



# ARIS PROJECT

AI SKILLS FOR ICT PROFESSIONALS

## ARIS

### Trainer Handbook (O2-T3)

Output type: Intellectual Output

### Business Training

February 2021

Project acronym: ARIS  
 Project name: Artificial Intelligence Skills For ICT Professionals  
 Project code: 2019-1-BE01-KA202-050425

### **Document History**

<b>Versions</b>	<b>Date</b>	<b>Changes</b>	<b>Type of change</b>	<b>Delivered by</b>
Version 1	28/11/2020	Initial Document	-	Business Training
Version 2	20/01/2021	Update on the Document Structure and Lesson plans	-	Business Training
Version 3	23/02/2021	Adding the content of the lesson plans and the VOOC Chapter	-	Business Training

### **Document Information**

Document ID name:

ARIS\_O2-T3\_Trainer\_Handbook

Document title: Trainer Handbook (O2-T3)  
 Output Type: Intellectual Output  
 Date of Delivery: 31/01/2021  
 Activity Type: Trainer Handbook  
 Activity Leader: Business Training (BT)  
 Contributor: UPC, ISTC, EXELIA  
 Dissemination level: Public

### **Acknowledgement**

The persons of involved in preparation of this document are Thierry Holoffe (BT), Mohamed Romdhani(BT), Dionysios Solomos (EXELIA), and Vassiliki Kostidou (EXELIA).

### **Disclaimer**

The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

This document is proprietary of the ARIS Consortium. Project material developed in the context of Project Management & Implementation activities is not allowed to be copied or distributed in any form or by any means, without the prior written agreement of the ARIS consortium.

## Table of Contents

1	Management Summary .....	6
2	Introductory notes .....	6
2.1	Rationale of ARIS.....	6
2.2	What is MOOC/VOOC ?.....	6
2.3	Overview of the ARIS VOOC Curriculum .....	7
2.4	Recommended Learner’s Background .....	8
2.5	Structure of the Trainer Handbook.....	8
3	Access to the ARIS Vocational Open Online Course (VOOC) .....	10
3.1	OpenLearning.....	10
3.2	Minimum system requirements .....	13
3.3	Creating an account on OpenLearning .....	14
3.4	How to customise your profile.....	15
3.5	How to navigate within the ARIS VOOC.....	17
4	Organization of teaching using the ARIS VOOC.....	19
4.1	Before the MOOC starts.....	20
4.1.1	Review the MOOC website .....	20
4.1.2	Read the lesson plans .....	20
4.1.3	Consider time .....	21
4.1.4	Format and technology MOOC .....	22
4.2	During the MOOC.....	22
4.3	Post-MOOC: stay connected!.....	22
5	How to facilitate the ARIS VOOC .....	23
5.1	Introduce yourself to the class.....	24
5.2	Promote online discussions and collaborative learning .....	24
5.3	Establish a communication scheme.....	26
5.4	Monitor learners’ progress and engagement.....	27
5.5	Create a sense of community and encourage interaction between students .....	28
5.6	Sharing the course .....	30
5.7	Tips for trainers and facilitators.....	31
6	Detailed Lesson Plans of Learning Unit 1: Foundations of Artificial Intelligence .....	31

6.1	Lesson plans of the Lesson 1.1. Scope of AI.....	32
6.2	Lesson plans of the Lesson 1.2. Problem Solving.....	33
6.3	Lesson plans of the Lesson 1.3. Knowledge Representation .....	34
6.4	Lesson plans of the Lesson 1.4. Machine Learning.....	36
6.5	Lesson plans of the Lesson 1.5. AI Applications.....	37
6.6	Lesson plans of the Lesson 1.6. Ethical implications .....	39
7	Detailed Lesson Plans of Learning Unit 2: Foundations of Artificial Intelligence .....	40
7.1	Lesson plans of the Lesson 2.1. Introduction to ML .....	41
7.2	Lesson plans of the Lesson 2.2. Languages and Resources .....	42
7.3	Lesson plans of the Lesson 2.3. Data Transformation and Visualization.....	44
7.4	Lesson plans of the Lesson 2.4. Supervised Linear ML .....	45
7.5	Lesson plans of the Lesson 2.5. Supervised Non Linear ML.....	47
7.6	Lesson plans of the Lesson 2.6. Unsupervised ML.....	48
8	Detailed Lesson Plans of Learning Unit 3: Neural Networks and Deep Learning .....	51
8.1	Lesson plans of the Lesson 3.1. Brain origin and elements of neural networks.....	51
8.2	Lesson plans of the Lesson 3.2. Simple perceptrons and supervised learning.....	53
8.3	Lesson plans of the Lesson 3.3. Multilayer perceptrons and Keras.....	54
8.4	Lesson plans of the Lesson 3.4. Deep learning for image classification: Convolutional neural networks .....	55
8.5	Lesson plans of the Lesson 3.5. Different CNNs for image classification .....	57
8.6	Lesson plans of the Lesson 3.6. Real-time object localization with YOLO models .....	58
9	Detailed Lesson plans of the Learning Unit 4: AI for solving real-life problems.....	60
9.1	Lesson plans of the Lesson 4.1. Word embedding and Text classification.....	60
9.2	Lesson plans of the Lesson 4.2. Neural networks for NLP and libraries .....	62
9.3	Lesson plans of the Lesson 4.3. New approaches, applications, open problems.....	63
9.4	Lesson plans of the Lesson 4.4. Big Data: Problems, core techniques and introduction to Hadoop and Spark.....	65
9.5	Lesson plans of the Lesson 4.5. Spark Big Data Processing .....	67
9.6	Lesson plans of the Lesson 4.6. Cloud computing and machine learning With PySpark.....	68
	References .....	70
	ANNEX I – ARIS VOOC Administration Guide .....	71
	I.1 How to modify the ARIS VOOC (as course administrators) .....	71

I.2 How to add, move and delete learning units.....	72
I.3 How to add content and resources to module sections (pages) .....	73
I.4 How to add facilitators for the ARIS VOOC.....	76

## 1 Management Summary

This document is deliverable O2-T3 "**Trainer Handbook**", as described in the ARIS Application Form. The main precedents of this report are the deliverables O1-T4 "**Definition of ARIS learning outcomes**" [1] and O2-T1 "**Definition of learning units**" [2]. The O2-T1 includes the slide sets components of the learning material, the lectures notes, the training exercises and the case studies.

The main purpose of this report is to provide 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 ARIS

The growing penetration of AI technology across the major sectors of the EU economy is increasing the need of up-skilling ICT professionals so that they are able to understand and work on AI applications.

The purpose of the ARIS project is to address this challenge by delivering a modular curriculum and Open Educational Resources (OERs) on AI technology and practical applications, enhancing the relevance of VET provision for ICT professionals to suit their skills with cutting-edge ICT innovations and enhancing employment.

### 2.2 What is 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 through informal quality educational experiences at scale.

A VOOC, as compared to MOOCs, has a vocational focus. It provides targeted, bite-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).

The ARIS Vocational Open Online Course (VOOC) acts as the main delivery method for the ARIS curriculum. It reflects the structure of the developed curriculum, as organised around learning units and lessons, and comprises the project's training courseware.

### 2.3 Overview of the ARIS VOOC Curriculum

The following table (Table 1) shows the breakdown of the **four learning units** in terms of lessons. Each learning unit contains theoretical lectures, practical work and individual assignment parts. The duration of these parts is shown also in Table 1.

Learning Units	Lessons	Duration
<b>Foundations of Artificial Intelligence</b>	Lesson 1 Scope of AI	Total: 22 hours Theory: 13,5 hours Practice: 8,5 hours
	Lesson 2 Problem Solving	
	Lesson 3 Knowledge Representation	
	Lesson 4 Machine Learning	
	Lesson 5 Applications	
	Lesson 6 Ethical Implications	
<b>Machine Learning</b>	Lesson 1 Introduction to ML	Total: 12 hours Theory: 9 hours Practice: 3 hours
	Lesson 2 Languages and Resources	
	Lesson 3 Data Transformation and Visualization	
	Lesson 4 Supervised Linear ML	
	Lesson 5 Supervised Non Linear ML	
	Lesson 6 Unsupervised ML	
<b>Neural Networks and Deep Learning</b>	Lesson 1 Brain origin and element of neural networks	Total: 12 hours Theory: 9 hours
	Lesson 2 Simple perceptrons and supervised learning	
	Lesson 3 Multilayer perceptrons and Keras	

	Lesson 4 Deep learning for image classification: Convolutional neural networks	Practice: 3 hours
	Lesson 5 Different CNNs for image classification	
	Lesson 6 Real-time object localization with YOLO models	
<b>AI for solving real-life problems</b>	Lesson 1 World embedding and Text classification	Total: 12 hours Theory: 9 hours Practice: 3 hours
	Lesson 2 Neural networks for NLP and libraries	
	Lesson 3 New approaches, applications, open problems	
	Lesson 4 Big Data: Problems, core techniques and introduction to Hadoop and Spark	
	Lesson 5 Spark Big Data Processing	
	Lesson 6 Cloud computing and machine learning With PySpark	
		Total: 58 hours Theory: 40,5 hours Practice: 17,5 hours

Table 1: The Learning Units of ARIS VOOC and their related lessons

## 2.4 Recommended Learner's Background

Target groups of learners include :

- ICT professionals employed in companies building and offering AI technology, who have some experience in AI technology and wish to improve themselves by taking suggested course;
- I-VET students aspiring to get employed as AI application developers;
- project managers who need to understand the need for different AI applications and implications of AI technology in the key sectors of economy.

## 2.5 Structure of the Trainer Handbook

The Trainer handbook is organized as follows :

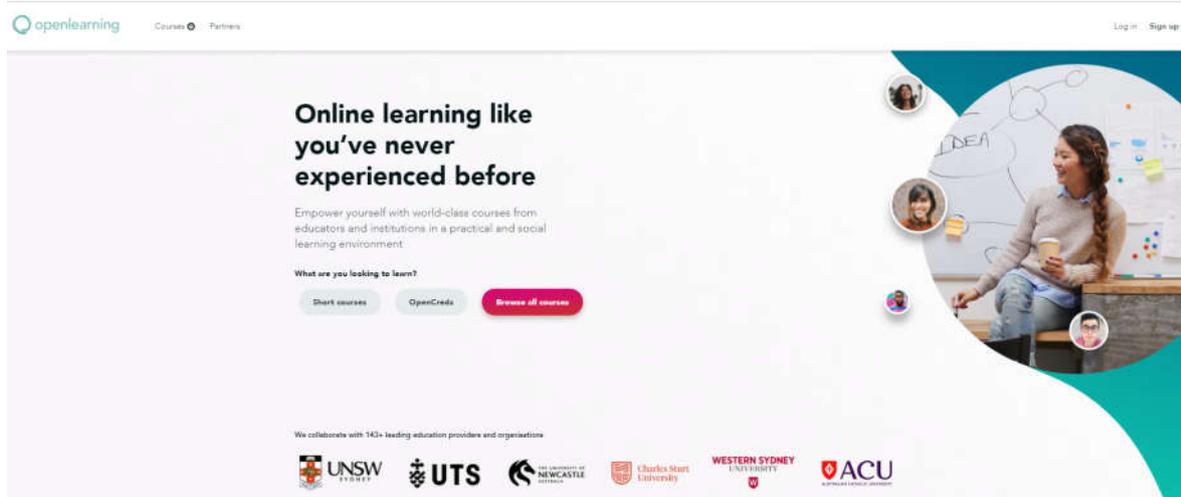
- **Section 3** gives the detailed instructions to access to the ARIS Online Course. It explains how to create an account and to customize the user profile
- **Section 4** provides useful recommendations for the trainer in order to organize the course. These include the activities to perform before the course, during the course, and after the course.
- **Section 5** gives the essential practices in order to facilitate the ARIS VOOC.

- **Sections 6, 7, 8 and 9** give the detailed lesson plans for each of the lessons of the four learning units of ARIS. These plans are helpful for the trainer in order to teach the content in an efficient way and to engage and motivate the participants.

### 3 Access to the ARIS Vocational Open Online Course (VOOC)

#### 3.1 OpenLearning

The “ARIS” online course is hosted on OpenLearning ([www.openlearning.com](http://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, infographics, 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 February 2021):

- 2.63 million learners
- 270 Higher Education (accredited) courses
- 143 institutions
- 3,602 private courses

#### Features, functionalities and tools

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

ARIS VOOC landing page

# Artificial Intelligence (AI) skills for ICT professionals



AI SKILLS FOR ICT PROFESSIONALS

Artificial Intelligence, Machine Learning, Big Data, Robotics, Natural Language Processing, Deep Learning, Artificial Neural Networks, Business Intelligence

Artificial Intelligence (AI) is revolutionizing the way the economy and society function, by automating tasks & business processes, and managing workflows & critical data more effectively. The fastpaced development of AI technologies in diverse economic and social realities is exponentially augmenting the demand for ICT professionals with the right combination of AI technical, non-technical and transversal skills. Recent market surveys show that the demand for AI skills has almost tripled over the past 3 years and the number of relevant job postings is up by 119%. Employers, however, struggle to find candidates with the right skill mix. Further to demand, the gap is amplified by the shortage and inadequacy of relevant skills expected via VET provision, given also that AI is currently a subject of ICT specialization mostly offered at the highest level of tertiary education. The **ARIS VOOC** is an up-to-date, self-standing, modular course for ICT professionals, who need to improve their skills, knowledge and competencies in AI technologies and practical applications. ICT professionals who follow this course will acquire and develop the AI related skills - along with problem solving, managerial and customer related (transversal) skills - required to respond to modern workplace requirements and succeed in a competitive labor market.



