

# INTELLIGENT MODELLING – HYBRID SOFT COMPUTING INFORMATION SYSTEMS

## 1. GENERAL

<b>SCHOOL</b>	OF ENGINEERING		
<b>DEPARTMENT</b>	CIVIL ENGINEERING/ MSc APPLIED MATHEMATICS		
<b>LEVEL OF STUDIES</b>	MSc - LEVEL 7		
<b>COURSE CODE</b>		<b>SEMESTER</b>	2 <sup>nd</sup> Semester
<b>COURSE TITLE</b>	INTELLIGENT MODELLING – HYBRID SOFT COMPUTING INFORMATION SYSTEMS		
<b>TEACHING ACTIVITIES</b> <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		<b>TEACHING HOURS PER WEEK</b>	<b>ECTS CREDITS</b>
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
<b>COURSE TYPE</b> <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific area		
<b>PREREQUISITES:</b>	NO		
<b>TEACHING &amp; EXAMINATION LANGUAGE:</b>	Greek		
<b>COURSE OFFERED TO ERASMUS STUDENTS:</b>	NO		
<b>COURSE URL:</b>	<a href="https://eclass.duth.gr/courses/TMB360/">https://eclass.duth.gr/courses/TMB360/</a>		

## 2. LEARNING OUTCOMES

<b>Learning Outcomes</b> <i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
<p>After completing the course, the participants will be able to:</p> <p>The purpose of the course is to introduce and deepen the graduate students in the following Areas of Machine Learning and Computational Intelligence:</p> <ul style="list-style-type: none"> <li>- Data Science (Data Preprocessing)</li> <li>- Knowledge Mining</li> <li>- Supervised Machine Learning</li> <li>- Unsupervised Machine Learning (FCMC Fuzzy c-means Clustering – SOM Self Organizing Maps)</li> <li>- Machine Learning Algorithms (Description and Analysis)</li> <li>- Soft Computing Modeling Applications (Fuzzy Logic modeling -Artificial Neural Networks – Support Vector Machines)</li> <li>- Deep Learning (Convolutional Neural Networks – Recurrent NN)</li> </ul>

- Case studies: Models' Development using real (raw) data

### General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,

Project design and management

ICT Use

Equity and Inclusion

Adaptation to new situations

Respect for the natural environment

Decision making

Sustainability

Autonomous work

Demonstration of social, professional and moral responsibility and sensitivity to gender issues

Teamwork

Critical thinking

Working in an international environment

Promoting free, creative and inductive reasoning

Working in an interdisciplinary environment

Production of new research ideas

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adaptation in new cases
- Decision Making
- Autonomous work.
- Interdisciplinary work
- Production of free, creative and inductive thinking.

### 3. COURSE CONTENT

Data Science

Data preprocessing

Parameter correlation analysis

Detection – Removal of outliers

Identifying and solving the problem of Minority classes

Data Transformation

Production of classes

Machine Learning

Presentation of the Mathematical Model of Artificial Neural Networks. THE

Back Propagation algorithm Examples - case studies – problems solving

The Gradient Descent optimization algorithm

Learning

Avoiding Memorization – Overtraining

Developing Regression Patterns Using Machine Learning

Classification and Use of Machine Learning algorithms

Feed Forward Multilayer Artificial Neural Networks

K-nearest neighbors

Recurrent Neural Networks

Fuzzy c-means clustering

Deep Learning – Convolutional Neural Networks

Examples of Machine Vision programs

MNIST and Deep Learning Standards

### 4. LEARNING & TEACHING METHODS - EVALUATION

#### TEACHING METHOD

Face to face, Distance learning, etc.

Distance learning

<p align="center"><b>USE OF INFORMATION &amp; COMMUNICATIONS TECHNOLOGY (ICT)</b></p> <p align="center"><i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	<p>Use of ICT technologies in Teaching and Communication with students</p>													
<p align="center"><b>TEACHING ORGANIZATION</b></p> <p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research &amp; analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	<table border="1"> <thead> <tr> <th align="center"><i>Activity</i></th> <th align="center"><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td>Lectures (Theory)</td> <td align="center">39</td> </tr> <tr> <td>Research &amp; Analysis</td> <td align="center">0</td> </tr> <tr> <td>Review studies</td> <td align="center">108</td> </tr> <tr> <td>Examinations</td> <td align="center">3</td> </tr> <tr> <td><b>Total</b></td> <td align="center"><b>150</b></td> </tr> </tbody> </table>		<i>Activity</i>	<i>Workload/semester</i>	Lectures (Theory)	39	Research & Analysis	0	Review studies	108	Examinations	3	<b>Total</b>	<b>150</b>
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<p align="center"><b>STUDENT EVALUATION</b></p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Examinations</p> <p>Assignments on Machine Learning modeling using real data or Written examination</p>													

## 5. SUGGESTED BIBLIOGRAPHY

A. Lazaros Iliadis, Antonis Papaleonidas, Computational Intelligence and Intelligent Agents 2016 Tziolas Publishing

B. Neural Networks and Learning Machines Simon Haykin, 3rd Edition, 2009, Prentice Hall

## ANNEX OF THE COURSE OUTLINE

### Alternative ways of examining a course in emergency situations

<b>Teacher (full name):</b>	Lazaros Iliadis
<b>Contact details:</b>	liliadis@civil.duth.gr
<b>Supervisors: (1)</b>	NO
<b>Evaluation methods: (2)</b>	I. Assignment of Machine Learning Modeling development on Real-Life Cases (datasets) /Or II. Written examination by distance learning methods
<b>Implementation Instructions: (3)</b>	• The students can chose either of the two above options. In the 1 <sup>st</sup> case they are assigned a Machine Learning Project based on Real-Life datasets. After developing the models the students have to submit their work /assignment and they have to defend to Prof Iliadis via Webex or Teachers.

(31) Please write YES or NO

(32) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(33) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.