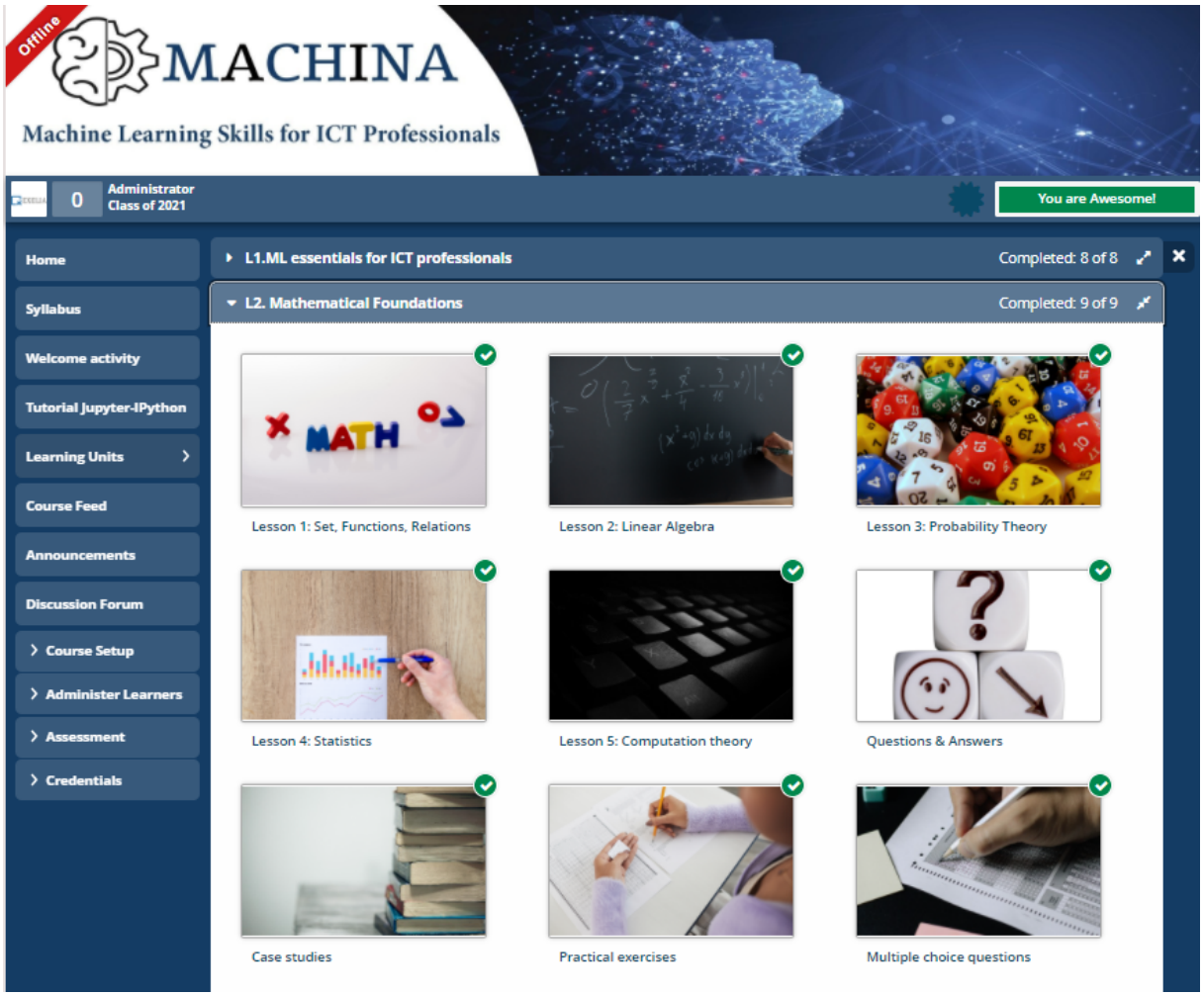
8.5 How to navigate within the MACHINA VOOC

The tabs on the left side bar will facilitate users to navigate through the online course. The course contains a **homepage** that introduces learners to the course and provides basic details that make learners feel welcomed, the **syllabus** page presenting course structure and learning outcomes, the **welcome activity to break the ice,** where each learner can introduce themselves to the other participants thereby creating a sense of community and increasing interaction, the **learning units** section that determines the major topics and materials students need to study to achieve learning outcomes, the **announcement section** in which facilitators post important messages relate to the course content and schedule, aiming also through motivational messages to increase students' engagement and activity, and the **student area (discussion forums)** where learners can interact with their peers, share files and views and post anything they think it is interesting and relevant to the course subject.