 Start date  
Start any time

 Duration  
Flexible

 Cost  
Free

JOINED

### 3.2 Minimum system requirements

This section presents the minimum system requirements for using OpenLearning (as of February 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.

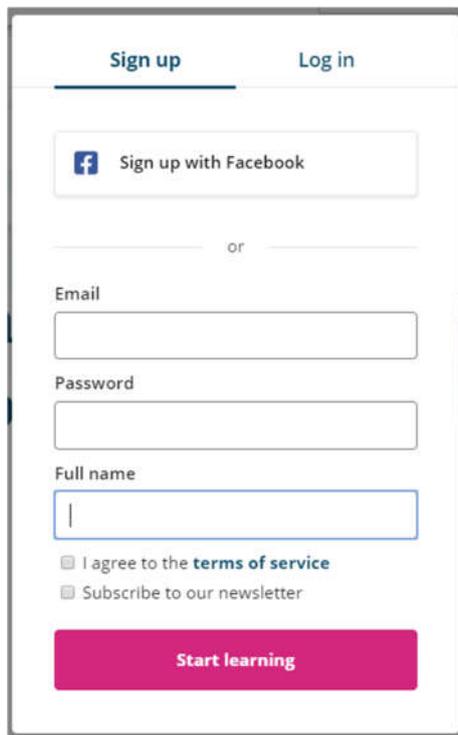
For more information on minimum system requirements, please visit:

<https://help.openlearning.com/t/y7grg4/minimum-system-requirements-for-maximising-your-openlearning-experience>

### 3.3 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.



The screenshot shows a sign-up form with the following elements:

- Two tabs at the top: "Sign up" (active) and "Log in".
- A "Sign up with Facebook" button with a Facebook icon.
- An "or" separator.
- Input fields for "Email", "Password", and "Full name".
- Two checkboxes: "I agree to the [terms of service](#)" and "Subscribe to our newsletter".
- A pink "Start learning" button at the bottom.

To create a user profile:

1. Go to [www.openlearning.com](http://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.

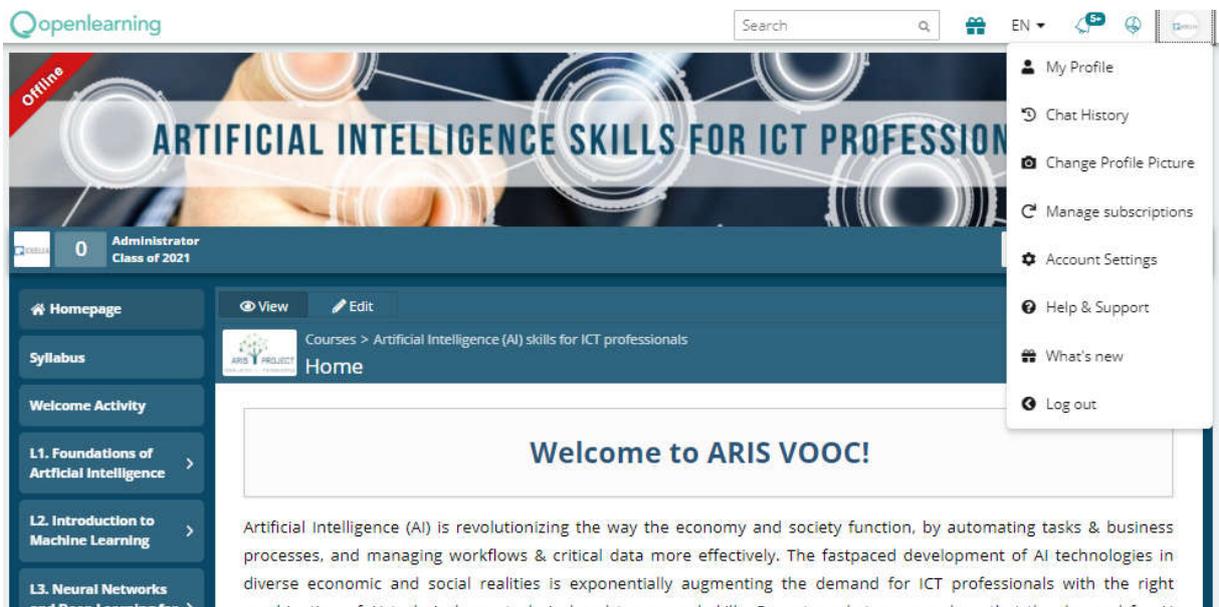
4. Create a user password. The user password must contain at least six characters.
5. Click on "Create my account".
6. To get started, you need to verify your email address by clicking on the relevant link in the email you will receive upon submitting the sign-up form.

### 3.4 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.



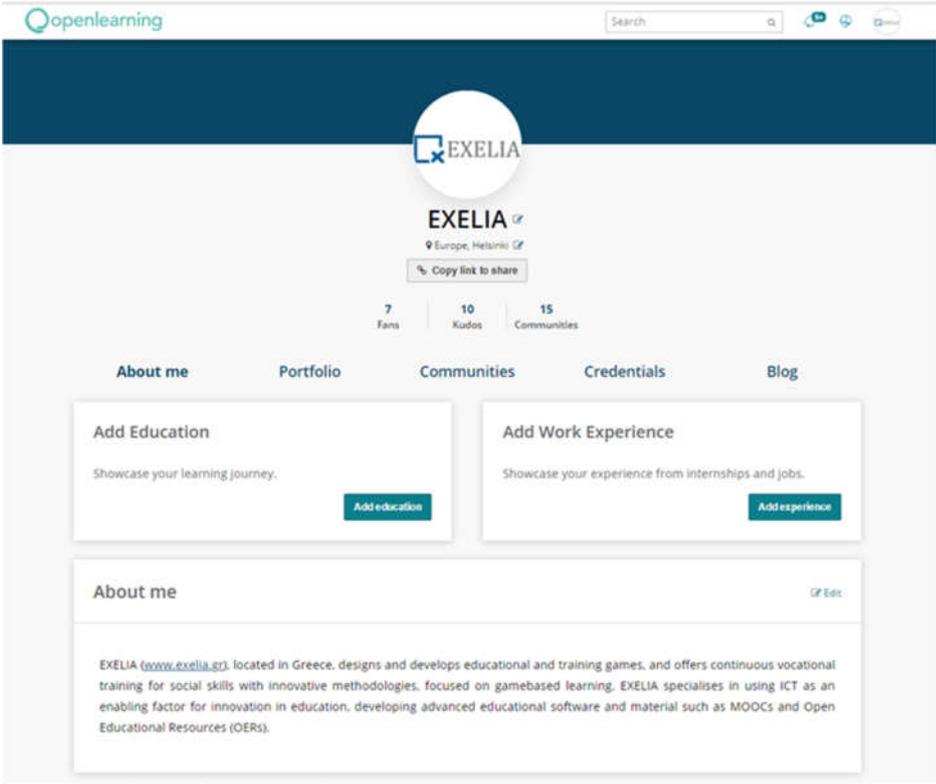
The screenshot displays the Openlearning platform interface. At the top, there is a search bar and navigation icons. The main header features a banner for "ARTIFICIAL INTELLIGENCE SKILLS FOR ICT PROFESSION" with a background image of hands interacting with a digital interface. Below the banner, the user's name "Administrator" and "Class of 2021" are visible. A dropdown menu is open, showing options: "My Profile", "Chat History", "Change Profile Picture", "Manage subscriptions", "Account Settings", "Help & Support", "What's new", and "Log out". The main content area shows a "Welcome to ARIS VOOC!" message and a brief introduction to Artificial Intelligence (AI) as a revolutionizing technology.

EXELIA ★ 9 Kudos

### General Account Settings

Profile image		Change profile image
Display name	EXELIA	Change display name
University Name and ID	None	Change university details
Primary email address	Verified <input type="text" value="exelias@exelia.gr"/>	Change primary email address
Other email addresses	None	Add email addresses
Email permissions	Currently, your primary email address is not shared with any course providers.	
Password	Changed 2 times.	Change password
Logout	<a href="#">Log out</a>	
	You are currently not logged in anywhere else.	
Profile privacy	Currently, your profile page is viewable by anybody in the world.	Change profile privacy
Portfolio privacy	Currently, your portfolio is viewable by anybody in the world.	Change portfolio privacy
Blogging	By default, new blog posts will be posted to your blog.	Change blog settings
Chat	Chat is currently enabled.	Change chat settings
Time zone	Europe, Helsinki	Change time zone
Interactive Tutorial	<input type="checkbox"/> Enable walkthrough.	
Deactivate account	This will deactivate your account from OpenLearning. You can login and reactivate at any time.	
	<a href="#">Deactivate Account</a>	

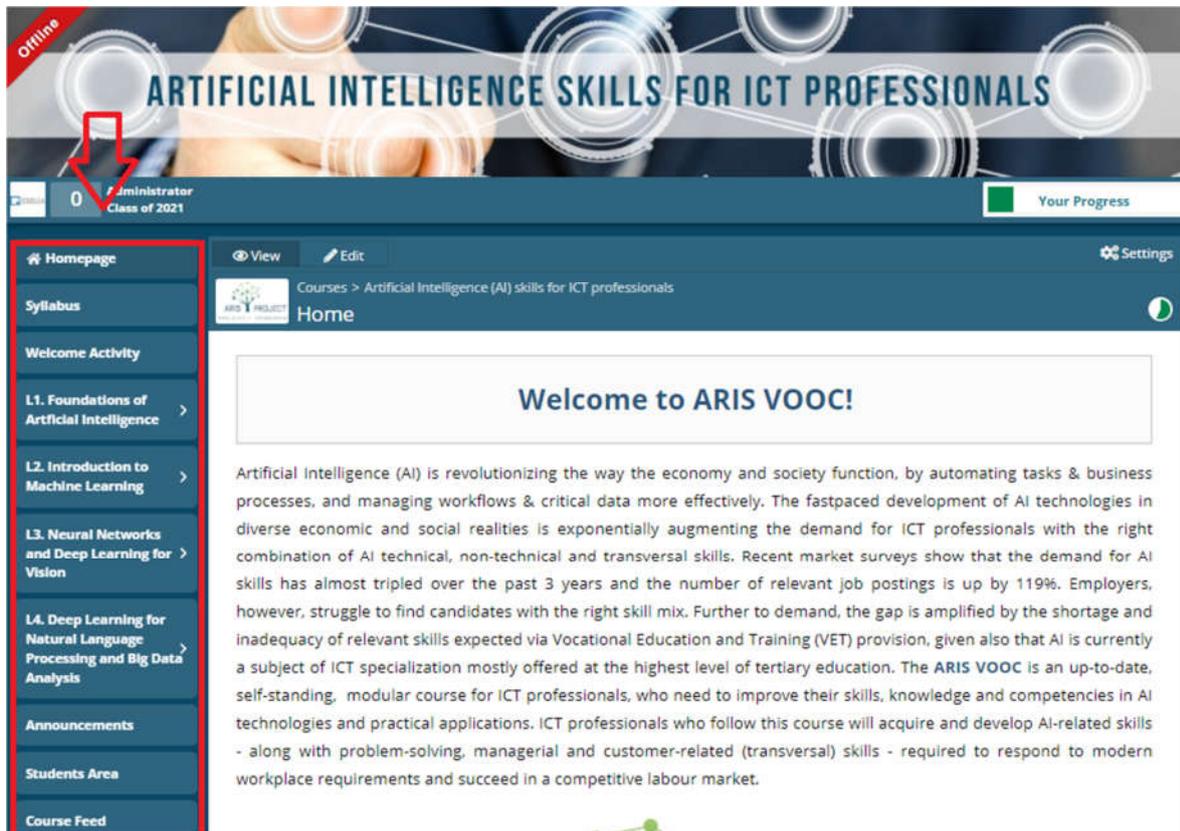
- To edit your biographical information, you need to go to the "My profile" section from the drop-down menu to access your profile summary and write a small paragraph about yourself. Keep in mind that when you create courses, some of your biographical information will automatically display on the course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



The screenshot shows the OpenLearning profile page for EXELIA. At the top, there is a search bar and navigation icons. The profile header includes the EXELIA logo, the name "EXELIA", and location "Europe, Helsinki". Below this, statistics show 7 Fans, 10 Kudos, and 15 Communities. A navigation menu contains "About me", "Portfolio", "Communities", "Credentials", and "Blog". Two main sections are visible: "Add Education" with a description "Showcase your learning journey." and an "Add education" button, and "Add Work Experience" with a description "Showcase your experience from internships and jobs." and an "Add experience" button. At the bottom, there is an "About me" section with an "Edit" link and a paragraph of text: "EXELIA ([www.exelia.gr](http://www.exelia.gr)), located in Greece, designs and develops educational and training games, and offers continuous vocational training for social skills with innovative methodologies, focused on gamebased learning. EXELIA specialises in using ICT as an enabling factor for innovation in education, developing advanced educational software and material such as MOOCs and Open Educational Resources (OERs).

