Course guides
270727 - MBM - Minds, Brains and Machines

Unit in charge: Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science.
              1004 - UB - (ENG)Universitat de Barcelona.
Degree: MASTER'S DEGREE IN ARTIFICIAL INTELLIGENCE (Syllabus 2017). (Optional subject).
Academic year: 2021  ECTS Credits: 4.0  Languages: English

LECTURER
Coordinating lecturer: ALFREDO VELLIDO ALCACENA
Others: Segon quadrimestre:
       ALFREDO VELLIDO ALCACENA - 10

PRIOR SKILLS
Students are expected to have at least some basic background in the area of artificial intelligence and, more specifically, with the
areas of Machine Learning and Computational Intelligence.
Some basic knowledge of probability theory and statistics, as well as neuroscience would be beneficial, but not essential.
Other than this, the course is open to students and researchers of all types of background

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEA11. Capability to understand the advanced techniques of Computational Intelligence, and to know how to design, implement and
apply these techniques in the development of intelligent applications, services or systems.
CEA3. Capability to understand the basic operation principles of Machine Learning main techniques, and to know how to use on the
environment of an intelligent system or service.
CEA4. Capability to understand the basic operation principles of Computational Intelligence main techniques, and to know how to use
in the environment of an intelligent system or service.
CEA8. Capability to research in new techniques, methodologies, architectures, services or systems in the area of ??Artificial
Intelligence.
CEP5. Capability to design new tools and new techniques of Artificial Intelligence in professional practice.

Generical:
CG1. Capability to plan, design and implement products, processes, services and facilities in all areas of Artificial Intelligence.

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to
projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and
information in the chosen area of specialisation and critically assessing the results obtained.

CT5. APPROPRIATE ATTITUDE TOWARDS WORK: Capability to be motivated for professional development, to meet new challenges and
for continuous improvement. Capability to work in situations with lack of information.
CT6. REASONING: Capability to evaluate and analyze on a reasoned and critical way about situations, projects, proposals, reports and
scientific-technical surveys. Capability to argue the reasons that explain or justify such situations, proposals, etc..
CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.
Basic:
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

TEACHING METHODOLOGY
This course will build on different teaching methodology (TM) aspects, including:
TM1: Expositive seminars
TM2: Expositive-participative seminars
TM3: Orientation for individual assignments (essays)
TM4: Individual tutorization

LEARNING OBJECTIVES OF THE SUBJECT
1. Understanding some Neuroscience basics
2. Understanding some Neuroimaging basics as a basis for Neuroscience
3. Understanding some basics of Computational Neuroscience
4. Application of Machine Learning and Computational Intelligence to Computational Neuroscience
5. Reward processing as a Computational Neuroscience problem
6. Computational Neuroscience of vision

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes</td>
<td>36,0</td>
<td>36.00</td>
</tr>
<tr>
<td>Self study</td>
<td>64,0</td>
<td>64.00</td>
</tr>
</tbody>
</table>

Total learning time: 100 h

CONTENTS

Basic concepts of brain function
Description:
Basic concepts of brain function

Introduction to Neuroimage Techniques in Neuroscience
Description:
Introduction to Neuroimage Techniques in Neuroscience

Brain functions in brain networks and their connectivity
Description:
Brain functions in brain networks and their connectivity
<table>
<thead>
<tr>
<th>Basics of Computational Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> Basics of Computational Intelligence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decoding neurocognitive states with neural networks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> Decoding neurocognitive states with neural networks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reward processing and reinforcement learning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> Reward processing and reinforcement learning</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Computational Intelligence of Vision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> Computational Intelligence of Vision</td>
</tr>
</tbody>
</table>

### ACTIVITIES

**essay on a topic of Computational Neuroscience**

**Description:** essay on a topic of Computational Neuroscience

**Specific objectives:**
1, 2, 3, 4, 5, 6

**Full-or-part-time:** 3h
Guided activities: 3h

**Basic concepts of brain function**

**Description:** Basic concepts of brain function

**Specific objectives:**
1

**Full-or-part-time:** 18h
Theory classes: 4h
Practical classes: 2h
Self study: 12h
<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Specific objectives</th>
<th>Full-or-part-time: 9h</th>
<th>Theory classes: 2h</th>
<th>Practical classes: 1h</th>
<th>Self study: 6h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Neuroimage Techniques in Neuroscience</td>
<td>Introduction to Neuroimage Techniques in Neuroscience</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brain functions in brain networks and their connectivity</td>
<td>Brain functions in brain networks and their connectivity</td>
<td>1, 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basics of Computational Intelligence</td>
<td>Basics of Computational Intelligence</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decoding neurocognitive states with neural networks</td>
<td>Decoding neurocognitive states with neural networks</td>
<td>3, 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Reward processing and reinforcement learning**

**Description:**
Reward processing and reinforcement learning

**Specific objectives:**
5

**Full-or-part-time:** 8h  
Theory classes: 2h 
Self study: 6h

---

**Computational Intelligence of Vision**

**Description:**
Computational Intelligence of Vision

**Specific objectives:**
6

**Full-or-part-time:** 21h  
Theory classes: 6h 
Practical classes: 1h 
Guided activities: 3h 
Self study: 11h

---

**GRADING SYSTEM**

The course will be evaluated through a final essay that will take one of these three modalities:
1. State of the art on an specific IDA-DM topic
2. Evaluation of an IDA-DM software tool with original experiments
3. Pure research essay, with original experimental content

**BIBLIOGRAPHY**

**Basic:**