Learners can navigate within the 6 learning units (modules) using the left-hand navigation bar and selecting the chapter they want to review and study.

Learning units are further broken down into reading materials (as presented within Lessons), Questions and Answers, Case Studies, Practical Exercises, and Multiple Choice Questionnaires. Once you click the title of a particular learning unit, the sub-sections will be automatically displayed. Users need to click on one of the section headers (displayed) to jump to that part of the module.

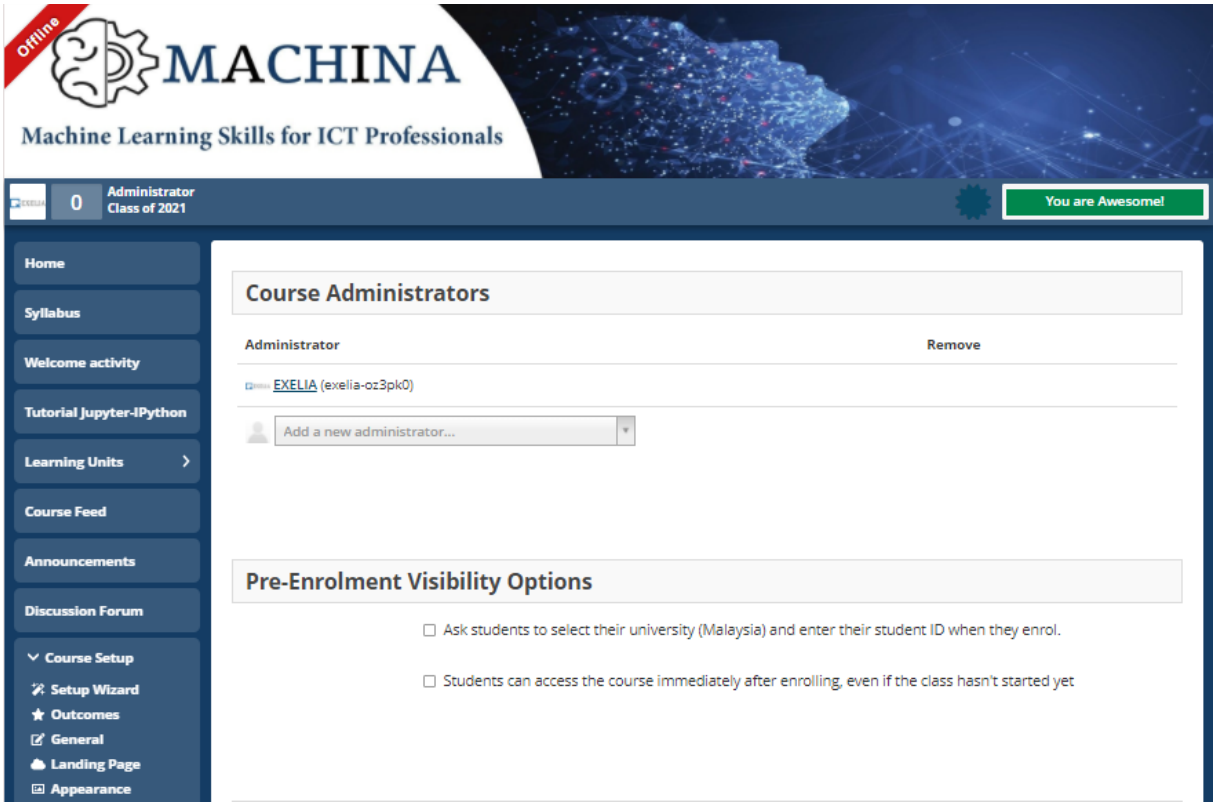


8.6 How to modify the MACHINA VOOC (as course administrators)

OPENLEARNING allows multiple educators to collaborate and create training content in real-time, as long as they have a publisher/educator subscription. All courses are collaborative by default. However, only administrators are involved in the course design and therefore have the right to add new material and resources or edit course structure and visual elements. They have maximum permissions within a course and access to all tabs (Course Setup, Administer Students, and Assessment). EXELIA, as the administrator of the "MACHINA" online course, retains the exclusive authority to provide editing rights to other users.