### 3.5 How to navigate within the ARIS 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.



Offline

# ARTIFICIAL INTELLIGENCE SKILLS FOR ICT PROFESSIONALS

Administrator  
Class of 2021

Your Progress

View Edit Settings

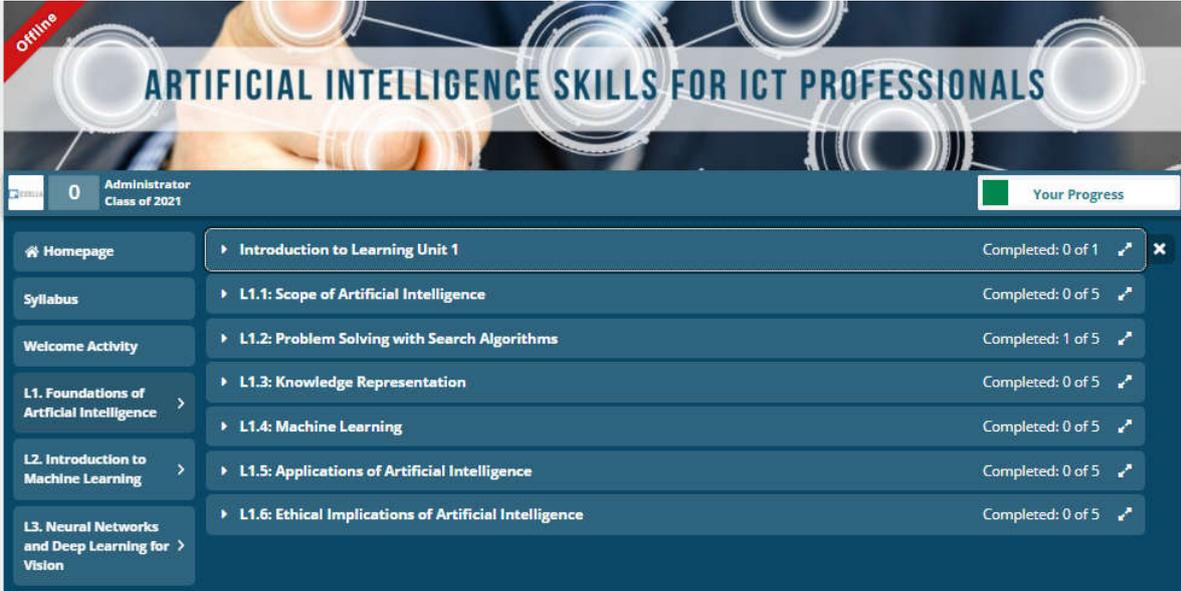
Courses > Artificial Intelligence (AI) skills for ICT professionals

## Home

### Welcome to ARIS VOOC!

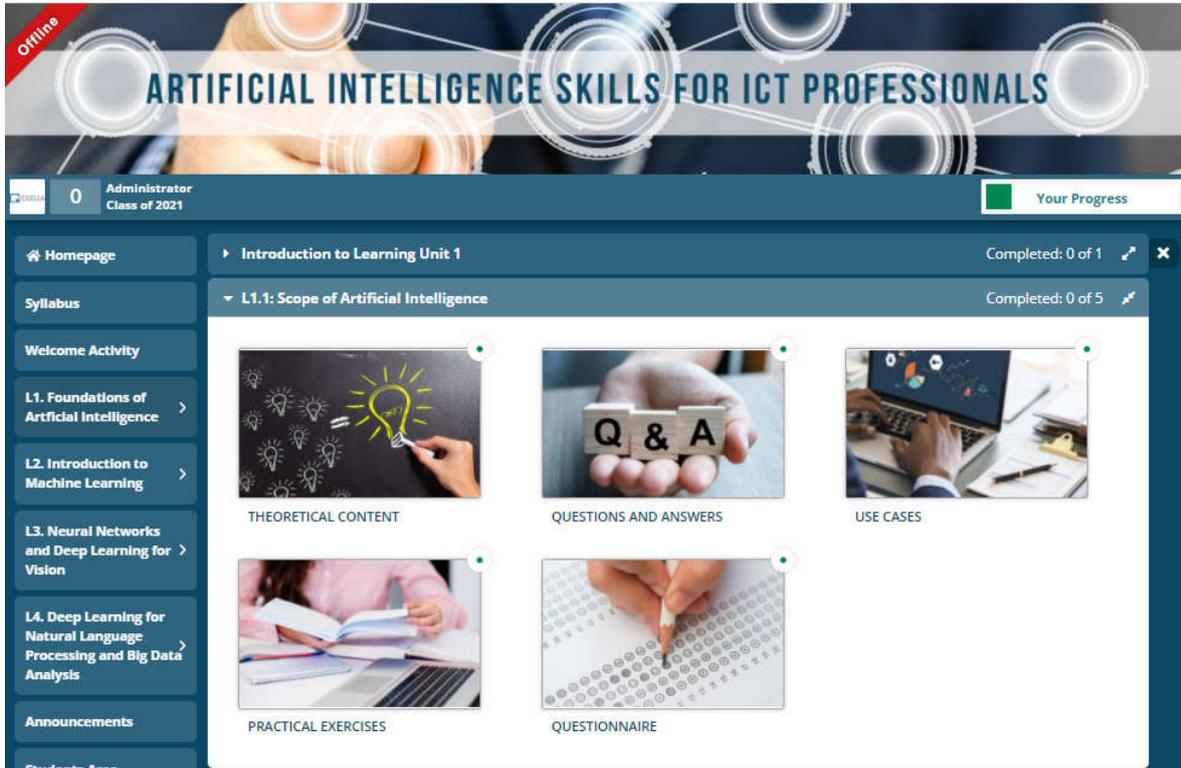
Artificial Intelligence (AI) is revolutionizing the way the economy and society function, by automating tasks & business processes, and managing workflows & critical data more effectively. The fastpaced development of AI technologies in diverse economic and social realities is exponentially augmenting the demand for ICT professionals with the right combination of AI technical, non-technical and transversal skills. Recent market surveys show that the demand for AI skills has almost tripled over the past 3 years and the number of relevant job postings is up by 119%. Employers, however, struggle to find candidates with the right skill mix. Further to demand, the gap is amplified by the shortage and inadequacy of relevant skills expected via Vocational Education and Training (VET) provision, given also that AI is currently a subject of ICT specialization mostly offered at the highest level of tertiary education. The **ARIS VOOC** is an up-to-date, self-standing, modular course for ICT professionals, who need to improve their skills, knowledge and competencies in AI technologies and practical applications. ICT professionals who follow this course will acquire and develop AI-related skills - along with problem-solving, managerial and customer-related (transversal) skills - required to respond to modern workplace requirements and succeed in a competitive labour market.

Learners can navigate within the 4 learning units (modules) using the left-hand navigation bar and selecting the chapter they want to review and study.



Navigation	Learning Unit	Progress
Homepage	Introduction to Learning Unit 1	Completed: 0 of 1
Syllabus	L1.1: Scope of Artificial Intelligence	Completed: 0 of 5
Welcome Activity	L1.2: Problem Solving with Search Algorithms	Completed: 1 of 5
L1. Foundations of Artificial Intelligence	L1.3: Knowledge Representation	Completed: 0 of 5
	L1.4: Machine Learning	Completed: 0 of 5
L2. Introduction to Machine Learning	L1.5: Applications of Artificial Intelligence	Completed: 0 of 5
L3. Neural Networks and Deep Learning for Vision	L1.6: Ethical Implications of Artificial Intelligence	Completed: 0 of 5

Learning units are further broken down into lessons. Lessons, in turn, are structured into 4 sub-sections: a) learning material, b) case studies, c) exercises, and d) quiz. 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.



The screenshot shows a MOOC interface for 'Artificial Intelligence Skills for ICT Professionals'. The header features the course title and a 'Your Progress' indicator. The main content area is titled 'Introduction to Learning Unit 1' and 'L1.1: Scope of Artificial Intelligence'. It displays five activity cards: 'THEORETICAL CONTENT' (lightbulb on chalkboard), 'QUESTIONS AND ANSWERS' (hand holding 'Q & A' blocks), 'USE CASES' (hand on laptop), 'PRACTICAL EXERCISES' (hand reading book), and 'QUESTIONNAIRE' (hand filling out a form). A sidebar on the left lists course sections: 'Welcome Activity', 'L1. Foundations of Artificial Intelligence', 'L2. Introduction to Machine Learning', 'L3. Neural Networks and Deep Learning for Vision', and 'L4. Deep Learning for Natural Language Processing and Big Data Analysis'.

#### 4 Organization of teaching using the ARIS 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".

In this section, we propose some recommendations that will help teachers and, consequently, learners to make the most of a MOOC experience.

## 4.1 Before the 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.

### 4.1.1 Review the MOOC 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.

### 4.1.2 Read the lesson plans

The lesson plans are concise guides that include in a crisp, tightly-focused format the essential technical knowledge that is necessary for the learning experience to succeed. For each lesson in the four learning units of the ARIS Course, a plan is available. Prior to the start of the course, read the plans for the lessons you are willing to teach.

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?
Main concepts or messages that need to be emphasized	List the key concepts or ideas that should be stressed by the teacher to make sure they are understood by the learners.
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)

*Table 2: Items of lesson plans*

#### 4.1.3 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.

#### 4.1.4 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.

## 4.2 During the MOOC

During the MOOC, the facilitator should introduce himself first. He should present the context and the objectives of the lesson. When teaching the content, he must solicit the students to participate to the discussion forum. The next section, section 5, gives more practical recommendations on how to facilitate the ARIS VOOC.

## 4.3 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.

## **5 How to facilitate the ARIS VOOC**

The ARIS 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 ARIS 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.

### **5.1 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 ARIS VOOC. Introductory videos should answer initial questions and concerns, and set the course expectations while assisting in creating a positive first impression.

### **5.2 Promote online discussions and collaborative learning**

The ARIS 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.



The screenshot shows a Moodle course page. At the top, there is a banner with the text "ARTIFICIAL INTELLIGENCE SKILLS FOR ICT PROFESSIONALS" and a red "Offline" tag. Below the banner, the page header includes "Administrator Class of 2021" and "Your Progress". The left sidebar contains a navigation menu with items like "Homepage", "Syllabus", "Welcome Activity", and four course modules: "L1. Foundations of Artificial Intelligence", "L2. Introduction to Machine Learning", "L3. Neural Networks and Deep Learning for Vision", and "L4. Deep Learning for Natural Language Processing and Big Data Analysis". The main content area is titled "Students Area" and features a large image of four diverse professionals holding up colorful speech bubbles. Below the image, a text box reads: "This page is a discussion and sharing space for course participants. Found something interesting? Share it with your class!". At the bottom, there is a toolbar with icons for "Thought", "Image", "Video", "Link", and "File".

### 5.3 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 ARIS student area (discussion forum). Trainers and facilitators need to monitor and interact in the forum as well.

#### **5.4 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 Administrator  
Class of 2019
72%

Your Kudos  
0 content + 9 comment

Syllabus

Welcome Activity

Learning Units >

Announcements

Discussion Forum

Course Feed

> Course Setup

▼ Administer Learners

📄 General

🕒 Timeline

👤 Learners

📊 Statistics

⚙️ Advanced

> Assessment

> Credentials

### Enrol learners

Enrol by email

---

### Learners in the class

✉ Send Reminder Message
📄 Export Data
🏆 Issue Badge
🗑 Remove Learners
☰ Sorting ▼

<input type="checkbox"/>	Learner Name	Enrolment Date	Completion Date	Active Time	Progress	Comments	Kudos	% Course Completed	Certificate ID	Email
<input type="checkbox"/>	 <a href="#">AIT ALDJET Nadjeb</a>	04 Nov 2019 05:04pm	N/A	52 Mins	0%	0	0	0%	N/A	aitnadjib@yahoo.fr
<input type="checkbox"/>	 <a href="#">ATHANASSIOS FAMELIARIS</a>	18 Dec 2019 01:13pm	N/A	2 Mins	0%	0	0	0%	N/A	fameliarisa@unisystem
<input type="checkbox"/>	 <a href="#">Abasi-amefon Affia</a>	05 Oct 2019 09:33pm	N/A	1 Days 7 Hrs	18.75%	0	0	18.75%	N/A	amefon.affia@ut.ee
<input type="checkbox"/>	 <a href="#">Abdul-Baaki Adedokun</a>	03 Jan 2021 12:04am	N/A	1 Hrs 20 Mins	0%	0	0	0%	N/A	adedokun2016@gmail.
<input type="checkbox"/>	 <a href="#">Ahmed Eleyan</a>	28 Sep 2019 07:08pm	N/A	2 Hrs 4 Mins	0%	0	0	0%	N/A	
<input type="checkbox"/>	 <a href="#">Ahmed Samir Imam</a>	07 Nov 2019 01:18am	N/A	3 Mins	3.13%	0	0	3.13%	N/A	ahmedsamir_imam@hi

## 5.5 Create a sense of community and encourage interaction between students

The ARIS VOOC features a welcome activity to make learners, to feel welcome right from the start of your course 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 share some personal (bio) information (e.g. occupation, position, areas of interest, hobbies) with the course’s learning community, and post a picture from their area (without specifying where it is from), letting their peers to guess the exact geographical location.

