Universidad Intercontinental de la Empresa

TEACHING GUIDE

1. BASIC INFORMATION

Subject	**Advanced Machine Learning**
Degrees	**Intelligent Systems Engineering (GISI)**
Faculties	**Faculty of Engineering and Business Technology**
ECTS	**6**
Character	**Mandatory**
Language	**English**
Mode	**In-person/Synchronous In-person**
Semester	**Fifth**
Subject Coordinator	**Alejandro Esteban Martínez**

2. PRESENTATION

The Subject Advanced Machine Learning will increase the student's knowledge of Machine Learning, studying the newest advancements in Deep Learning, Deep Reinforcement Learning, Heuristic Methods and Evolutionary algorithms. It will explore the current state of the art of each Unit and the different commercial applications available.
The student should be able to analize complex problems in structured and not structured data, design the best solution available and execute it in the Python programming Language.

3. COMPETENCIES AND LEARNING OUTCOMES

Competencies	Code	Description
Basic Competencies	**CB01**	That students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
	CB02	That students know how to apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the development and defense of arguments and problem solving within their area of study.
General Competencies	**CG02**	Effectively determine objectives, priorities, methods and controls to perform tasks by organizing activities with the deadlines and means available in the engineering field.
	CG03	Demonstrate the ability to analyze, synthesize and evaluate engineering data and information.
	CG04	Work in an international and intercultural context in the field of engineering.
	CG05	Utilize the potential of cutting-edge technologies to contribute to the improvement of the company's or organization's competitiveness in the field of engineering.
Transversal Competencies	**CT03**	Demonstrate oral and written communication skills in a foreign language.
	CT05	Solve problems and make decisions by applying knowledge, methods and tools in their academic and professional field.
	CT07	Demonstrate skills and attitudes for autonomous work and teamwork.

Competencies	Code	Description
	CT08	Use knowledge, skills, abilities and attitudes to communicate in digital environments.
Specific Competencies	**CE18**	The graduate will be able to use machine and deep learning techniques in engineering and business problems.

Code	Description
LO01	To know the theoretical foundations of deep learning.
LO02	Identify, analyze, formulate and solve problems using convolutional and recurrent neural networks.
LO03	Identify, analyze, formulate and solve problems using heuristic and metaheuristic methods.
LO04	Identify, analyze, formulate and solve problems using swarm intelligence and genetic algorithms.
LO05	Formulate and solve optimization and multiobjective optimization problems using genetic algorithms as a strategy.
LO06	Use software tools in the field of the subject.
LO07	Elaborate a final work of application of the contents.

4. CONTENT

Unit I Deep Learning

1.1. Fundamentals of Deep Learning

1.2. Deep Feed-Forward Networks

1.3. Convolution Neural Networks (CNN)

1.4. Recurrent Neural Networks (RNN)

1.5. Green, Explainable and Safe AI

Unit II Deep Reinforcement Learning

2.1 Fundamentals of Deep Reinforcement Learning

2.2 Deep Q-Networks (DQN)

Unit III Heuristic and Metaheuristic Methods

3.1. Heuristic Methods

3.2. Metaheuristic Methods

3.3. Genetic algorithms

Unit IV Evolutionary algorithms

4.1 Particle Swarm Optimization (PSO)

4.2 Ant Colony Optimization (ACO)

5. TEACHING AND LEARNING METHODOLOGIES

UIE develops an innovative academic model centered on the learner, combining different philosophical approaches to Teaching-Learning (T-L), a wide variety of learning activities—especially those in which students take an active role in knowledge construction—continuous guidance, and the intensive use of technology as a facilitating tool, creating a unique and innovative learning ecosystem.

The training is conducted in an in-person modality, including synchronous virtual learning, supported by a cutting-edge virtual campus that provides flexibility and personalization within a ubiquitous learning (U-Learning) model.

Additionally, in alignment with its founding and corporate principles of social responsibility, UIE not only encourages the participation of its entire university community in volunteer and social service activities but also incorporates the Service-Learning (ApS) approach as a formal component of its teaching-learning strategies.

Code	Activity	Type	Teaching Modalities	Mode
MD01	First Contact and Motivation	**I**	Introductory	PR
MD02	Presentation, Course Plan and Commitment	**I**		
MD03	Lecture	**T**	Expository and Participatory	PR
MD04	Guest Lectures by Experts	**T**		
MD05	UIE Methodology	**T/P**	Guided / Autonomous	PR / NP
MD06	Problem Solving and Exercises	**P**		
MD07	Activity in the Virtual Campus UIE	**T/P**		

I: Informative **T**: Theoretical **P**: Practical **C**: Complementary

PR: In-person **NP**: Non-in-person

I: Informative; **T**: Theoretical; **P**: Practical; **C**: Complementary; **PR**: In-Person; **NP**: Non-In-Person.

6. TRAINING ACTIVITIES

The following identifies the types of educational activities that will be carried out:

Code	Name	Modality	Type of activity
AF01	Introductory	IP	Motivational/Informative
AF02	Expository and Participatory	IP	Theoretical
AF03	Guided	IP	Theoretical / Practical
AF04	Personalized (Individual / Group)	IP	Theoretical / Practical
AF05	Autonomous	NP	Theoretical / Practical
AF06	Service-Learning	IP	Service-Learning
AF07	Continuous self-assessment	NP	Quality Assessment

IP: In-person NP: Non-in-person

7. EVALUATION

The model also includes the continuous assessment process as an essential part of verifying the competencies acquired. For UIE, and in line with the proposed improvement of the teaching-learning process for the European Higher Education Area (EHEA), the assessment system, called Learning Outcomes Review (LOR), is developed as a more humanized process, distancing itself from traditional systems where students risk their fate in exams (sessions), sometimes with high and decisive percentage weights, leading to stress, frustration, and occasionally, dropout.

The UIE LOR system is continuous, shared, and progressive, allowing for the monitoring of learning throughout the entire period, making it a natural process to which students turn without negative emotions and aware of the need to understand their own progress.

Code	Evaluation Activity	Weighting %	Type	Mode
AE01	Partial Tests	40	Discrete	W
AE03	Projects	20	Discrete	W/O
AE04	Presentation	9	Discrete	
AE05	Participation in the Virtual Campus	6	Discrete (Pass/ Fail)	
AE06	Participation, Daily Activities and Volunteering	5	Discrete (Pass/ Fail)	O
AE09	Digital Portfolio	20	Continuos	O/E
AE10	Retake Partials	-	Discrete	W/O
		100		

Mode: O: Oral W: Written O/E: Both

8. BIBLIOGRAPHY

- Aggarwal, C. C. (2018). *Neural Networks and Deep Learning*. Springer.Zhang, Z. (2017) *Environmental Data Analysis. Methods and Applications.* De Gruyter.
- Olsson, A. E. (2011). *Particle swarm optimization: Theory, techniques and applications*. Nova Science Publishers.
- Rabadi. (2016). Heuristics, Metaheuristics and Approximate Methods in Planning and Scheduling. Springer.

9. TUTORIALS

MD20 Tutorial (2%): Students must attend at least three personalized tutorials throughout the semester. This is an all-or-nothing activity ("Pass-Fail"), meaning that all three tutorials must be completed.

10. QUALITY SURVEYS

MD25 Quality Management (2%): Students must complete four forms throughout the semester related to UIE's quality management. This is an all-or-nothing activity ("Pass-Fail"), meaning that all four forms must be completed within the deadlines specified in the course activity plan. The activity aims to timely assess the development of the teaching-learning process and the transversal competence related to critical and self-critical thinking.