How to add course administrators

1. Go to the "Course Setup" tab in the left navigation.
2. Click on "Advanced".
3. Type in the profile name of the person you want to add.
4. Click its profile from the drop-down menu to set him/her as an administrator. Keep in mind that administrators need to have an active educator account in the platform.



How to add, move and delete learning units

Learning units enable trainers to define a structured path for progressing through content within a course, and allows learners to view content in an intuitive, self-paced style. Learning units can be considered as structured collections of learning material and resources that learners can move within. Furthermore, learning units can be viewed in sequential order or in a modular way if learners decide to follow a personal learning path to accommodate individual needs. The sequencing of modules is important for students to not only build their topic knowledge in a logical and appropriate flow, but also for capturing their interest. This section will provide a step-by-step guide on how to add, move, and delete learning units in the MACHINA VOOC.

1. To set up a new module, go to Course Setup > Content. Click on the tab "add a new module", located at the bottom of the page, and type in the title of the module.

2. Each chapter (lesson) may consist of multiple sections. To add a section to your chapters, simply type in the name of the page you would like to insert.

3. To move a chapter (lesson), hove over the lesson title. A “cross” icon will display. Then "grab" the hamburger (cross) icon to the right of the learning unit, and drag the module to its new

location within the structure and sequence of modules in the page (move the module up and down).

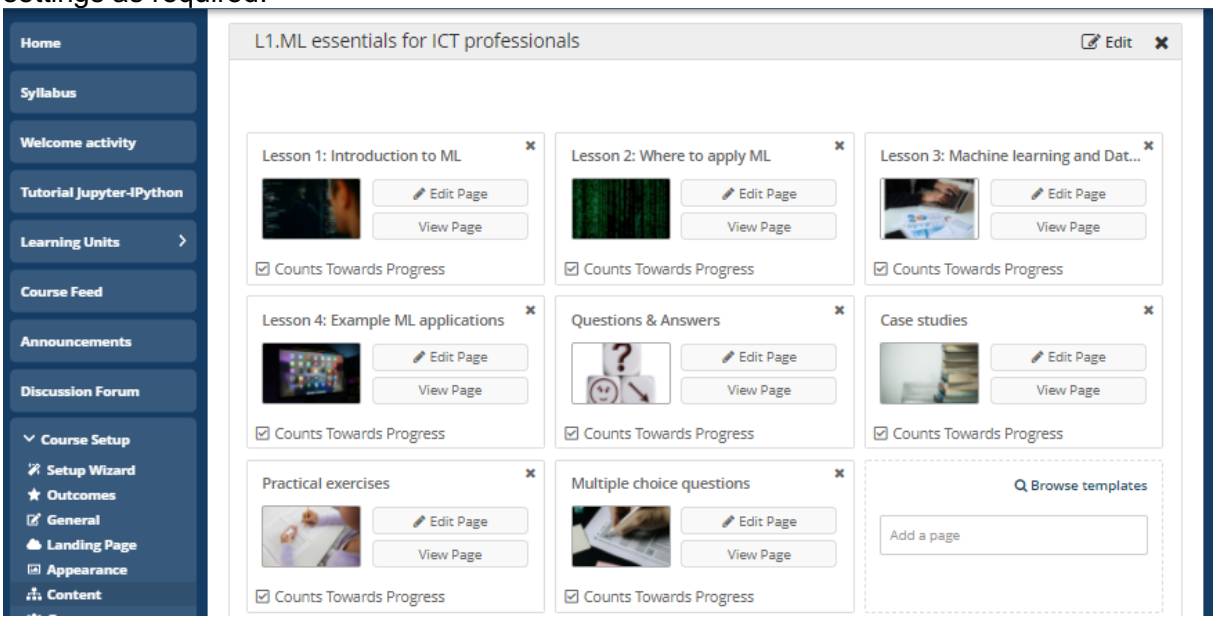
4. To delete a lesson, hover over the module title. An “X” icon will appear next to the “edit” tab. Click the “X” to delete the module.