Administrator  
Class of 2021
Your Progress

- Homepage
- Syllabus
- Welcome Activity
- L1. Foundations of Artificial Intelligence >
- L2. Introduction to Machine Learning >
- L3. Neural Networks and Deep Learning for Vision >
- L4. Deep Learning for Natural Language Processing and Big Data Analysis >
- Announcements
- Students Area
- Course Feed
- > Course Setup
- > Administer Learners
- > Assessment
- > Credentials

## WELCOME ACTIVITY

*Before getting started, let's have some fun and get to know each other a little.*



### Welcome Activity: Say hello and play "Where in Europe?"

Time to say hello, introduce ourselves and guess where in Europe we are coming from to participate in this course.

**WHAT TO DO**

- 1 In the comment thread below, say hello.
- 2 Introduce yourself, state the reason why you enrolled in the course, and share a picture of where in Europe you are right now (to add a picture, click on "Attach a file"). Don't tell us where you are. Let the others guess.
- 3 Now, see if you can guess where your fellow learners are located, by clicking "reply" on their post.



Shipwreck (Navagio) Beach, Zakynthos, Greece

The platform 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-

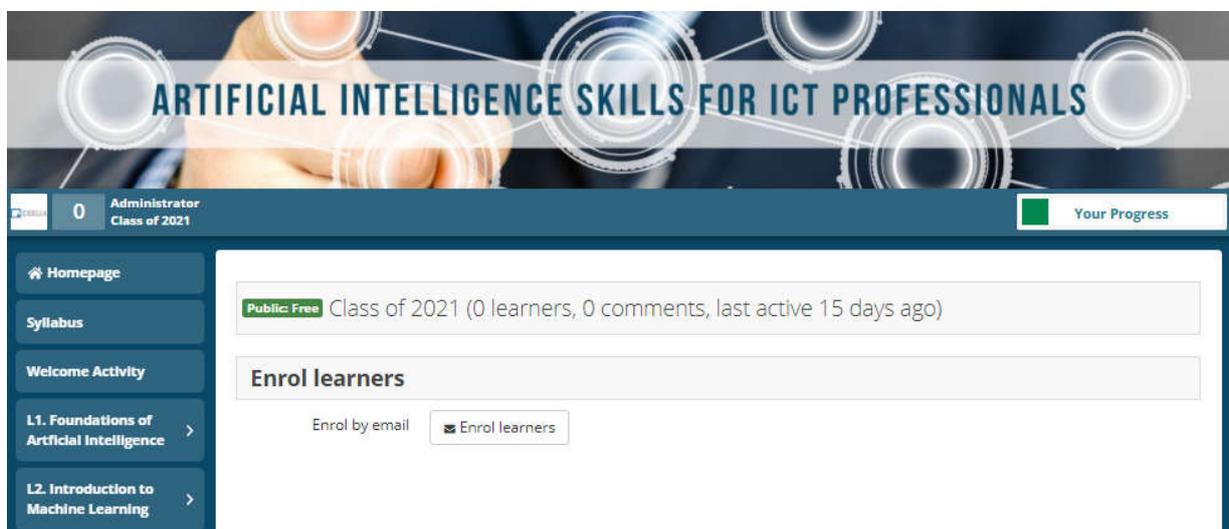
time, work on common projects, and build an open environment of collaboration and co-creation.

## 5.6 Sharing the course

There are several options for sharing and disseminating the ARIS 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 ARIS 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>)



The screenshot shows the course page for "ARTIFICIAL INTELLIGENCE SKILLS FOR ICT PROFESSIONALS". The header features the course title in large, bold, blue letters. Below the header, there is a navigation bar with a "0" icon, the text "Administrator Class of 2021", and a "Your Progress" indicator. The main content area is divided into a left sidebar and a main panel. The sidebar contains links for "Homepage", "Syllabus", "Welcome Activity", "L1. Foundations of Artificial Intelligence", and "L2. Introduction to Machine Learning". The main panel displays the course details: "Public: Free", "Class of 2021 (0 learners, 0 comments, last active 15 days ago)", and an "Enrol learners" section with an "Enrol by email" button and an "Enrol learners" button.

## 5.7 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 ARIS 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 ARIS 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.

## 6 Detailed Lesson Plans of Learning Unit 1: Foundations of Artificial Intelligence

These sections give the detailed lesson plans for the Learning Unit 1. These plans aim to provide the trainers with a guidance for a successful teaching experience.

The learning Unit 1 aims to define the essential characteristics of AI. It addresses the fundamental features of AI technology and provides a common theoretical background regarding the AI landscape.

This unit is composed of the following lessons:

1. Scope of AI
2. Problem Solving
3. Knowledge Representation
4. Machine Learning
5. AI Applications
6. Ethical Implications

After the completion of this unit, the learners should be aware of the scope of Artificial Intelligence and its main topics and areas. They should know the main methods for problem solving include the machine learning.

### 6.1 Lesson plans of the Lesson 1.1. Scope of AI

This section reviews the target knowledge and skills for Lesson 1.1 "Scope of AI". Then, it gives the trainer's lesson plans.

#### 5.1.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Definition of Artificial Intelligence</li> <li>• Main areas of Artificial intelligence, their goals and their scope</li> </ul>	<ul style="list-style-type: none"> <li>• Explain what are the goals of artificial intelligence</li> <li>• Define the areas of artificial intelligence and their scope</li> <li>• Identify the area of an artificial intelligence application</li> </ul>

#### 5.1.2 Lesson plans for Lesson 1.1 Scope of AI

Item	Content
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2h Lecture: 1.5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (AI, areas of AI) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<i>- Ensure that participants are able to define AI and understand its scope.</i>

	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to identify the fundamental areas of AI and their scope</i></li> <li>- <i>Ensure that participants understand the relation between ML and AI</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What's the future of AI" or "Is AI the solution for anything?".</i></li> <li>- <i>Initiate a debate around topics like "What's the future of AI" or "Is AI the solution for anything?".</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of AI technology.</i>
Resources	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 6.2 Lesson plans of the Lesson 1.2. Problem Solving

This section reviews the target knowledge and skills for Lesson 1.2. "Problem Solving". Then, it gives the trainer's lesson plans.

### 5.2.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Definition of a problem in Artificial Intelligence</li> <li>• Methodologies for automatic problem solving, their definition and their algorithms</li> </ul>	<ul style="list-style-type: none"> <li>• Identify the methodology of problem solving adequate for an application</li> <li>• Identify the elements of a problem solving methodology in a problem</li> </ul>

### 5.2.2 Lesson plans for Lesson 1.2 Problem Solving

Item	Content
Setting	<i>Classroom or Online</i>

Duration:	<i>Online: 2h Lecture: 1.5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (Problem solving, problem representation) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define what is a problem and their elements.</i></li> <li>- <i>Ensure that participants are able to define and distinguish the existing solving problem methodologies in AI</i></li> <li>- <i>Ensure that participants are able to enumerate the elements that compose each problem solving methodology</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What is a problem" or "How a problem can be solve by a computer program?".</i></li> <li>- <i>Initiate a debate around topics like "What is a problem" or "How a problem can be solve by a computer program?".</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of problem solving methodologies.</i>
Resources	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

### 6.3 Lesson plans of the Lesson 1.3. Knowledge Representation

This section reviews the target knowledge and skills for Lesson 1.3. "Knowledge Representation". Then, it gives the trainer's lesson plans.

### 5.3.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>• Definition of knowledge and information</li> <li>• Definitions of the types of knowledge</li> <li>• Definition of knowledge representation schema</li> <li>• Definition and elements of production rule systems</li> <li>• Definition and elements of structured knowledge representation languages</li> <li>• Definition and elements of representation languages for uncertain knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Identify the knowledge needed for solving problems in an application domain</li> <li>• Analyze the elements that define the knowledge of an application domain</li> <li>• Apply the steps an ontology development methodology</li> <li>• Formalize as rules the decisions taken in an application domain of a simple problem</li> <li>• Analyze the need for the representation of uncertainty in an application domain</li> </ul>

### 5.3.2 Lesson plans for Lesson 1.3 Knowledge Representation

<b>Item</b>	<b>Content</b>
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2h</i> <i>Lecture: 1.5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (Knowledge representation, ontologies, rules, logic) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define knowledge and information</i></li> <li>- <i>Ensure that participants are able to identify the elements of a knowledge representation schema</i></li> <li>- <i>Ensure that participants understand the goals and limitations of the different knowledge representation schemas in Artificial Intelligence</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> </ul>

	<ul style="list-style-type: none"> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What is knowledge" or "How a computer can represent knowledge?".</i></li> <li>- <i>Initiate a debate around topics like "What is knowledge" or "How a computer can represent knowledge?".</i></li> </ul>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of knowledge representation methods.</i>
<b>Resources</b>	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 6.4 Lesson plans of the Lesson 1.4. Machine Learning

This section reviews the target knowledge and skills for Lesson 1.4. "Machine Learning". Then, it gives the trainer's lesson plans.

### 5.4.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Goals of machine learning algorithms</li> <li>• Typology and characteristics of machine learning algorithms</li> <li>• Methods for supervised machine learning</li> <li>• Principles of the decision trees algorithm</li> <li>• Principles of naïve bayes algorithm</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the different types of machine learning algorithms</li> <li>• Apply decision trees algorithm to a small dataset</li> <li>• Apply naïve bayes algorithm to a small dataset</li> </ul>

### 5.4.2 Lesson plans for Lesson 1.4 Machine Learning

Item	Content
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2h Lecture: 1.5h; practice/individual work 0.5h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners (machine learning, supervised learning) using "Who knows about..." questions.</i>

Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define machine learning and its goals</i></li> <li>- <i>Ensure that participants are able to differentiate among the different types of machine learning algorithms</i></li> <li>- <i>Ensure that participants understand the goals of supervised machine learning algorithms</i></li> <li>- <i>Ensure that participants understand the basics of decision trees algorithms</i></li> <li>- <i>Ensure that participants understand the basics of naïve bayes algorithm</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "how to teach a machine to solve new problems?".</i></li> <li>- <i>Initiate a debate around topics like "how to teach a machine to solve new problems?".</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of supervised machine learning algorithms.</i>
Resources	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 6.5 Lesson plans of the Lesson 1.5. AI Applications

This section reviews the target knowledge and skills for Lesson 1.5. "AI Applications". Then, it gives the trainer's lesson plans.

### 5.5.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>• Application of Artificial Intelligence</li> <li>• Main languages used in Artificial Intelligence development and applications</li> </ul>	<ul style="list-style-type: none"> <li>• Analyze the need for artificial intelligence in an application or domain</li> <li>• Identify artificial intelligence areas and techniques that can be used for solving the elements of an application or domain</li> </ul>

### 5.5.2 Lesson plans for Lesson 1.5 AI Applications

<b>Item</b>	<b>Content</b>
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 12h Lecture: 6h; practice/individual work 6h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (every day applications of Artificial Intelligence) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to enumerate current applications of artificial intelligence</i></li> <li>- <i>Ensure that participants are able to identify the areas of AI that are used in common applications</i></li> <li>- <i>Ensure that participants are able to enumerate languages used in the development of artificial intelligence applications</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What are AI applications that you use every day" or "how can impact AI your daily work?".</i></li> </ul>

	- <i>Initiate a debate around topics like "What are AI applications that you use every day" or "how can impact AI your daily work?".</i>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of AI applications.</i>
<b>Resources</b>	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 6.6 Lesson plans of the Lesson 1.6. Ethical implications

This section reviews the target knowledge and skills for Lesson 1.6. "Ethical implications". Then, it gives the trainer's lesson plans.

