COURSE CONTENT

(1) GENERAL INFO

SCHOOL	ENGINEERING			
DEPARTMENT	BIOMEDICAL ENGINEERING			
MSc PROGRAM	BIOMEDICAL ENGINEERING AND TECHNOLOGY			
STUDY LEVEL	POSTGRADUATE, MSc			
COURSE CODE	**BMET208**	**SEMESTER**	**B**	
COURSE TITLE	**Machine Learning in Medicine and Biology**			
TEACHING			**HOURS**	**ECTS**
	LECTURES AND WORKSHOPS		26	5
COURSE TYPE	SPECIALIZATION			
COURSE REUIREMENTS:	-			
TEACHING AND EXAMINATION LANGUAGE:	ENGLISH			
IS THIS COURSE OFFER TO ERASMUS STUDENTS	YES (IN ENGLISH)			
COURSE WEBPAGE (URL)	https://eclass.uniwa.gr/courses/322/			

(2) LEARNING OUTCOMES

Learning outcomes

Course Objectives:
The purpose of this course is to study the methodologies used in the design of Machine Learning systems for applications in medicine and biology. The methods (a) for data acquisition and cleaning (usually files in csv, excel, json, xml, yaml formats), (b) for generating features from medical and/or biological images of patients, (c) for statistical analysis of data will be analyzed. Supervised Machine Learning methodologies will also be analyzed in the design of machine learning algorithms in programming language, and will be used for the design of Machine Learning systems in disease discrimination and also in disease assessment. Students will also be trained in the design of unsupervised learning and deep learning systems, in a programming language using real medical or biological data and using modern software libraries.

Learning Outcomes:
After the end of the course students:

1. Will know the theory and implementation technologies of methodologies related to the application of Machine Learning in Medicine and Biology,
2. Will understand the methods used in modern computing systems where Machine Learning is applied,
3. Will be able to distinguish and understand the processing and analysis methods required in the different cases of data cleaning and analysis as well as the selection of appropriate Machine Learning algorithms,
4. Be able to apply Machine Learning algorithms, in programming language code and using modern software technologies, to integrated engineering systems in medicine and biology.

Achievement of Course Objectives and Learning Outcomes:
To achieve the above objectives, a comprehensive introduction to programming will be provided for the acquisition, cleaning and transformation of medical data prior to its use in Machine Learning algorithms. Subsequently, Machine Learning methods will be analyzed with their modern programming language implementation, making use of functions from relevant open-source software libraries. More in-depth evaluation of the functionality and suitability in medical applications will be achieved by designing and implementing systems, in the form of group projects, to solve specific issues related to medical or biological data.

General abilities

- Search, analysis and synthesis of data and information, using the necessary technologies
- Adaptation to new situations
- Decision-making
- Autonomous work
- Teamwork
- Working in an international environment
- Working in an interdisciplinary environment

(3) COURSE CONTENT

"Introduction to Machine Learning"
Definitions, basic concepts, methodologies used, data used in medicine and biology.

"Cleaning and analysis of medical and biological data"
Definitions, basic concepts, existing databases with data, cleaning data from gaps, incorrect record formats, statistical analysis of data, converting data into a format suitable for use by Machine Learning algorithms.

"Machine Learning Methods"
Definitions, basic concepts of methodologies for the design of Machine Learning algorithms and methods for the design and evaluation of integrated Machine Learning systems in a programming language.

"Unsupervised and Deep Learning Methods"
Definitions, basic concepts, implementation of algorithms for solving problems related to (a)finding categories within data (unsupervised Machine Learning) and (b)designing neural networks for Deep Machine Learning and using with appropriate adaptation ready-made Deep Learning networks.

(4) TEACHING AND LEARNING METHODS - EXAMINATIONS

COURSE DELIVERY	Physical presence, face to face at the auditorium
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	The theoretical part of the course is conducted with a projector (for the presentation of basic theory) and on the blackboard. The laboratory part of the course is carried out in the laboratory and includes the implementation of algorithms in Machine Learning in a programming language.
TEACHING ORGANIZATION	

Activity	***Semester workload***
Teaching / lectures	26
Lecture material study	30
Unsupervised literature review and preparation of the final project	69
Total	***125***

STUNDET EVALUATION	60% final examination with problem-solving questions 20% by individual written work with code 20% by group work written in code

(5) SUGGESTED LITERATURE

Books, scientific articles and related scientific resources:

[1] Brownlee J. “Deep Learning with Python. Develop Deep Learning Models On Theano And TensorFlow Using Keras (2016).
[2] François Chollet - Deep Learning with Python-Manning (2018), Manning Publications Co.
[3] Grus J. “Data Science from Scratch”, O’REILLY (2019).
[4] Raschka S and Mirjalili V. ‘Pyhthon Machine Learning’, Packt (2019).
[5] Siggh P and Manure A. ‘Learn Tesnor Flow: Implement Machine Learning and Deep Learning Models with Python’, Apress (2020).
[6] Singh H. ‘Practical Machine Learning and Image Processing’, Apress (2019).
[7] Swamynathan M., ‘Mastering Machine Learning with python in six steps’, Apress (2019).

Scientific journals:

[1] Machine learning, https://link.springer.com/journal/10994.
[2] Journal of Machine Learning Research, https://www.jmlr.org/.
[3] Machine Learning with Applications, https://www.sciencedirect.com/journal/machine-learning-with-applications.
[4] Nature Machine Intelligence, https://www.nature.com/natmachintell/.
[5] Machine learning in healthcare, https://www.nature.com/collections/zbkpvddmhm.