8.7 How to add content and resources to module sections (pages)

In OPENLEARNING, educators may use a wide range of widgets to build modules and sections. Widgets are mini-JavaScript applications that enable educators to create content, import existing educational materials (documents, presentations, images, etc.), and create interactive exercises (e.g., online quizzes). Each widget has a particular function, such as adding text and videos, importing resources, or creating interactive elements. It goes without saying that the content and resources in the course need to be relevant to the learning outcomes, module topics and sections, and sequenced in a way that helps students to learn the module topic best. You can include a range of resources on a page such as video, presentation, info graphic, text, embedded articles and audio files. Follow the steps below to add content to module sections (pages).

How to add new content in the MACHINA VOOC

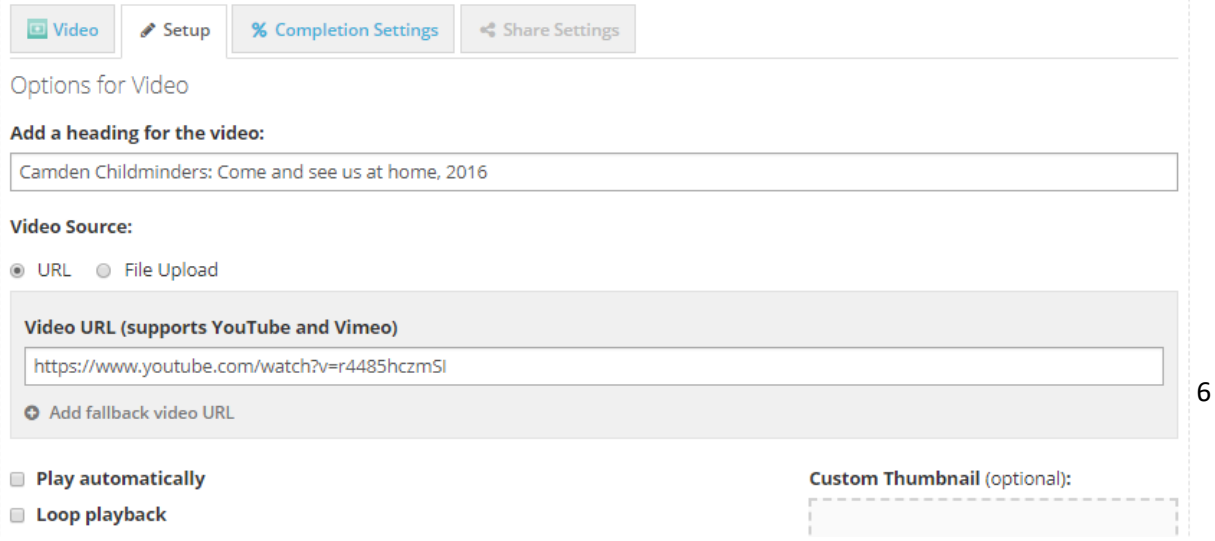
Navigate to the module section (page) you would like to add content and click Edit. In the left-hand side bar, there is a range of widgets you can add to your page. Select one of the content widgets and drag it into the page. Add the relevant content to the widget and customise the settings as required.



How to customise content and resources used in the MACHINA VOOC

Widgets are designed to be flexible and customisable. You can access the properties of the widget by clicking on the “Setup” tab. The box with the available options and settings (for this gadget) will be displayed in the page, as shown in the following picture. As an example, see the “Video” widget. You can easily add a heading for this video, adjust the start/end points, and insert a custom thumbnail to be used as a preview image. After you have set the widget’s details/properties, click the “Done” tab to save your widget customisations and click “View” to save the page.


Offline
MACHINA
Machine Learning Skills for ICT Professionals
You are Awesome!
Click or drag icons to add content
View
Edit
Settings
Core
Case studies
12/100 characters
Tags
Content
Text
White space
Video
Accessible Video
File
Audio
Posting
Post text
Post image
Post file
Interactive prompts
Checklist
Random selector
DRAG WIDGET
Text
Setup
Completion Settings
Share Settings
CASE STUDY 1: Alexnet, a case study for CNN
AlexNet is the name of a convolutional neural network (CNN) architecture, designed by Alex Krizhevsky in collaboration with Ilya Sutskever and Geoffrey Hinton, who was Krizhevsky's Ph.D. advisor.
AlexNet competed in the ImageNet Large Scale Visual Recognition Challenge on September 30, 2012. The network achieved a top-5 error of 15.3%, more than 10.8 percentage points lower than that of the runner-up. The original paper's primary result was that the depth of the model was essential for its high performance, which was computationally expensive but made feasible due to the utilization of graphics processing units (GPUs) during training
AlexNet contained eight layers; the first five were convolutional layers, some of them followed by max-pooling layers, and the last three were fully connected layers. It used the non-saturating ReLU activation function, which showed improved training performance over tanh and sigmoid.
CONV 11x11, stride=4, 96 kernels
Overlapping Max POOL 3x3, stride=2
CONV 5x5,pad=2 256 kernels
Overlapping Max POOL 3x3, stride=2
CONV 3x3,pad=1 384 kernels


