Machine Learning

1. **Course number and name:** 020MLRES4 Machine Learning

2. **Credits and contact hours:** 4 ECTS credits, 2x1:15 contact hours

3. **Name(s) of instructor(s) or course coordinator(s):** Youssef El Bakouny

4. **Instructional materials:** PowerPoint slides; Moodle Ressources; Assignments

   References:
   - Textbook: Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow, Third Edition. Aurélie Géron. O'Reilly, 2022.

5. **Specific course information**
   a. **Catalog description:**
   Machine learning (ML) is a subfield of Artificial intelligence. It is the science of making the machine learn by examples. The goal of ML is to make a computer that can learn from examples autonomously. The main research topics in ML include: Computer Vision (CV) and Natural Language Processing (NLP) and precision medicine for personalized treatments. The main goal of this course is to acquire a basic understanding of ML algorithms as well as hands-on ML engineering experience with regards to its application to realistic datasets through Python implementations that make use of state-of-the-art libraries such as Scikit-learn, Tensorflow and Keras.

   b. **Prerequisites:** None

   c. **Selected Elective** for CCE, EE and ME students

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
      - Understand supervised and unsupervised learning.
      - Understand classification, regression, clustering and dimensionality reduction.
      - Implement and evaluate traditional classification, regression, clustering and dimensionality reduction solutions.
      - Implement, analyze and evaluate deep neural network solutions to solve regression, classification and dimensionality reduction problems.
      - Understand and Implement Convolutional Neural Networks (CNN).
      - Understand and Implement Recurrent Neural Networks (RNN).
      - Understand Computer Vision (CV).
      - Understand Generative AI and Natural Language Processing (NLP).

b. PI addressed by the course:

PI	1.3	2.4	2.5	3.2	4.1	4.2	5.1	6.3	6.4	7.1
Covered	x	x	x		x	x		x	x	
Assessed	x	x	x	x			x	x	x	x

7. Brief list of topics to be covered
- Introduction: supervised vs unsupervised learning (2 lectures)
- Traditional Classification supervised learning solutions (2 lectures)
- Traditional Regression supervised learning solutions (2 lectures)
- Traditional Clustering unsupervised learning solutions (2 lectures)
- Traditional Dimensionality reduction unsupervised learning solutions (2 lectures)
- Introduction to Deep Learning (2 lectures)
- Regression and Classification using dense neural networks (2 lectures)
- Image Classification using CNN (2 lectures)
- Introduction to Computer Vision (2 lecture)
- Dimensionality reduction using autoencoders (2 lectures)
- RNN and Long-Short Term Memory (LSTM) networks (2 lectures)
- Introduction to Generative AI and Natural Language Processing (2 lectures)