]MODULE OUTLINE

1. GENERAL INFORMATION

SCHOOL	SCHOOL OF SCIENCE AND TECHNOLOGY		
PROGRAM COURSE	DATA SCIENCE AND MACHINE LEARNING		
LEVEL OF STUDY	POSTGRADUATE		
MODULE CODE	DAMA-61	**YEAR OF STUDY**	2nd
MODULE TITLE	Numerical and Computational Techniques for Data Science and Machine Learning		

INDEPENDENT TEACHING ACTIVITIES *in case credits are awarded for separate components/parts of the course, e.g. in lectures, laboratory exercises, etc. If credits are awarded for the entire course, give the weekly teaching hours and the total credits*	**HOURS**	**CREDIS**
Weekly teaching hours: 21-25 x 32 weeks	840	30 ECTS

COURSE TYPE Compulsory, Optional, Optional mandatory	Compulsory
PREREQUISITE MODULES:	The selection of DAMA61 does not require the simultaneous selection or completion of any other DAMA module.
LANGUAGE OF INSTRUCTION AND EXAMS	ENGLISH
THE MODULE IS OFFERED TO ERASMUS STUDENTS	No (due to the annual duration of the module)
MODULE WEBSITE (URL)	https://www.eap.gr/education/postgraduate/annual/data-science-and-machine-learning/topics/#dama61 Each module has its own space in the Learning Management System of EAP (http://study.eap.gr), with controlled access (use of code) for students and teaching staff.

2. LEARNING OUTCOMES

Learning Outcomes
● *The course learning outcomes, specific knowledge, skills and competences of an appropriate (certain) level, which students will acquire upon successful completion of the course, are described in detail. It is necessary to consult:*
• Recognize and execute Jupyter notebooks with machine learning procedures • Implement TensorFlow and Keras • Define Linear and/or nonlinear regression variables in supervised learning mode • Implement support vector machines for data classification • Identify decision boundaries • Create decision trees and implement random forests • Execute Lasso and alternative regularizations

- Perform dimensionality as well as principal component analysis
- Use TensorFlow/Keras to introduce fully connected neural networks
- Perform Deep Learning training and hyperparameter testing
- Execute code for recurrent neural networks
- Apply convolutional neural networks to specific data sets
- Perform unsupervised learning by implementing autoencoders
- Apply reinforcement learning and physics informed machine learning
- Describe restricted Boltzmann machines

General Competences

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aim?

Search for, analysis and synthesis of data and information by the use of appropriate technologies,
Adapting to new situations
Decision-making
Individual/Independent work
Group/Team work
Working in an international environment
Working in an interdisciplinary environment
Introduction of innovative research
Project planning and management
Respect for diversity and multiculturalism
Environmental awareness
Social, professional and ethical responsibility and sensitivity to gender issues
Critical thinking
Development of free, creative and inductive thinking
……
(Other…….citizenship, spiritual freedom, social awareness, altruism etc.) …….

Search for, analysis and synthesis of data and information by the use of appropriate technologies,
Adapting to new situations
Decision-making
Individual/Independent work
Project planning and management
Critical thinking
Development of free, creative and inductive thinking

3. MODULE CONTENT

The students will be able to implement basic machine learning methods in Jupyter notebooks, use TensorFlow and Keras, write and execute python code, utilize linear and nonlinear regression, support vector machines, perform model regularization, implement decision trees and ensemble learning in the form of random forests. The students are expected to know how to perform dimensionality reduction and use principal component analysis. The module will also focus on neural network methods and deep learning including fully connected deep networks, convolutional neural networks and autoencoders. Use of recurrent neural networks, physics informed neural networks and restricted Boltzmann machines completes the material of the module. DAMA-61 builds heavily on DAMA-50 and after its completion the students will be able to use the mathematical tools acquired in the latter in real world data problems.

The key subjects of the module are:

A. “Supervised/Unsupervised Learning”
B. “Neural Networks and Deep Learning”
C. ”Optimization”

4. TEACHING METHODS--ASSESSMENT

<table>
<tr><td>MODES OF DELIVERY
Face-to-face, in-class lecturing, distance teaching and distance learning etc.</td><td>Distance education with five Group Counseling Meetings (OSS) during the academic year on weekends.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY
Use of ICT in teaching, Laboratory Education, Communication with students</td><td>We use :
Remote meetings tools (cisco webex),
Presentation software (e.g. power point),
Specialized software in the subjects under study (Python, etc.).

Additionally, the students use office automation tools, web browsers and e-reader for digital books.</td></tr>
<tr><td>MODULE DESIGN
Description of teaching techniques, practices and methods: Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, Internship, Art Workshop, Interactive teaching, Educational visits, projects, Essay writing, Artistic creativity, etc

The study hours for each learning activity as well as the hours of selfdirected study are given following the principles of the ECTS.</td><td><table>
<tr><th>Activity</th><th>Annual Workload</th></tr>
<tr><td>5 Tutorial Meetings (x 4 hours)</td><td>20</td></tr>
<tr><td>Preparation of Assignments (6 assignments x 10 hours)</td><td>60</td></tr>
<tr><td>Examination</td><td>3</td></tr>
<tr><td>Individual study</td><td>672-800</td></tr>
<tr><td>Total module workload (hours)</td><td>755-883</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION/ASSESSMENT METHODS
Detailed description of the evaluation procedures.

Language of evaluation, assessment methods, formative or summative (conclusive), multiple choice tests, short- answer questions, open-ended questions, problem solving, written work, essay/report, oral exam, presentation, laboratory work, other……etc.</td><td>Elaboration of written assignments during the academic year, the average of the grades of which participates in the formation of the final grade of module by 30%, if there is a passable in the final or repetitive examinations. In the final written exams the grade of the written assignments participates in the formation of the final grade of module by 70%.

All the criteria are posted, both in each written assignment (in the LMS study.eap.gr), as well as in the general regulation of HOU at:
https://www.eap.gr/education/study-regulations/</td></tr>
</table>

Specifically defined evaluation criteria are stated, as well as if and where they are accessible by the students	

(5) SUGGESTED BIBLIOGRAPHY

- *Suggested bibliography:*

- A. Geron (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* (2nd edition). O' Reilly Media.
    - https://github.com/ageron/handson-ml2
- I. Goodfellow and Y. Bengio and A. Courville (2016). *Deep Learning*. MIT Press.
    - https://www.deeplearningbook.org

- *Related scientific Journals:* *Neural Computing and Applications, Springer*