Video
Setup
Completion Settings
Share Settings
Options for Video
Add a heading for the video:
Camden Childminders: Come and see us at home, 2016
Video Source:
URL
File Upload
Video URL (supports YouTube and Vimeo)
https://www.youtube.com/watch?v=r4485hczmSI
Add fallback video URL
Play automatically
Loop playback
Custom Thumbnail (optional):

8.8 How to add facilitators for the MACHINA VOOC

Educators, wishing to use the MACHINA VOOC to provide training to construction technicians, especially site managers, can only obtain the role of facilitator, upon request to the partnership.
A facilitator is someone who is involved in facilitating the course once it is live and accessible to students. Facilitators' primary role is to engage and interact with students throughout the course lifecycle. They are not allowed to edit or modify course content and have access to the “Administer Students” tab only. They can only check students’ enrolments, students’ progress, analytics and potentially marking students’ work assignments.
To add a facilitator, go to “Administer Students” tab in the left navigation, click on “General” and type in the profile name of the person you want to add.

IMPORTANT NOTE: The individuals, wishing to be added as facilitators to the MACHINA VOOC, need to have an educator subscription on OpenLearning.

9. HOW TO FACILITATE THE MACHINA VOOC

The MACHINA VOOC employs a learner-entered and personalised learning approach that places the learner at the heart of learning activities and educational process. Learner-centeredness is an educational approach that leads to high motivation and personal commitment to learn, deeper immersion in learning activities, and greater knowledge acquisition. In this context, learners can determine their own learning path, formulate individual goals, and select educational material and resources that address their distinct needs, preferences and expectations.

When teaching with the use of a VOOC, educators need to abandon their traditional role, which is to be the main source of information, and become a facilitator and motivator of learning. They should be more focused on the development of skills, competences and attributes and on comprehensive feedback, rather than on the dissemination of content. In V/MOOCs, the responsibilities of trainers include:

- Encouraging critical thinking.
- Fostering self-directed learning and curiosity.
- Motivating learners to engage in learning activities and collaborative mechanisms.

In addition, trainers should find ways to create a learning environment that stimulates all participants in the virtual classroom, generates deep understanding, and promotes collaborative learning throughout the course.