### 5.6.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>Ethical Implications of AI systems</li> </ul>	<ul style="list-style-type: none"> <li>Explain the ethical implications of developing and deploying an AI system</li> <li>Anticipate ethical dilemmas before the system is deployed</li> </ul>

### 5.6.2 Lesson plans for Lesson 1.6 Ethical Implications

<b>Item</b>	<b>Content</b>
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2h Lecture: 1.5h; practice/individual work 0.5h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners asking them what they know about ethical dilemmas. Ask them if they know about any company that they believe may behave unethically</i>
<b>Engage/motivation</b>	<i>Use practical examples of technology companies that have been accused of being unethical and use this examples to introduce the basic vocabulary</i>
<b>Main concepts or messages that need to be emphasized</b>	- <i>Ensure that participants are able to distinguish legal from ethical principles.</i>

	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to identify an ethical dilemma where a non-completely satisfactory course of action exists.</i></li> <li>- <i>Ensure that participants understand the important role of engineers to anticipate and report ethical problems in the deployment of AI systems</i></li> <li>- <i>Ensure that participants are able to identify the main elements of AI systems that are ethically delicate.</i></li> <li>- <i>Ensure that participants understand that a company that promotes ethical principles among its workers is beneficial for the society</i></li> </ul>
Whole group instructions	Yes.
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: encourage learners to solve the exercises and answer the multiple choice tests</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings. Encourage learners to search on internet for discussions about the ethics of AI</i></li> <li>- <i>Start a new topic in a forum with open questions like "why companies should promote ethical principles?", "why engineers should have deontological codes similar to doctors or lawyers?"</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs;</i>
Resources	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## **7 Detailed Lesson Plans of Learning Unit 2: Foundations of Artificial Intelligence**

The aim of this learning unit is to master the foundations for Machine Learning. This unit teaches how to select the right ML model and to implement it in a given domain. This unit is composed of the following lessons:

1. Introduction to ML

2. Languages and Resources
3. Data Transformation and Visualization
4. Supervised Linear ML
5. Supervised Non-Linear ML
6. Unsupervised ML

After the completion of this unit, the learners should be able to evaluate the feasibility of implementing a suitable ML algorithm in a novel domain. They will have the required skills to develop a detailed plan to gather the right data, select the right algorithm taking advantage of existing resources and conducting a suitable validation.

### 7.1 Lesson plans of the Lesson 2.1. Introduction to ML

This section reviews the target knowledge and skills for Lesson 2.1. "Introduction to ML". Then, it gives the trainer's lesson plans.

#### 6.1.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Goals of machine learning</li> <li>• Areas of machine learning</li> <li>• Foundations of supervised machine learning</li> <li>• Evaluation of supervised machine learning algorithms</li> </ul>	<ul style="list-style-type: none"> <li>• Recognize the type of machine learning algorithm that is needed for solving a problem</li> <li>• Identify the type of machine learning task that is needed for a problem</li> <li>• Identify and enumerate elements that can be used for solving a problem using machine learning</li> </ul>

#### 6.2.2 Lesson plans for Lesson 2.1 Introduction to ML

Item	Content
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2h Lecture: 1.5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (Machine Learning, types of machine learning) using "Who knows about..." questions.</i>

Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define machine learning and understand its scope.</i></li> <li>- <i>Ensure that participants are able to identify and define the different areas of machine learning</i></li> <li>- <i>Ensure that participants understand the elements and principles of supervised learning</i></li> <li>- <i>Ensure that participants understand the strategies for training and evaluating machine learning algorithms</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "How a machine can learn" or "what is the importance of machines that can learn and adapt?".</i></li> <li>- <i>Initiate a debate around topics like "How a machine can learn" or "what is the importance of machines that can learn and adapt?".</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of machine learning tasks and its evaluation.</i>
Resources	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 7.2 Lesson plans of the Lesson 2.2. Languages and Resources

This section reviews the target knowledge and skills for Lesson 2.2. "Languages and Resources". Then, it gives the trainer's lesson plans.

### 6.2.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Main libraries for data manipulation in python</li> <li>• Main libraries for machine learning in python</li> <li>• Main libraries for data visualization and results presentation in python</li> </ul>	<ul style="list-style-type: none"> <li>• Use different libraries for data loading, manipulation and visualization</li> <li>• Apply simple transformations to a dataset</li> <li>• Perform different visualizations of a dataset</li> </ul>

### 6.2.2 Lesson plans for Lesson 2.2 Languages and Resources

Item	Content
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2h</i> <i>Lecture: 1.5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (languages for machine learning, data manipulation, visualization) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to enumerate libraries for data manipulation</i></li> <li>- <i>Ensure that participants are able to enumerate libraries for machine learning</i></li> <li>- <i>Ensure that participants are able to enumerate libraries for data visualization</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What languages do you know for machine learning applications?".</i></li> </ul>

	- <i>Initiate a debate around topics like "What languages do you know for machine learning applications?".</i>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of the different python libraries for machine learning.</i>
<b>Resources</b>	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

### 7.3 Lesson plans of the Lesson 2.3. Data Transformation and Visualization

This section reviews the target knowledge and skills for Lesson 2.3. "Data Transformation and Visualisation". Then, it gives the trainer's lesson plans.

#### 6.3.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>• Goals of Dimensionality reduction and visualization</li> <li>• Principles of Principal Component Analysis</li> <li>• Principles of Multidimensional Scaling</li> <li>• Principles of Locally Linear Embedding</li> <li>• Principles of t-Stochastic Neighbour Embedding</li> </ul>	<ul style="list-style-type: none"> <li>• Explore and visualize a dataset reducing its dimensionality</li> <li>• Apply different dimensionality reduction algorithms</li> <li>• Analyse the results of a dimensionality reduction algorithm</li> </ul>

#### 6.3.2 Lesson plans for Lesson 2.3 Data Transformation and Visualization

<b>Item</b>	<b>Content</b>
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2h Lecture: 1.5h; practice/individual work 0.5h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners (Visualization, Data dimensionality) using "Who knows about..." questions.</i>
<b>Engage/motivation</b>	<i>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.</i>

Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to understand the purpose of dimensionality reduction</i></li> <li>- <i>Ensure that participants are able to identify the different algorithms for dimensionality reduction</i></li> <li>- <i>Ensure that participants are able to understand the principles of the algorithms for dimensionality reduction</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What is the problem of high dimensional data" or "how can data be inspected?".</i></li> <li>- <i>Initiate a debate around topics like "What is the problem of high dimensional data" or "how can data be inspected?".</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of dimensionality reduction algorithms.</i>
Resources	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 7.4 Lesson plans of the Lesson 2.4. Supervised Linear ML

This section reviews the target knowledge and skills for Lesson 2.4. "Supervised Linear ML". Then, it gives the trainer's lesson plans.

### 6.4.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>• Goals and limitations of supervised linear machine learning algorithms</li> <li>• Principles of Linear regression algorithms</li> <li>• Principles of Decision and Regression Trees algorithms</li> </ul>	<ul style="list-style-type: none"> <li>• Generate a training and test set from dataset for training a machine learning model</li> <li>• Adjust the hyper parameters of different linear machine learning algorithm</li> </ul>

<ul style="list-style-type: none"> <li>Principles of Naïve Bayes algorithm</li> <li>Principles of K-Nearest Neighbours algorithm</li> </ul>	<ul style="list-style-type: none"> <li>Validate a model using cross validation</li> <li>Apply linear machine learning models to classification and regression problems</li> <li>Analyze and compare the results obtained using different linear machine learning models</li> </ul>
---	--

#### 6.4.2 Lesson plans for Lesson 2.4 Supervised Linear ML

<b>Item</b>	<b>Content</b>
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2h Lecture: 1,5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (linear regression, decision trees, naïve bayes) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to identify the different methods of supervised linear machine learning</i></li> <li>- <i>Ensure that participants understand the principles of linear regression algorithms</i></li> <li>- <i>Ensure that participants understand the principles of decision and regression trees algorithms</i></li> <li>- <i>Ensure that participants understand the principles of Naïve Bayes algorithms</i></li> <li>- <i>Ensure that participants understand the principles of K-Nearest Neighbours algorithm</i></li> <li>- <i>Start a new topic in a forum with open questions like "What makes a machine learning model appropriate for a problem?".</i></li> <li>- <i>Initiate a debate around topics like "What makes a machine learning model appropriate for a problem?".</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> </ul>

	- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of linear machine learning algorithms.</i>
<b>Resources</b>	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 7.5 Lesson plans of the Lesson 2.5. Supervised Non Linear ML

This section reviews the target knowledge and skills for Lesson 2.5. "Supervised Non Linear ML". Then, it gives the trainer's lesson plans.

### 6.5.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>Goals and limitations of supervised non linear machine learning algorithms</li> <li>Principles of Support Vector Machines</li> <li>Principles of Multilayer Perceptrons</li> <li>Principles of Model Ensembles</li> </ul>	<ul style="list-style-type: none"> <li>Generate a training and test set from dataset for training a machine learning model</li> <li>Adjust the hyper parameters of different non linear machine learning algorithm</li> <li>Validate a model using cross validation</li> <li>Apply non linear machine learning models to classification and regression problems</li> <li>Analyze and compare the results obtained using different non linear machine learning models</li> </ul>

### 6.5.2 Lesson plans for Lesson 2.5 Supervised non linear ML

<b>Item</b>	<b>Content</b>
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2h Lecture: 1.5h; practice/individual work 0.5h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners (non linear methods, neural networks) using "Who knows about..." questions.</i>

Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to identify the different methods of supervised non linear machine learning</i></li> <li>- <i>Ensure that participants understand the principles of Support Vector Machines</i></li> <li>- <i>Ensure that participants understand the principles of Multilayer Perceptrons</i></li> <li>- <i>Ensure that participants understand the principles of Model Ensembles</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of non linear machine learning algorithms</i>
Resources	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 7.6 Lesson plans of the Lesson 2.6. Unsupervised ML

This section reviews the target knowledge and skills for Lesson 2.6. "Unsupervised ML". Then, it gives the trainer's lesson plans.

### 6.6.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Principles and goals of unsupervised learning algorithms</li> <li>• Principles of Hierarchical Clustering algorithms</li> <li>• Principles of K-Means algorithm</li> </ul>	<ul style="list-style-type: none"> <li>• Apply unsupervised learning algorithms to a problem</li> <li>• Adjust the hyperparameters of unsupervised learning algorithms</li> </ul>

<ul style="list-style-type: none"> <li>Principles of Gaussian Mixture Models algorithms</li> <li>Evaluation of unsupervised machine learning algorithms</li> </ul>	<ul style="list-style-type: none"> <li>Analyze and compare the results obtained using different unsupervised learning algorithms</li> </ul>
--	---

### 6.6.2 Lesson plans for Lesson 2.6 Unsupervised ML

<b>Item</b>	<b>Content</b>
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2h</i> <i>Lecture: 1.5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (unsupervised learning, clustering) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants understand the goals and principles of unsupervised learning algorithms</i></li> <li>- <i>Ensure that participants understand the principles of hierarchical clustering algorithms</i></li> <li>- <i>Ensure that participants understand the principles of K-means algorithm</i></li> <li>- <i>Ensure that participants understand the principles of Gaussian Mixture Models algorithms</i></li> <li>- <i>Ensure that participants understand the principles of unsupervised learning validation</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "Why is unsupervised learning needed" or "What can be solved using unsupervised learning?".</i></li> <li>- <i>Initiate a debate around topics like "Why is unsupervised learning needed" or "What can be solved using unsupervised learning?".</i></li> </ul>

Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of unsupervised learning algorithms.</i>
Resources	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>

## 8 Detailed Lesson Plans of Learning Unit 3: Neural Networks and Deep Learning

The aim of this learning unit is to teach the foundations for Neural Network (NN) and Deep Learning (DL). Attendees will acquire the required skills to implement solutions using NN and DL algorithms in a given domain.

This unit is composed of the following lessons:

1. Brain origin and elements of neural networks
2. Simple perceptrons and supervised learning
3. Multilayer perceptrons and Keras
4. Deep learning for image classification: Convolutional neural networks
5. Different CNNs for image classification
6. Real-time object localization with YOLO models

After the completion of this unit, the learners should be able to evaluate the feasibility of implementing a suitable NN architecture and DL algorithm in a novel domain. They should have the required skills to provide expertise on a detailed plan to gather the right data, develop the right algorithm taking advantage of existing resources and conducting a suitable validation.

### 8.1 Lesson plans of the Lesson 3.1. Brain origin and elements of neural networks

This section reviews the target knowledge and skills for Lesson 3.1. "Brain origin and elements of neural networks". Then, it gives the trainer's lesson plans.

#### 7.1.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>• Goals of machine learning</li> <li>• Areas of machine learning</li> <li>• Foundations of supervised machine learning</li> </ul>	<ul style="list-style-type: none"> <li>• Recognize the type of machine learning algorithm that is needed for solving a problem</li> <li>• Identify the type of machine learning task that is needed for a problem</li> </ul>

<ul style="list-style-type: none"> <li>Evaluation of supervised machine learning algorithms</li> </ul>	<ul style="list-style-type: none"> <li>Identify and enumerate elements that can be used for solving a problem using machine learning</li> </ul>
--	---

7.1.2 Lesson plans for Lesson 3.1 Brain origin and elements of Neural Networks

<b>Item</b>	<b>Content</b>
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2h</i> <i>Lecture: 1.5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (Machine Learning, types of machine learning) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define machine learning and understand its scope.</i></li> <li>- <i>Ensure that participants are able to identify and define the different areas of machine learning</i></li> <li>- <i>Ensure that participants understand the elements and principles of supervised learning</i></li> <li>- <i>Ensure that participants understand the strategies for training and evaluating machine learning algorithms</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to solve the practical exercises and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "How a machine can learn" or "what is the importance of machines that can learn and adapt?".</i></li> <li>- <i>Initiate a debate around topics like "How a machine can learn" or "what is the importance of machines that can learn and adapt?".</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of machine learning tasks and its evaluation.</i>

<b>Resources</b>	<i>Paper, pencil, board. If possible, computer classroom for individual exercises.</i>
------------------	--

## 8.2 Lesson plans of the Lesson 3.2. Simple perceptrons and supervised learning

This section reviews the target knowledge and skills for Lesson 3.2. "Simple perceptrons and supervised learning". Then, it gives the trainer's lesson plans.

