

## COURSE OUTLINE

### (1) GENERAL

SCHOOL			
ACADEMIC UNIT	Interdisciplinary Graduate Programme in the BRAIN and MIND sciences		
LEVEL OF STUDIES	7		
COURSE CODE	B&M-R-119	SEMESTER	depending on availability
COURSE TITLE	Machine Learning and Statistical Analysis of Biomedical Data		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
laboratory exercises		6	9-27
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	Special background, skills development		
PREREQUISITE COURSES:	CS-577 Machine Learning or equivalent		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	<a href="https://elearn.uoc.gr/course/view.php?id=4457">https://elearn.uoc.gr/course/view.php?id=4457</a>		

### (2) LEARNING OUTCOMES

<p><b>Learning outcomes</b></p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i></li> <li>• <i>Guidelines for writing Learning Outcomes</i></li> </ul>
<p>As part of the laboratory internship, the student will work on a research topic jointly selected with the internship supervisor, according to the student's interests and abilities.</p> <p>The student will learn to:</p> <ul style="list-style-type: none"> <li>• Identify gaps in our knowledge in the field of bioinformatics</li> <li>• Conduct a thorough literature review on the research question</li> <li>• Develop new methodologies or optimally apply existing ones to biological data analysis problems</li> <li>• Interpret biological results and compare them with existing biological knowledge</li> <li>• Become familiar with the research process in molecular biology using machine learning and data analysis methods</li> </ul>

Upon completion of the laboratory internship, the student will be able to:

- Reproduce, analyze, integrate, and apply the knowledge acquired from compulsory and elective courses of the program in the research context of their internship topic
- Use this knowledge as the basis for original ideas and research
- Apply acquired knowledge at a high level of abstraction
- Think conceptually, develop, and elaborate arguments
- Analyze and carry out complex scientific work
- Collaborate effectively with colleagues and supervisors
- Take responsibility for the outcomes of their work
- Communicate conclusions and knowledge—arising from original research, self-study, or experience—clearly and accurately to both specialist and non-specialist audiences

If the laboratory internship develops into a Master's thesis, the student's further engagement with the research topic will enable them to:

- Independently complete fundamental research based on methodological knowledge
- Contribute originally to the development and application of ideas in the research field
- Recognize the limitations of existing knowledge in their scientific domain and at the interface between neighboring scientific fields, adapting their actions accordingly
- Identify and analyze complex problems and solve them with strategy and creativity
- Take responsibility for managing complex processes
- Communicate in a targeted manner with colleagues, both specialists and non-specialists, as well as supervisors, depending on the context, using conventions relevant to the field of knowledge.

#### General Competences

*Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>
<i>Decision-making</i>	<i>Respect for the natural environment</i>
<i>Working independently</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an interdisciplinary environment</i>	<i>.....</i>
<i>Production of new research ideas</i>	<i>Others...</i>
	<i>.....</i>

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Project planning and management
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking

The student, in collaboration with the project supervisor, will select a research topic on the analysis of biological data using machine learning methods. If the chosen topic is broader in scope and ambition than what can be carried out within the framework of an internship, the student will be supported by other student researchers in the group.

Research topics currently pursued by the laboratory and representing potential internship activities include:

- The design, implementation, and comparison of new algorithms or new variants of algorithms for the analysis of biological data
- The optimal application of existing machine learning methods to specific datasets in order to extract new biological knowledge

#### (4) TEACHING and LEARNING METHODS - EVALUATION

<p style="text-align: center;"><b>DELIVERY</b></p> <p><i>Face-to-face, Distance learning, etc.</i></p>	Face-to-face	
<p style="text-align: center;"><b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b></p> <p><i>Use of ICT in teaching, laboratory education, communication with students</i></p>	Use of shared analysis codes. Use of publisher databases/electronic repositories of scientific articles	
<p style="text-align: center;"><b>TEACHING METHODS</b></p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<b>Activity</b>	<b>Semester workload</b>
	Study and analysis of bibliography	50-150
	project	100-300
	essay writing	25-75
	non-directed study	50-150
	<b>225-675</b>	
<p style="text-align: center;"><b>STUDENT PERFORMANCE EVALUATION</b></p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Evaluation Language: English</p> <p>Evaluation Criteria: The student's dedication to conducting the study, autonomy and independence, critical review and analysis of the literature, progress over time, and the quality of the report are evaluated.</p> <p>Evaluation criteria are outlined in the study guide and communicated to students at the beginning of the course.</p>	

#### (5) ATTACHED BIBLIOGRAPHY

**- Suggested bibliography:**  
 Scientific articles published in reputable scientific journals in the field of the research interests of the Computer Science Laboratory at the Institute of Computational Mathematics of FORTH and the Department of Computer Science of the University of Crete.