270023 - IA - Artificial Intelligence

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science

Academic year: 2019
Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Optional)

ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: - Javier Vazquez Salceda (jvazquez@cs.upc.edu)
Others: - Javier Bejar Alonso (bejar@cs.upc.edu)
- Maria Teresa Abad Soriano (mabad@cs.upc.edu)
- Sergio Alvarez Napagao (salvarez@cs.upc.edu)

Prior skills

Prior skills on Logics acquired in the course Mathematica Foundations (FM):
- Knowledge of the basic concepts: logical propositions and predicates
- Ability to formulate a problem in logical terms.
- Knowledge of logical inference and decision. Understanding resolution strategies.

Prior skills on Algorithmics acquired in the course on Data Structures and Algorithmics (EDA):
- Knowledge on tree and graph structures.
- Knowledge on tree and graph search algorithms.
- Basic notions in algorithmic complexity.

Requirements

- Prerequisite EDA
- Corequisite PROP

Degree competences to which the subject contributes

Specific:
- CCO2.1. To demonstrate knowledge about the fundamentals, paradigms and the own techniques of intelligent systems, and analyse, design and build computer systems, services and applications which use these techniques in any applicable field.
- CCO2.2. Capacity to acquire, obtain, formalize and represent human knowledge in a computable way to solve problems through a computer system in any applicable field, in particular in the fields related to computation, perception and operation in intelligent environments.
- CCO2.4. To demonstrate knowledge and develop techniques about computational learning; to design and implement applications and system that use them, including these ones dedicated to the automatic extraction of information and knowledge from large data volumes.

Generical:
- G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.
- G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume
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Teaching methodology

The classroom sessions are divided into theory, problems and laboratory sessions.

Theory sessions introduce the knowledge of the course concepts, switching between the exhibition of new material with examples and discussion with students on concepts and examples.

Problem sessions deepen the knowledge on techniques and algorithms explained in the Theory sessions. They stimulate the participation of students to discuss possible alternatives.

Laboratory sessions develop small practical assignments by using AI tools and languages in order to practice and enhance the students' knowledge on concepts, techniques and algorithms.

Learning objectives of the subject

1. Know the origins and foundations of artificial intelligence.
2. Understand the basic concepts: artificial intelligence and rationality.
3. Learn different problem-solving techniques based on search.
4. Understanding knowledge representation concepts and techniques.
5. Analyze a problem and determine which problem-solving techniques are best suited.
6. Analyze the knowledge needed to solve a problem.
7. Extracting and representing the knowledge needed to build an application in the field of knowledge-based systems.
8. To analyze a problem and determine which representation and reasoning techniques are best suited.
9. Understand the basic planning concepts and techniques.
10. Extract and represent the actions needed to solve a problem by means of a planner.
11. Understand the machine learning concept and know some of its types.
12. Understanding the relationship between adaptation and learning.
14. Knowing some artificial intelligence application areas.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 84h</td>
<td>56.00%</td>
</tr>
</tbody>
</table>
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Content

Problem-Solving by means of Search

Degree competences to which the content contributes:
Description:
Introduction to automatic problem-solving methods: state space representation, informed and local search algorithms, genetic algorithms, games, and constraint satisfaction problems.

Knowledge representation and reasoning

Degree competences to which the content contributes:
Description:

Planning

Degree competences to which the content contributes:
Description:
Introduction to problem-solving through planning. Linear and hierarchical planning. Planning in deterministic and stochastic environments.

Machine Learning

Degree competences to which the content contributes:
Description:
Machine Learning and its role in systems which adapt to the user or the environment. Types of learning. Learning Decision Trees. Artificial Neural Networks.

Other Artificial Intelligence techniques, areas and applications

Degree competences to which the content contributes:
Description:
### Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Theory classes:</th>
<th>Practical classes:</th>
<th>Laboratory classes:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction to Artificial Intelligence</strong></td>
<td>4h</td>
<td>2h</td>
<td>0h</td>
<td>0h</td>
<td>0h</td>
<td>2h</td>
</tr>
<tr>
<td><strong>Problem-Solving through Search</strong></td>
<td>52h</td>
<td>10h</td>
<td>6h</td>
<td>5h</td>
<td>0h</td>
<td>31h</td>
</tr>
<tr>
<td><strong>Delivering the Search practical assignment.</strong></td>
<td>0h</td>
<td>Guided activities: 0h</td>
<td>Self study: 0h</td>
<td>Guided activities: 0h</td>
<td>Self study: 0h</td>
<td></td>
</tr>
<tr>
<td><strong>Partial AI exam</strong></td>
<td>1h</td>
<td>Guided activities: 1h</td>
<td>Self study: 0h</td>
<td>Guided activities: 1h</td>
<td>Self study: 0h</td>
<td></td>
</tr>
</tbody>
</table>