### 7.2.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>Supervised learning processes</li> <li>Simple perceptrons architecture and functioning</li> </ul>	<ul style="list-style-type: none"> <li>Init a simple perceptron architecture</li> <li>Train a simple perceptron using a supervised learning training set to solve a classification task</li> </ul>

### 7.2.2 Lesson plans for Lesson 3.2 Simple perceptrons and supervised learning

<b>Item</b>	<b>Content</b>
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2 h Lecture: 1,5 h; practice/individual work 0,5 h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners (Artificial neuron, ANN architectures) using "Who knows about..." questions.</i>
<b>Engage/motivation</b>	<i>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.</i>
<b>Main concepts or messages that need to be emphasized</b>	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to Describe a supervised learning process</i></li> <li>- <i>Ensure that participants are able to Describe and code a simple perceptron from scratch using python</i></li> <li>- <i>Ensure that participants are able to Manage a labelled training set to train a simple perceptron to solve a classification task</i></li> </ul>
<b>Whole group instructions</b>	<i>Yes.</i>

<b>Evaluate understanding/assessment</b>	<ul style="list-style-type: none"> <li>- 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.</li> <li>- Individual task: Encourage learners to read the use cases and to comment on their findings.             <ul style="list-style-type: none"> <li>- Start a new topic in a forum with open questions like "What's a training epoch" or "what are the differences between simple perceptrons and single-layer perceptrons?".</li> </ul> </li> <li>- Initiate a debate around topics like "in which real-life processes a classification task can be applied?".</li> </ul>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of supervised learning and classification task with perceptrons</i>
<b>Resources</b>	<i>Paper, pencil, board, personal computer for individual exercises.</i>

### 8.3 Lesson plans of the Lesson 3.3. Multilayer perceptrons and Keras

This section reviews the target knowledge and skills for Lesson 3.3. "Multilayer perceptrons and Keras". Then, it gives the trainer's lesson plans.

#### 7.3.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Multilayer Perceptrons and Deep neural Networks</li> <li>• Deep learning: Backpropagation algorithm, Loss functions, Optimizers</li> <li>• Multilayer perceptrons (MLPs)</li> </ul>	<ul style="list-style-type: none"> <li>• Init and train a Multilayer Perceptron (MLP) to solve regression and classification tasks with Keras</li> </ul>

#### 7.3.2 Lesson plans for Lesson 3.3 Multiplayer perceptrons and Keras

Item	Content
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2 h Lecture: 1,5 h; practice/individual work 0,5 h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners (simple perceptrons, supervised learning processes) using "Who knows about..." questions.</i>

Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to identify the main processes of deep learning ( backpropagation, loss function, optimizers, evaluation and test)</i></li> <li>- <i>Ensure that participants are able to understand the advantages of using Keras compared to code the perceptron from scratch</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like How the back propagation algorithm works? ”.</i></li> <li>- <i>Initiate a debate around topics like "which is the correct loss function to be used in a regression task?".</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of Multilayer Perceptrons and Keras</i>
Resources	<i>Paper, pencil, board, personal computer for individual exercises.</i>

## 8.4 Lesson plans of the Lesson 3.4. Deep learning for image classification: Convolutional neural networks

This section reviews the target knowledge and skills for Lesson 3.4. “Deep learning for image classification: Convolutional neural networks”. Then, it gives the trainer's lesson plans.

### 7.4.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Elements of Computer Vision (CV)</li> <li>• Convolutional Neural Networks</li> <li>• LeNet5: the first CNN.</li> </ul>	<ul style="list-style-type: none"> <li>• Train CNNs using pre-built keras image dataset</li> </ul>

<ul style="list-style-type: none"> <li>MNIST dataset</li> </ul>	
---	--

#### 7.4.2 Lesson plans for Lesson 3.4 Deep learning for image classifications: convolutional neural networks

<b>Item</b>	<b>Content</b>
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2 h</i> <i>Lecture: 1,5 h; practice/individual work 0,5 h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners on Deep Learning fundamentals, <b>and how to solve classification tasks</b> using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to understand image data</i></li> <li>- <i>Ensure that participants are able to understand and build a convolutional region</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What's a convolutional layer" or "which are the main elements of the architecture of LeNet5?"</i></li> <li>- <i>Initiate a debate around topics like "How it is possible to test the results obtained in the training phase?"</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of Convolutional Neural Networks</i>
Resources	<i>Paper, pencil, board, personal computer for individual exercises.</i>

## 8.5 Lesson plans of the Lesson 3.5. Different CNNs for image classification

This section reviews the target knowledge and skills for Lesson 3.5. "Different CNNs for image classification". Then, it gives the trainer's lesson plans.

### 7.5.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Different CNN for image classification.</li> <li>• CNN issues and limits.</li> <li>• Residual networks (ResNet)</li> <li>• R-CNN</li> <li>• Fast R-CNN.</li> <li>• Faster R-CNN</li> <li>• Mask R-CNN.</li> </ul>	<ul style="list-style-type: none"> <li>• Preprocess images.</li> <li>• Predict image class</li> <li>• Customise Keras models with transfer learning</li> </ul>

### 7.5.2 Lesson plans for Lesson 3.5 Different CNNs for image classification

Item	Content
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2 h Lecture: 1,5 h; practice/individual work 0,5 h..</i>
Lesson beginning	<i>Assess the awareness of the group of learners (Image data, Convolutional Neural Networks using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define the limits of each architectures and how to manage them</i></li> <li>- <i>Ensure that participants are able to point out the advantages of massive learning process</i></li> <li>- <i>Ensure that participants understand how to use transfer learning processes</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> </ul>

	<ul style="list-style-type: none"> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What's the advantage of a transfer learning process" or "which architecture to choose for a object segmentation task?"</i></li> <li>- <i>Initiate a debate around topics like "How could the R-CNN be improved?"</i></li> </ul>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of the evolution of COnvolutional Neural Networks</i>
<b>Resources</b>	<i>Paper, pencil, board, personal computer for individual exercises.</i>

## 8.6 Lesson plans of the Lesson 3.6. Real-time object localization with YOLO models

This section reviews the target knowledge and skills for Lesson 3.6. "Real-time object localization with YOLO models". Then, it gives the trainer's lesson plans.

### 7.6.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Object localization</li> <li>• YOLOv1</li> <li>• YOLOv2</li> <li>• YOLOv3</li> </ul>	<ul style="list-style-type: none"> <li>• How to manage a Deep Neural Networks Object Localization Project</li> </ul>

### 7.6.2 Lesson plans for Lesson 3.6 Real-time object localization with YOLO models

Item	Content
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2 h</i> <i>Lecture: 1,5 h; practice/individual work 0,5 h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners (<b>Elements of computer vision, object localization task</b>) using "Who knows about..." questions.</i>

Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define <b>differences between a classic CNN for image classification and Yolo</b></i></li> <li>- <i>Ensure that participants are able to identify mechanisms underlying Yolo model evolution</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like <b>Which are the mechanism underlying the improvements from Yolo v1 to Yolo v2.</b></i></li> <li>- <i>Initiate a debate around topics like <b>"Why Yolo Models can be used for video real time analysis?"</b></i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of real time <b>object localization with Yolo models</b></i>
Resources	<i>Paper, pencil, board, personal computer for individual exercises</i>

## 9 Detailed Lesson plans of the Learning Unit 4: AI for solving real-life problems

The aim of this learning unit is to provide the expertise of the whole software development cycle of an AI solution. This learning unit provides different case studies related to several application domains where AI techniques are applied.

This unit is composed of the following lessons:

1. Word embedding and Text classification
2. Neural networks for NLP and libraries
3. New approaches, applications, open problems
4. Big Data: Problems, core techniques and introduction to Hadoop and Spark
5. Spark Big Data Processing
6. Cloud computing and machine learning With PySpark

After the completion of this unit, the learners should be able to analyse strengths, weakness, opportunities and threats of AI solutions for specific industry, mainly on those domains where the technology has already been tested and resources can be reused. Learners should have the expertise of the whole software development cycle of an AI solution including design, development and validation.

### 9.1 Lesson plans of the Lesson 4.1. Word embedding and Text classification

This section reviews the target knowledge and skills for Lesson 4.1. "Word embedding and Text classification". Then, it gives the trainer's lesson plans.

#### 8.1.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"><li>• Elements of NLP</li><li>• Text classification</li><li>• Supervised ML with a NN</li></ul>	<ul style="list-style-type: none"><li>• Create embedding or find a pre-trained one</li><li>• Create a dictionary with the word as a key and the vector as a value</li></ul>

<ul style="list-style-type: none"> <li>• Words Embeddings</li> <li>• Word2vec</li> <li>• GloVe</li> </ul>	<ul style="list-style-type: none"> <li>• Building a Text classification Model</li> <li>• Test, evaluate, adjust, save, use the Model</li> <li>• Collect and label text documents</li> <li>• Text Preprocessing (lowercasing, Normalization, Noise Removal, Tokenisation, Stopword removal, Lemmatisation/Stemming)</li> <li>• Realise a sentiment classification</li> </ul>
---	---

### 8.1.2 Lesson plans for Lesson 4.1 Word embedding and Text classification

<b>Item</b>	<b>Content</b>
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2h Lecture: 1,5h; practice/individual work 0.5h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (Basic Linear Algebra Basic knowledge of Python language) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to specify what NLP does, understand its scope, understand how it achieves its objectives.</i></li> <li>- <i>Ensure that participants are able to identify the fundamental areas of application of NLP.</i></li> <li>- <i>Ensure that participants understand how to perform all the fundamental steps in relation to NLP, in particular: preprocessing, text embedding, model construction, parameter tuning and measure of classification quality.</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "Which operations should be performed for text preprocessing".</i></li> </ul>

	- <i>Initiate a debate around topics like: "What are the possible applications of NLP?" or "What are the key processes of NLP?".</i>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs, focusing on the essentials of NLP technology, in particular text pre-processing, word embedding and text .</i>
<b>Resources</b>	<i>Paper, pencil, board, personal computer for individual exercises</i>

## 9.2 Lesson plans of the Lesson 4.2. Neural networks for NLP and libraries

This section reviews the target knowledge and skills for Lesson 4.2. "Neural networks for NLP and libraries". Then, it gives the trainer's lesson plans.

### 8.2.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>Know the characteristics of the main layers used in NLP and how to implement them with the most used libraries: Scikit-learn, Keras and Tensorflow, SPACY, Gensim, Stanford CoreNLP, Natural Language Toolkit (NLTK)</li> <li>Convolutional Neural Network, Recurrent Neural Network and RNN variants (LSTM, GRU) for NLP problems.</li> <li>Attention Mechanism, Reinforcement Learning, Unsupervised Learning for NLP .</li> </ul>	<ul style="list-style-type: none"> <li>Perform basic tensor operation (add, matmul, square) and print result, shape and data type</li> <li>Tokenization, Stopwords and POS with Spacy and NLTK</li> <li>Use the appropriate NLP model based on the task to be solved</li> <li>Analysis of web site recensions</li> </ul>

### 8.2.2 Lesson plans for Lesson 4.2 Neural networks for NLP and libraries

<b>Item</b>	<b>Content</b>
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2h Lecture: 1,5h; practice/individual work 0,5h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners (Natural Language Processing, Neural Networks, Machine Learning) using "Who knows about..." questions.</i>

Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to select appropriate NLP Model to different tasks</i></li> <li>- <i>Ensure that participants are able to identify the different kinds of Neural Networks for NLP (e.g., recurrent, convolutional)</i></li> <li>- <i>Ensure that participants understand the difference between Unsupervised Learning models and Reinforcement Learning</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What's the Tokenization," , "How CNN are applied to NLP problems" or "The main issue of a Recurrent Neural Network LSTM vs GRU".</i></li> <li>- <i>Initiate a debate around topics like "Different Tasks and NLP models applied".</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs; focusing on the essentials of NN for NLP.</i>
Resources	<i>Paper, pencil, board, personal computer for individual exercises</i>

### 9.3 Lesson plans of the Lesson 4.3. New approaches, applications, open problems

This section reviews the target knowledge and skills for Lesson 4.3. "New approaches, applications, open problems". Then, it gives the trainer's lesson plans.