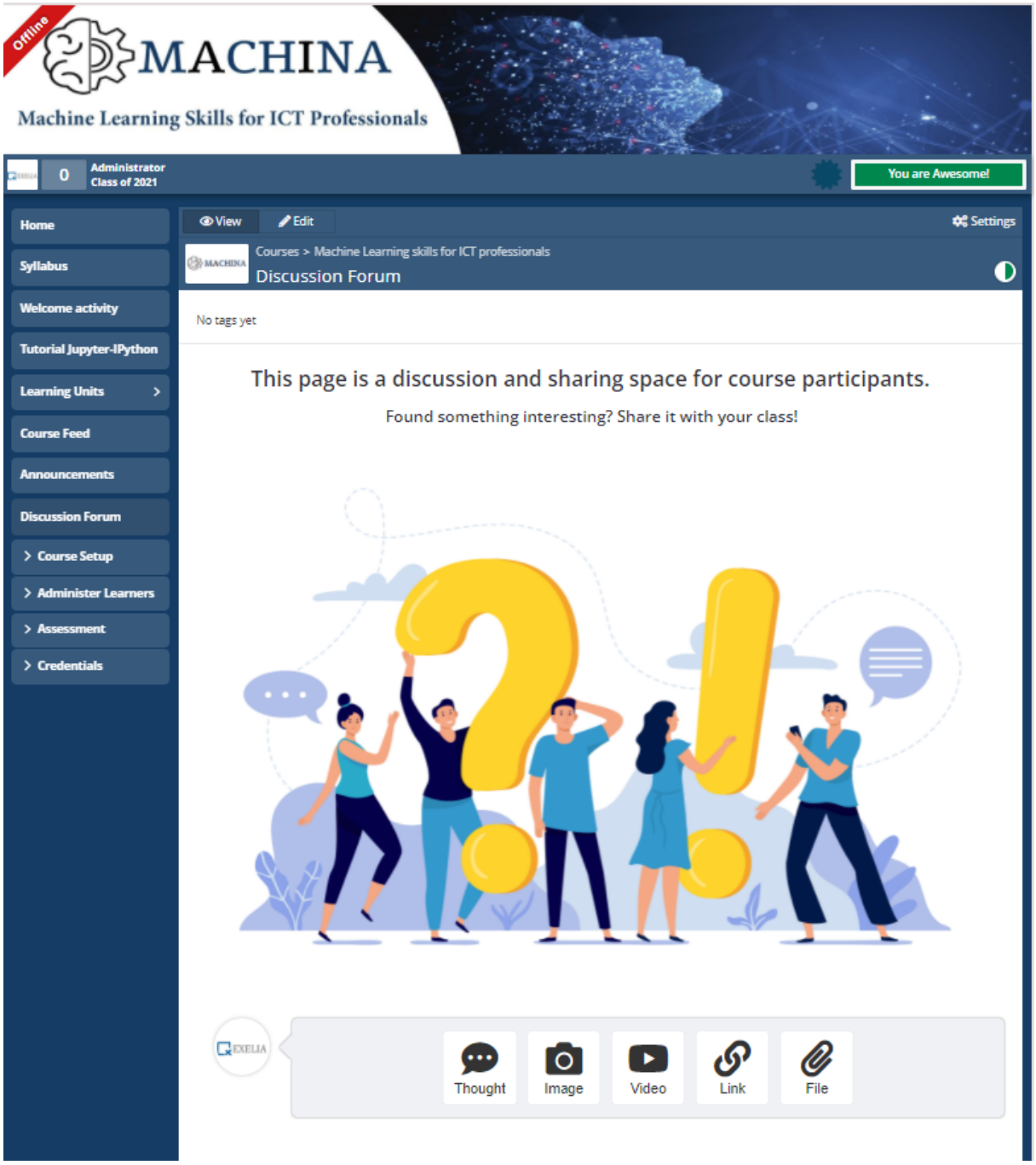
Consequently, the trainer in MACHINA VOOC has to assume the role of facilitator a) providing regular and consistent feedback on tasks and exercises delivered by VOOC participants, b) encouraging learners to participate in learning activities, c) pinpointing learners' weaknesses and misconceptions, and d) responding to learners' questions and requests.

9.1 Introduce yourself to the class

Trainers are encouraged to introduce themselves to the class by presenting a short personal bio that demonstrates their educational background and area of expertise. From the very beginning, trainers need to set the tone for the course and describe their expectations in the virtual classroom. An interesting introduction will effectively increase participants' willingness to experience new learning opportunities and develop a sense of connection between trainer and learners. Trainers can prepare a welcome video to introduce the course and help learners get used to the format of the MACHINA VOOC. Introductory videos should answer initial questions and concerns, and set the course expectations while assisting in creating a positive first impression.

9.2 Promote online discussions and collaborative learning

The MACHINA VOOC highlights the value of peer assistance and collaborative learning through the incorporation of discussion boards, online chat, social media links, and a students' area. The students' area (i.e., discussion forum) is the place where learners can share knowledge and information with other participants, discuss key concepts and problems associated with the course, exchange views and opinions with trainers, and cooperate with peers to complete tasks and exercises. Trainers should encourage learners to participate in the discussion forum by providing incentives (e.g., provision of access to additional learning materials and pedagogical resources). Also, trainers need to enhance learners' motivation by being explicit about expectations and ground rules for the online discussion forum, setting the framework for interaction, peer collaboration and dialogue. To moderate the forum, the trainer should become a facilitator and review the discussions without controlling or intervening in the dialogues. When it comes to questions, sometimes it is better to leave time for other participants to answer so as to encourage interaction among students.

