270033 - SID - Distributed Intelligent Systems

Department: Distributed Intelligent Systems

Universitat Politècnica de Catalunya

Degree competences to which the subject contributes

1. To master the basic concept of Artificial Intelligence
2. To master the concept of intelligent agent and its role in the development of Multi Agent Systems
3. To Master the specific logics for Artificial Intelligence and Multiagent systems
4. To manage the basic of concepts of Ontologies and their application to real-world problems
5. To manage and apply development methodologies of Multiagent systems
6. To manage interaction protocols for agents' communication
7. Be able to analyze communication needs for a Multiagent system and be able to implement a pertinent communication protocol

Coordinator:
- Ulises Cortés García (ia@cs.upc.edu)

Teaching staff

Requirements

- Prerequisite IA

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.

General:
- 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 compromises taking into account the available resources.
- G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.
- G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Teaching methodology

The teaching methodology consists exposure theory classes in theory and application of concepts in classes and laboratory problems.

The examination will the same for all groups.

Learning objectives of the subject

1. To master the basic concept of Artificial Intelligence
2. To master the concept of intelligent agent and its role in the development of Multi Agent Systems
3. To Master the specific logics for Artificial Intelligence and Multiagent systems
4. To manage the basic of concepts of Ontologies and their application to real-world problems
5. To manage and apply development methodologies of Multiagent systems
6. To manage interaction protocols for agents' communication
7. Be able to analyze communication needs for a Multiagent system and be able to implement a pertinent communication protocol
8. To understand the foundations of game theory and decision theory and their relation with Multiagent systems
9. To understand negotiation mechanisms for Multiagent Systems
10. Be able to understand applications of MAS to robotics

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

## Artificial Intelligence perspectives

**Degree competences to which the content contributes:**

**Description:**
Introduction to those real fields in which AI is or can be successfully applied.

## An introduction to intelligent agents

**Degree competences to which the content contributes:**

**Description:**
- What is an agent?
- Agents as basic building blocks.
- Agent types.
- Agent-building architectures and methodologies.

## Ontologies

**Degree competences to which the content contributes:**

**Description:**
- What is an Ontology?
- Methods for constructing Ontologies.
- Description logics.
- Ontological languages.

## Logic systems for Artificial Intelligence

**Degree competences to which the content contributes:**

**Description:**
- Reasoning for AI applications.
- Modal logics.
- Temporal logics.
- Reasoning under uncertainty.

## Communication

**Degree competences to which the content contributes:**
Description:
The need for communication between agents.

Speech Act Theory.

Languages for establishing communication between agents.

Coordination

Degree competences to which the content contributes:

Description:
Need for co-ordination in multi-agent systems.
Cooperation
Negotiation between intelligent agents.

Introduction to Physical Agents

Degree competences to which the content contributes:

Description:
Agents for the real world: robotics, domotics, machine vision, control
## Planning of activities

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
<th>Description</th>
<th>Specific objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Artificial Intelligence Perspectives</strong></td>
<td>10h</td>
<td>The student will learn about the origins and foundations of Artificial Intelligence as well as some of the areas of application. To enhance student's learning he should read and understand the material assigned by the teacher.</td>
<td>1</td>
</tr>
<tr>
<td><strong>An introduction to intelligent agents</strong></td>
<td>22h</td>
<td>Students not only should attend the lectures, but also do exercises on the use of Ontologies 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.</td>
<td>2, 5</td>
</tr>
<tr>
<td><strong>Ontologies</strong></td>
<td>24h</td>
<td>Students not only should attend the lectures, but also do exercises on the use of Ontologies 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.</td>
<td>4</td>
</tr>
<tr>
<td><strong>Logic systems for Artificial Intelligence</strong></td>
<td>26h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<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>2h</td>
<td>1h</td>
<td>1h</td>
<td>0h</td>
<td>6h</td>
</tr>
<tr>
<td>4h</td>
<td>2h</td>
<td>2h</td>
<td>0h</td>
<td>14h</td>
</tr>
<tr>
<td>4h</td>
<td>2h</td>
<td>3h</td>
<td>0h</td>
<td>15h</td>
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<tr>
<td>5h</td>
<td>3h</td>
<td>3h</td>
<td>0h</td>
<td>15h</td>
</tr>
</tbody>
</table>
**Partial Exam**

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

**Description:**
The partial exam will be done during standard class hours. People who do not pass the partial will be evaluated again on the final exam.