#### 8.3.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Understand how the latest approaches to NLP work</li> </ul>	<ul style="list-style-type: none"> <li>• Fine tune Transformers, BERT, and ELMo in order to built a model for</li> </ul>

<ul style="list-style-type: none"> <li>• Character-Based Neural Language Model</li> <li>• Transformers, BERT, and ELMo</li> <li>• Natural language processing applications</li> <li>• Open problems: risks and ethics (exclusion, overgeneralization, exposure, dual-use)</li> </ul>	<p>testing if two sentences are semantically equivalent or not</p> <ul style="list-style-type: none"> <li>• Automatic word completion</li> <li>• Choice of appropriate NLP model for a given application</li> </ul>
--	---

### 8.3.2 Lesson plans for Lesson 4.3 New approaches, applications, open problems

Item	Content
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2 h</i> <i>Lecture: 1,5 h; practice/individual work 0,5 h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (Fundamentals of NLP, Linear Algebra, Python programming) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define and illustrate the new approaches of NLP, and understand their scope of application.</i></li> <li>- <i>Ensure that participants are able to identify the fundamental applications of NLP techniques.</i></li> <li>- <i>Ensure the participants have understood the ethical risks linked to NLP applications.</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "Which are the new approaches of NLP" or "What are the main ethic issues of NLP techniques?".</i></li> </ul>

	- <i>Initiate a debate around topics like "what are the main applications of the new NLP approaches".</i>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs, focusing on the essentials of NLP new approaches, their applications, ethical issues and open problems.</i>
<b>Resources</b>	<i>Paper, pencil, board, personal computer for individual exercises</i>

## 9.4 Lesson plans of the Lesson 4.4. Big Data: Problems, core techniques and introduction to Hadoop and Spark

This section reviews the target knowledge and skills for Lesson 4.4. "Big Data: Problems, core techniques and introduction to Hadoop and Spark". Then, it gives the trainer's lesson plans.

### 8.4.1 Targeted Knowledge and Skills

<b>Knowledge</b>	<b>Skills</b>
<ul style="list-style-type: none"> <li>• Introduction to big data and big data analysis</li> <li>• Paradigm of big data</li> <li>• Big data value chain</li> <li>• Map Reduce Overview</li> <li>• Hadoop Framework</li> <li>• From Hadoop to Spark</li> </ul>	<ul style="list-style-type: none"> <li>• Storing and manipulating massive datasets</li> <li>• Manipulating files in the HDFS</li> <li>• Use of the basic functionalities of Hadoop</li> <li>• Use of the basic functionalities of Spark</li> </ul>

### 8.4.2 Lesson plans for Lesson 4.4 Big Data: Problems, core techniques and introduction to Hadoop and Spark

<b>Item</b>	<b>Content</b>
<b>Setting</b>	<i>Classroom or Online</i>
<b>Duration:</b>	<i>Online: 2 h Lecture: 1,5 h; practice/individual work 0,5 h.</i>
<b>Lesson beginning</b>	<i>Assess the awareness of the group of learners (Big Data Analysis, Spark, Hadoop) using "Who knows about..." questions.</i>
<b>Engage/motivation</b>	<i>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.</i>

<p>Main concepts or messages that need to be emphasized</p>	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define what Big Data Analysis and understand its scope.</i></li> <li>- <i>Ensure that participants know the fundamentals of HDFS and YARN</i></li> <li>- <i>Ensure that participants understand how Hadoop is different from other parallel computing system</i></li> </ul>
<p>Whole group instructions</p>	<p><i>Yes.</i></p>
<p>Evaluate understanding/assessment</p>	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "What are the main features of Hadoop" or "What are the main uses of Spark".</i></li> <li>- <i>Initiate a debate around topics like "What applications do you think can be faced with Big Data Analysis?".</i></li> </ul>
<p>Closing activities</p>	<p><i>Summarize the main key elements learned and provide common feedback based on learner inputs, focusing on the essentials of Big Data Analysis and the tools considered in the lesson (Hadoop, Spark, etc.).</i></p>
<p>Resources</p>	<p><i>Paper, pencil, board, personal computer for individual exercises</i></p>

## 9.5 Lesson plans of the Lesson 4.5. Spark Big Data Processing

This section reviews the target knowledge and skills for Lesson 4.5. "Spark Big Data Processing". Then, it gives the trainer's lesson plans.

### 8.5.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Spark Architectures</li> <li>• Sparks Components (spark Core, SPark SQL, Spark Streaming, GraphX, Mllib; Resilient Distributed Datasets RDD)</li> <li>• Spark Execution modo and Cluster Managers (Apache Mesos, Kubernetes, Hadoop YARN, Spark shell interface, Spark SQL, GraphX)</li> <li>• DataFrame Operation in Spark</li> </ul>	<ul style="list-style-type: none"> <li>• Manipulate processes in Spark DataFrame</li> <li>• Given a dataset, write queries using the SQL language via Spark SQL</li> <li>• Create a GraphFrame from vertex and edge DataFrames.</li> </ul>

### 8.5.2 Lesson plans for Lesson 4.5 Spark Big Data Processing

Item	Content
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2 h Lecture: 1,5 h; practice/individual work 0,5 h.</i>
Lesson beginning	<i>Assess the awareness of the group of learners (Spark DataFrame, Spark SQL) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define the Spark architecture for data processing.</i></li> <li>- <i>Ensure that participants are able to define the Spark main components.</i></li> <li>- <i>Ensure that participants understand the advantages of Sparks over other tools</i></li> </ul>
Whole group instructions	<i>Yes.</i>

<b>Evaluate understanding/assessment</b>	<ul style="list-style-type: none"> <li>- 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.</li> <li>- Individual task: Encourage learners to read the use cases and to comment on their findings.</li> <li>- Start a new topic in a forum with open questions like "what are main features of the Spark architecture?" or "what are the main components of Spark?".</li> <li>- Initiate a debate around topics like "What are the major challenges posed by the use of the Spark DataFrame".</li> </ul>
<b>Closing activities</b>	<i>Summarize the main key elements learned and provide common feedback based on learner inputs, focusing on the essentials of Spark for Big Data processing</i>
<b>Resources</b>	<i>Paper, pencil, board, personal computer for individual exercises</i>

## 9.6 Lesson plans of the Lesson 4.6. Cloud computing and machine learning With PySpark

This section reviews the target knowledge and skills for Lesson 4.6. "Cloud computing and machine learning With PySpark". Then, it gives the trainer's lesson plans.

### 8.6.1 Targeted Knowledge and Skills

Knowledge	Skills
<ul style="list-style-type: none"> <li>• Cloud Computing</li> <li>• Infrastructures as a Service (IAAS)</li> <li>• Platform as a Service (PAAS)</li> <li>• Software as a Service (SAAS)</li> <li>• Databricks</li> </ul>	<ul style="list-style-type: none"> <li>• Create a Cluster on Databricks</li> <li>• Use the fundamentals of Spark for ML</li> <li>• Perform regression, classification, and clustering with Spark</li> <li>• Use TensorFlow on a Spark driver node to fit a neural network on MNIST handwritten digit recognition data.</li> </ul>

### 8.6.2 Lesson plans for Lesson 4.6 Cloud computing and machine learning With PySpark

Item	Content
Setting	<i>Classroom or Online</i>
Duration:	<i>Online: 2 h</i> <i>Lecture: 1,5 h; practice/individual work 0,5 h.</i>

Lesson beginning	<i>Assess the awareness of the group of learners (Cloud computing, Databricks) using "Who knows about..." questions.</i>
Engage/motivation	<i>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.</i>
Main concepts or messages that need to be emphasized	<ul style="list-style-type: none"> <li>- <i>Ensure that participants are able to define Cloud computing and understand its scope.</i></li> <li>- <i>Ensure that participants are able to identify the fundamental areas of Cloud Computing (IAAS, PAAS, SAAS).</i></li> <li>- <i>Ensure that participants understand the key concepts such as scalability and elasticity.</i></li> </ul>
Whole group instructions	<i>Yes.</i>
Evaluate understanding/assessment	<ul style="list-style-type: none"> <li>- <i>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.</i></li> <li>- <i>Individual task: Encourage learners to read the use cases and to comment on their findings.</i></li> <li>- <i>Start a new topic in a forum with open questions like "Which platforms are used for large scale cloud computing? What are hybrid clouds?"</i></li> <li>- <i>Initiate a debate around topics like "What are the main advantages of cloud computing? What are some typical pipelines in cloud ML?"</i></li> </ul>
Closing activities	<i>Summarize the main key elements learned and provide common feedback based on learner inputs, focusing on the essentials of Cloud computing technology.</i>
Resources	<i>Paper, pencil, board, personal computer for individual exercises</i>

## References

[1] ARIS O1-T4: Definition of ARIS learning outcomes based on training needs analysis, ARIS Output type: Intellectual output, February 2020

[2] ARIS O2-T1: Definition of Learning Units, ARIS Output type: Intellectual output, April 2020

[3] EXELIA, ARIS: Identification of suitable platforms to host VOOC infrastructure and content, ARIS Output type: Intellectual output, October 2020

[4] The European e-Competence Framework (e-CF) - A common European framework for ICT Professionals in all industry sectors, <http://www.ecompetences.eu/>

[5] The European Qualifications Framework,  
[https://ec.europa.eu/ploteus/search/site?f%5B0%5D=im\\_field\\_entity\\_type%3A97](https://ec.europa.eu/ploteus/search/site?f%5B0%5D=im_field_entity_type%3A97)  
and <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-qualifications-framework-eqf>

## **ANNEX I – ARIS VOOC Administration Guide**

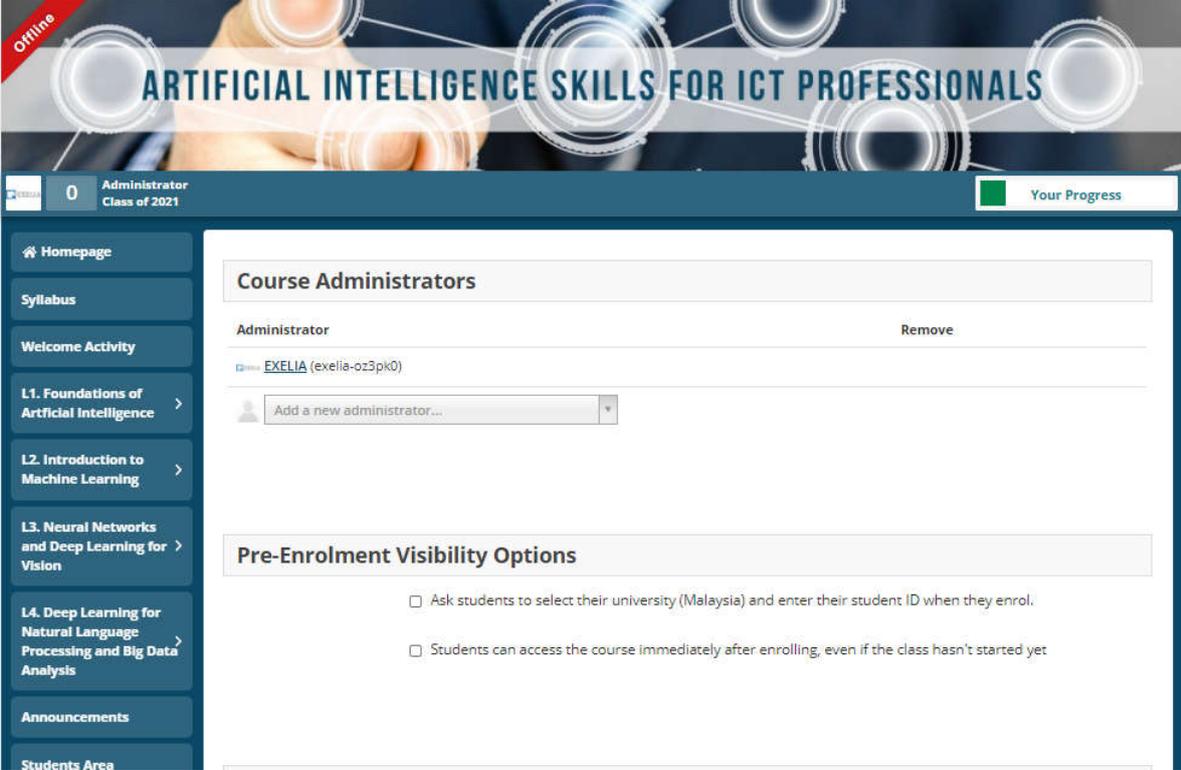
This annex provides some administrative HOW-TOs which are useful for course administrators.

### **I.1 How to modify the ARIS 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 “ARIS” 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 account in the platform.