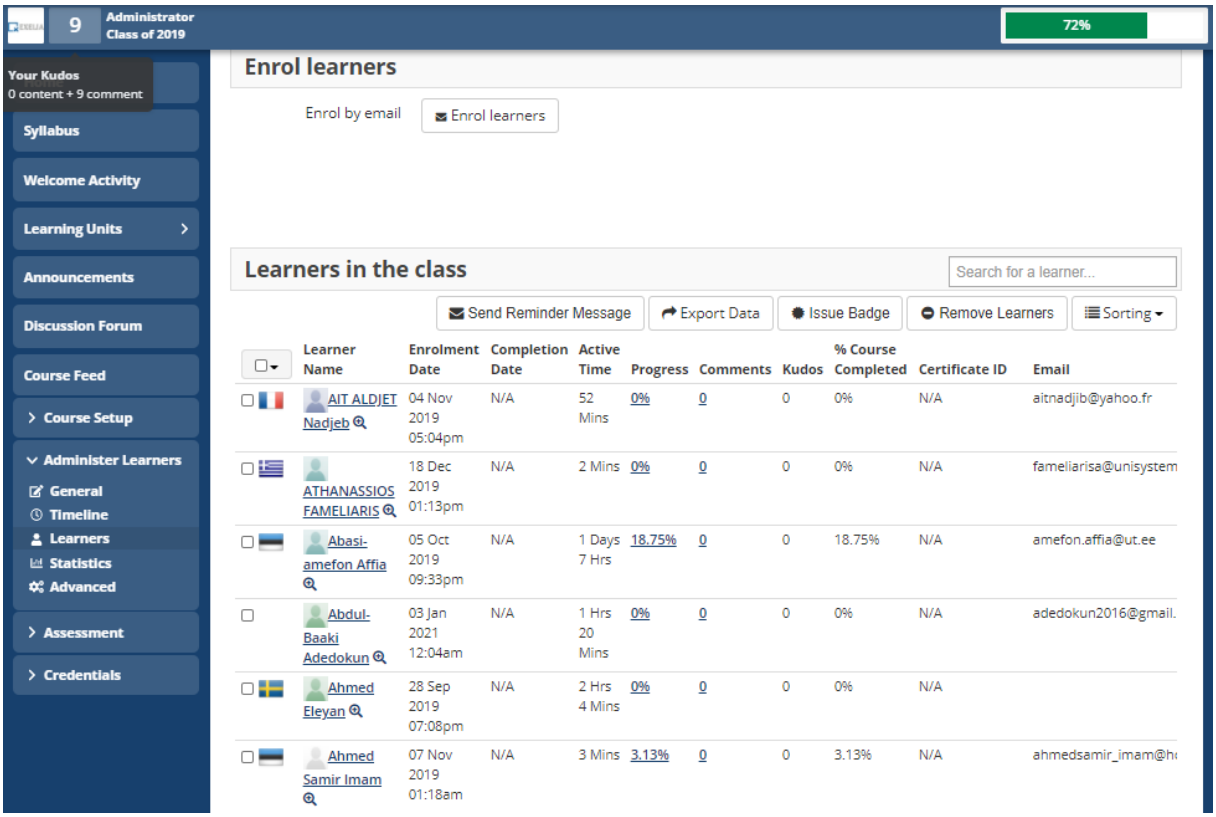

Offline
MACHINA
Machine Learning Skills for ICT Professionals
0
Administrator
Class of 2021
You are Awesome!
Home
Syllabus
Welcome activity
Tutorial Jupyter-IPython
Learning Units
Course Feed
Announcements
Discussion Forum
Course Setup
Administer Learners
Assessment
Credentials
View
Edit
Settings
Courses > Machine Learning skills for ICT professionals
Discussion Forum
No tags yet
This page is a discussion and sharing space for course participants.
Found something interesting? Share it with your class!
Thought
Image
Video
Link
File

9.3 Establish a communication scheme

Trainers should establish a well-defined communication scheme to facilitate interaction with learners and support learning throughout the course. The platform very recently released the "**Microsoft Teams Meeting**" widget which allows educators to engage with their learners in live audio/video meetings via the Microsoft Teams application. This widget enables Course Creator/Administrators, facilitators, and learners with an Active Microsoft Teams license, to schedule live audio/video meetings; and it enables learners themselves to participate in multimedia equipped meetings with fellow learners from within an OpenLearning course.
In addition, Trainers and Facilitators are encouraged to set/schedule online office hours once a week through the announcement section or the online chat, to engage in active discussions with learners, and providing assistance and clarifications, where needed. Strategic structured communication through regular emails and messages, including weekly feedback, announcements, and reminders will assist to maintain the engagement and focus of learners on the course experience and enhance the perception of a "teaching presence" by participants. Another channel to interact and communicate with learners is through the MACHINA student area (discussion forum). Trainers and facilitators need to monitor and interact in the forum as well.