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

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**Communication**

<table>
<thead>
<tr>
<th>Hours</th>
<th>20h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes</td>
<td>4h</td>
</tr>
<tr>
<td>Practical classes</td>
<td>2h</td>
</tr>
<tr>
<td>Laboratory classes</td>
<td>2h</td>
</tr>
<tr>
<td>Guided activities</td>
<td>0h</td>
</tr>
<tr>
<td>Self study</td>
<td>12h</td>
</tr>
</tbody>
</table>

**Description:**
Students not only attend lectures, but also do exercises on the use of mechanisms for communication between autonomous agents and discuss with the teacher and other students when it is best to use each technique. In the laboratory the students apply what they learned in a problem.

**Specific objectives:**
6, 7

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**Coordination**

<table>
<thead>
<tr>
<th>Hours</th>
<th>26h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes</td>
<td>5h</td>
</tr>
<tr>
<td>Practical classes</td>
<td>3h</td>
</tr>
<tr>
<td>Laboratory classes</td>
<td>3h</td>
</tr>
<tr>
<td>Guided activities</td>
<td>0h</td>
</tr>
<tr>
<td>Self study</td>
<td>15h</td>
</tr>
</tbody>
</table>

**Specific objectives:**
8, 9

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**Introduction to Physical Agents**

<table>
<thead>
<tr>
<th>Hours</th>
<th>14h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes</td>
<td>4h</td>
</tr>
<tr>
<td>Practical classes</td>
<td>2h</td>
</tr>
<tr>
<td>Laboratory classes</td>
<td>1h</td>
</tr>
<tr>
<td>Guided activities</td>
<td>0h</td>
</tr>
<tr>
<td>Self study</td>
<td>7h</td>
</tr>
</tbody>
</table>
### Description:
Students not only should attend the lessons, but also read the proposed papers.

### Specific objectives:
- 10

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#### Evaluation of practical exercises

**Description:**
Delivery of the report on the practical works (3 or 4 four) made along the laboratory sessions.

**Specific objectives:**
- 5, 6, 7

**Hours:** 3h  
Guided activities: 3h  
Self study: 0h

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#### Final Exam

**Description:**
Final exam for all the course contents.

**Specific objectives:**
- 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

**Hours:** 3h  
Guided activities: 3h  
Self study: 0h
Evaluation is based on a final exam and a part exam, grading of course assignments, and a grade for lab work. The final and part exams will test the theoretical knowledge and the methodology acquired by students during the course. The grade for course assignments will be based on submissions of small problems set during the course. Lab grades will be based on students’ reports and lab practical work carried out throughout the course.

At about half of the 4-moth term there will be an exemptive exam, testing the first half of the course (exemptive only if the grade is 5 or more). The final exam will test both the first and the second part of the course. The first half is compulsory for those students who did not pass the part exam, and optional for the rest. The maximum of both grades (or only the one for the midterm exam) will stand as the grade for the first part.

The final grade will be calculated as follows:

\[
G_{\text{Par}} = \text{part exam grade} \\
G_{\text{Ex1}} = \text{1st half of the final exam grade} \\
G_{\text{Ex2}} = \text{2nd half of the final exam grade} \\
\text{Total Exams grade} = \frac{\max(G_{\text{par}}, G_{\text{Ex1}}) + G_{\text{Ex2}}}{2} \\
\text{Final grade} = \text{Total Exams grade} \times 0.5 + \text{Exercises grade} \times 0.2 + \text{lab grade} \times 0.3 \text{ (code + inform)}
\]

Competences’ Assessment

The assessment of the competence on teamwork is based on work done during the laboratory assignments.
Bibliography

Basic:


Complementary:


Others resources:

Hyperlink

http://aima.cs.berkeley.edu/