**Description:**

- Students will learn the origins and foundations of Artificial Intelligence and some of the application areas. To reinforce learning, the student must read chapter 1 of the book of Russell & Norvig, which is available online.
- Specific objectives:
  - 1, 2, 15

**Description:**

- Students not only should attend the teacher lectures, but also do exercises on the use of search algorithms, and participate in discussions with the teacher and other students on when is best to use each of the algorithms. In the laboratory students will apply what they learned in a moderate problem.
- Specific objectives:
  - 3, 5, 6

**Description:**

- Delivery of the report on the search algorithms practical assignment that students have done in the lab sessions.
- Specific objectives:
  - 3, 5

**Description:**

- Partial exam on problem solving
- Specific objectives:
  - 3, 5, 6
### Knowledge Representation and Reasoning

**Hours:** 45h 30m  
- Theory classes: 8h  
- Practical classes: 5h  
- Laboratory classes: 7h  
- Guided activities: 0h  
- Self study: 25h 30m

**Description:**  
Students not only should attend the teacher lectures, but also do exercises on the use of Knowledge Representation techniques and discuss with the teacher and other students on when is best to use each technique. In the laboratory students will apply what they learned in a moderate problem.

**Specific objectives:**  
4, 6, 7

### Problem-solving through Planning

**Hours:** 18h  
- Theory classes: 4h  
- Practical classes: 2h  
- Laboratory classes: 3h  
- Guided activities: 0h  
- Self study: 9h

**Description:**  
Students not only need to attend the presentations the teacher, but also do exercises on the use of planning algorithms, and participate in discussions with the teacher and other students on when is best to use each of the algorithms. In the laboratory students will apply what they learned in an easy problem.

**Specific objectives:**  
6, 9, 10

### Delivering the Knowledge Representation practical assignment.

**Hours:** 0h  
- Guided activities: 0h  
- Self study: 0h

**Description:**  
Delivery of the report of the practical assignment on knowledge representation that students have developed in the laboratory.

**Specific objectives:**  
4, 6, 7, 8
### Machine Learning

<table>
<thead>
<tr>
<th>Hours: 14h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 0h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 9h</td>
</tr>
</tbody>
</table>

**Description:**
Students not only should attend the teacher lectures, but also do exercises on the use of basic Machine Learning algorithms and participate in discussions with the teacher and other students on when is best to use these algorithms.

**Specific objectives:**
11, 12, 13

### Delivering the Innovation assignment.

<table>
<thead>
<tr>
<th>Hours: 0h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 0h</td>
</tr>
</tbody>
</table>

**Description:**
Delivery of the report on examples of business innovation related to the use of Artificial Intelligence techniques.

**Specific objectives:**
2, 15

### Other Artificial Intelligence techniques, areas and applications

<table>
<thead>
<tr>
<th>Hours: 13h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 0h</td>
</tr>
<tr>
<td>Guided activities: 4h</td>
</tr>
<tr>
<td>Self study: 7h 30m</td>
</tr>
</tbody>
</table>

**Description:**
Students not only should attend to the other student's presentations, but also participate in discussions with the professor and the other students on the potential impact Artificial Intelligence techniques have had on the companies analyzed in the Innovation assignment that students have made during the course.

**Specific objectives:**
15

### Final AI exam

<table>
<thead>
<tr>
<th>Hours: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td>Self study: 0h</td>
</tr>
</tbody>
</table>

**Description:**
Final exam for the course contents.
Specific objectives:
5, 6, 7, 8, 10, 13

Qualification system

The student assessment will consist of a partial exam mark, a final exam mark, a mark for the Innovation assignment and a laboratory mark.

The partial exam will be done during standard class hours. Passing the partial exam does not mean that those course contents won't appear again in the final exam. People who do not pass the partial will be evaluated their theoretical knowledge only on the final exam mark.

The mark of the Innovation assignment will come from a group work where examples on business innovation related to the use of Artificial Intelligence techniques should be found and analyzed. The work will be presented and discussed in the classroom.

The laboratory mark will come from the practical assignments' reports.

The calculation of the final mark will be as follows:
PM = partial exam mark
FM = final exam mark
LM = laboratory mark
IM = Innovation assignment mark

MARK = \max ((PM \times 0.2 + FM \times 0.4), FM \times 0.6) + LM \times 0.35 + IM \times 0.05

Competences' Assessment

The assessment of the competence on entrepreneurship and innovation is based on work done during the laboratory assignments and the Innovation assignment. The ABCD grade is calculated from a detailed rubric given to students at the beginning of the course.

The assessment of the competence on teamwork is also based on work done during the laboratory assignments and the Innovation assignment. The ABCD grade is calculated from a detailed rubric given to students at the beginning of the course.
Bibliography

Basic:

Complementary:

Others resources:
Hyperlink
http://www.cs.berkeley.edu/%7Erussell/aima1e/chapter01.pdf
http://en.wikipedia.org/wiki/Turing_test
http://plato.stanford.edu/entries/chinese-room/