9.4 Monitor learners' progress and engagement

OPENLEARNING provides several options to monitor learners' activity throughout the course, providing analytics for all students such as enrolment and completion date, active time spent in the course, overall progress status, and comments posted in discussion boards. This allows facilitators to extract aggregate statistics for the course (e.g., dropout rate, engagement, interactivity) and most importantly to identify which students lag behind or demonstrate a low engagement so as to take remedial actions that increase their willingness to complete the course. For instance, facilitators can send reminder messages to students, indicating their progress and encouraging them to complete all sections. Another option is to issue badges for students that are actively involved in learning activities and have successfully completed work assignments and quizzes.



9.5 Create a sense of community and encourage interaction between students

The MACHINA VOOC features a welcome activity to make learners, to feel welcome right from the start of your course, warm up interaction, and help create a sense of community. The “Welcome Activity” acts as an “ice-breaker” inviting students to introduce themselves, share interesting information, fostering thus a sense of rapport and collective learning. Trainers are highly encouraged to prompt registered students to share a short message on the platform and take part in the welcome activity. In this activity, students are invited to play the game “**two truths, one lie**”. The game is very simple and straightforward, and does not require any previous planning. The game is played as follows. Newcomers have to briefly introduce themselves and post three statements about their life to the rest of the community. The trick, here, is that the two of the statements given should be true and one should be a lie. At a next stage, the community (“peers”) shall attempt to guess which

statement is not true, and indicate the lie. Once a number of course participants have made their guess, the learner who started the group discussion shall reveal which statement is the lie.

The platform has also recently released the "**chat room**" widget; a collaboration and communication tool, to bring learners together and engage them in active discussion on designated topics. Trainers and facilitators are encouraged create breakaway groups of learners at key points in the course so that they can share ideas in real-time, work on common projects, and build an open environment of collaboration and co-creation.

9.6 Sharing the course

There are several options for sharing and disseminating the MACHINA VOOC.

1. You can invite students by email through the platform, as shown in the image below.

2. You can share the course in social media (FaceBook, Twitter, and LinkedIn).
3. You can email the link of the course.
4. You can embed the MACHINA VOOC into your own blog or website.
5. You can submit a request for publishing the course in the platform's marketplace. OPENLEARNING lists courses that have successfully passed the "OPENLEARNING" course quality review. (https://help.openlearning.com/t/63j3nl/1-about-our-course-quality-review-process)

9.7 Tips for trainers and facilitators

1. Facilitate the course and help learners achieve their personal learning objectives.
2. Encourage learners to participate in the “welcome activity” before engaging with learning activities.
3. Login daily to interact with participants and/or monitor course activity.
4. Monitor learners’ progress and send reminder messages to students indicating their progress status and encouraging them to complete all sections.
5. Moderate learners’ interaction in the MACHINA student area and chat rooms, as well as the comment threads on each course page.
6. Respond to learners’ emails, messages and discussion postings within a day.
7. Prior to MACHINA VOOC release date, trainers should proofread the entire course, review all educational material, post an introductory announcement (or a welcome video), provide contact details, and set online office hours.
8. Schedule online office hours for learners that will take place once a week via the announcement section or the online chat.
9. Provide regular feedback on tasks and exercises submitted by learners and grade assignments (if relevant. Personalised feedback must be provided within forty-eight (48) hours after the submission of tasks due date.

10. References

[1] MACHINA: Definition of MACHINA learning outcomes based on training needs analysis, Output type: Intellectual output, O1-T4-b

[2] MACHINA: Report on Curriculum Outline O2-T1

[3] MACHINA: Course Contents O2-T2

[4] Identification of suitable platforms to host VOOC infrastructure and content, Output type: Intellectual output

[5] BLISS: Grouping of learning outcomes into BLISS learning units, Output type: Intellectual output, October 2018

[6] BLISS, Trainer Handbook, Output type: Intellectual output, May 2019

[7] VET4APPS, Trainer Handbook, Output type: Intellectual output, May 2015