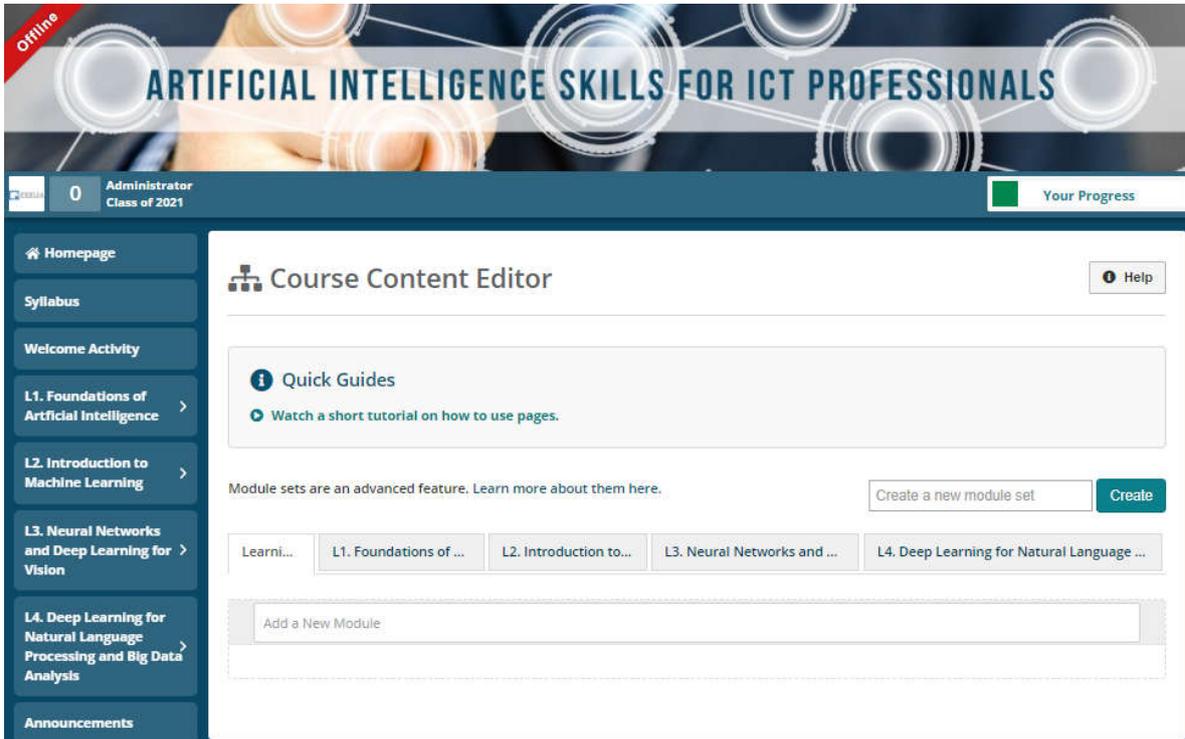


## I.2 How to add, move and delete learning units

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 ARIS 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.

- 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.



- 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).
- 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.

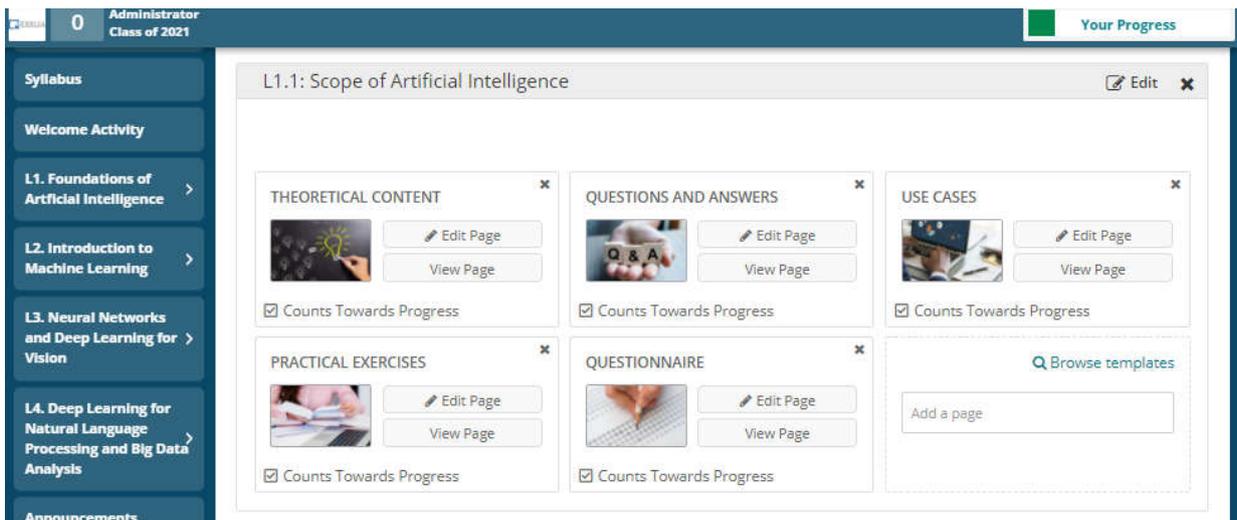
### I.3 How to add content and resources to module sections (pages)

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, infographic, text, embedded articles and audio files. Follow the steps below to add content to module sections (pages).

### **How to add new content in the ARIS 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 ARIS 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.

☰ DRAG WIDGET ↔ 🗑

📺 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

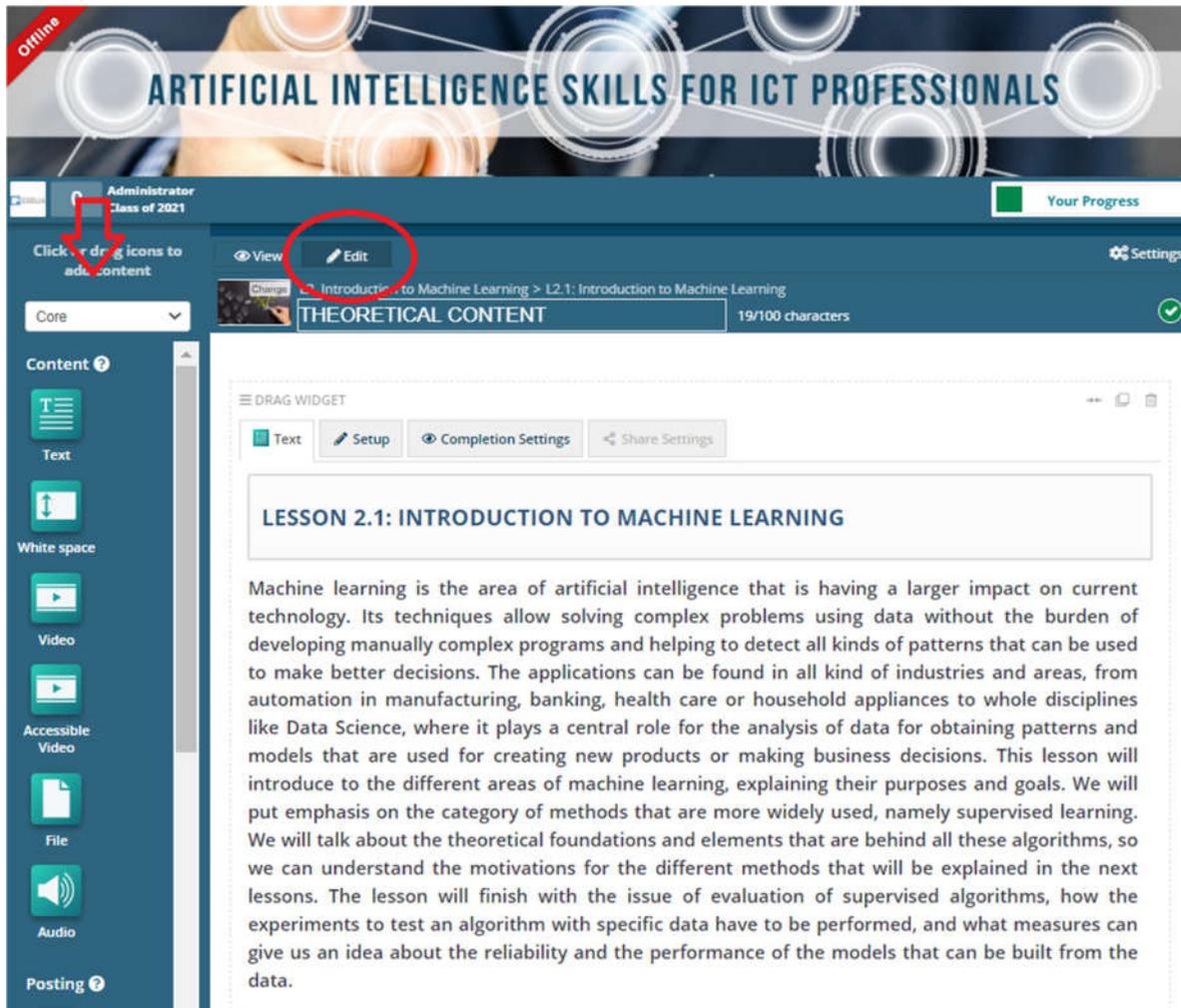
**Video URL (supports YouTube and Vimeo)**

https://www.youtube.com/watch?v=r4485hczmSI

⊕ Add fallback video URL

Play automatically
 **Custom Thumbnail (optional):**

Loop playback



The screenshot shows a course page with a header banner for 'ARTIFICIAL INTELLIGENCE SKILLS FOR ICT PROFESSIONALS'. Below the banner, there is a navigation bar with 'Administrator Class of 2021' and 'Your Progress'. A red arrow points to a 'Click or drag icons to add content' area. A red circle highlights the 'Edit' button in the top right of the content area. The main content area displays 'THEORETICAL CONTENT' with a character count of 19/100. A 'DRAG WIDGET' is embedded in the content, showing a 'Text' widget with the heading 'LESSON 2.1: INTRODUCTION TO MACHINE LEARNING' and a paragraph of text about machine learning.

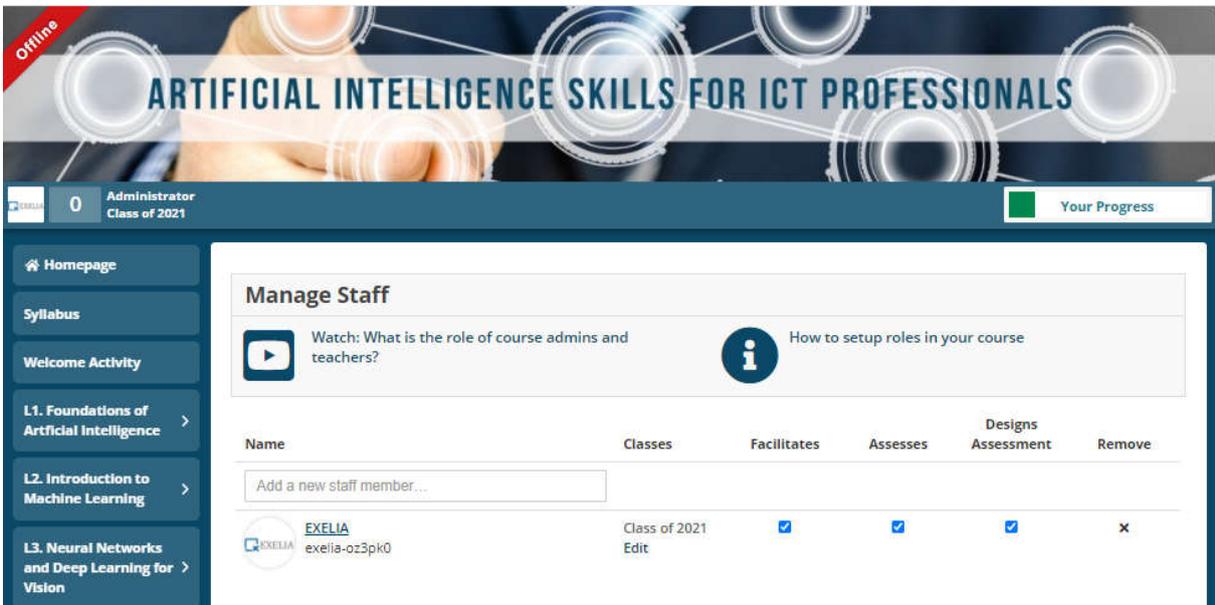
## I.4 How to add facilitators for the ARIS VOOC

Educators, wishing to use the ARIS 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 ARIS VOOC, need to have an educator subscription on OpenLearning.



The screenshot shows the 'Manage Staff' interface in an OpenLearning course. The course title is 'ARTIFICIAL INTELLIGENCE SKILLS FOR ICT PROFESSIONALS'. The user is logged in as 'Administrator' for the 'Class of 2021'. The interface includes a navigation menu on the left with options like 'Homepage', 'Syllabus', and 'Welcome Activity'. The main content area has a 'Manage Staff' section with a video player and an information icon. Below this is a table with columns for 'Name', 'Classes', 'Facilitates', 'Assesses', 'Designs Assessment', and 'Remove'. A search bar 'Add a new staff member...' is present above the table. One staff member is listed: EXELIA (exelia-oz3pk0) with checkboxes for 'Facilitates', 'Assesses', and 'Designs Assessment'.

Name	Classes	Facilitates	Assesses	Designs Assessment	Remove
EXELIA exelia-oz3pk0	Class of 2021 Edit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>