270089 - ECSDI - Knowledge Engineering and Distributed Intelligent Systems

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science
Academic year: 2018
Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: - Javier Béjar Alonso (bejar@cs.upc.edu)

Prior skills

Prior skills on service architectures and design services acquired in the course Software Architecture (AS):
- Knowledge of service architectures.
- Knowledge of the principles of services’ design.
- Knowledge of design patterns for services.

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.

Requirements

- Prerequisite AS

Degree competences to which the subject contributes

Specific:
CES1.4. To develop, maintain and evaluate distributed services and applications with network support.

CT4.3. To demonstrate knowledge and capacity to apply the fundamental principles and the basic techniques of the intelligent systems and its practical application.

General:
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 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 methodologies, explained in the Theory sessions. The participation of students will be stimulated 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 methodologies.
Learning objectives of the subject

1. Understand the origins and foundations of distributed computing on the Internet
2. Understanding the basic concepts: Computing as Interaction, Service Orientation, Cloud Computing, Future Internet
3. Knowing the possible applications of artificial intelligence for distributed systems on the Internet
4. Understanding the basics of Service Orientation
5. Understanding the basics of Agent Orientation
6. To analyze a problem distributed in nature to identify the different actors and their functionalities
7. Designing distributed systems using an agent-oriented methodology
8. Analysing an agent-oriented design and identifying where to improve it.
9. Understand the basic concepts of context representation.
10. Analyze a problem distributed in nature and identify the context information that is necessary.
11. Extract and represent knowledge about the context necessary to build a distributed application on the Internet that is flexible and robust.
12. Designing context ontologies by applying a methodology properly
13. Understanding the concepts related to the dynamic composition of services
14. Describe Web services so that they can be incorporated into a dynamic composition process
15. Extract and represent the necessary actions to solve dynamic composition by using a planner
16. Understand the machine learning concept and know some of its types.
17. Understanding the relationship between adaptation and learning.
18. Understand how to apply machine learning to adapt to the user.
19. Understand how to apply machine learning to adapt to failures.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></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

Introduction

Degree competences to which the content contributes:

Description:

Agent-Oriented Software Engineering

Degree competences to which the content contributes:

Description:

Modeling context in distributed systems

Degree competences to which the content contributes:

Description:

Dynamic service composition

Degree competences to which the content contributes:

Description:
Semantic description of services, Service Discovery and Service Matchmakers. Problems of static orchestration and choreography models. Different approaches to dynamic composition: goal driven, state driven, utility driven. Planning applied to dynamic composition of services.

Adapting to the user. User Profile

Degree competences to which the content contributes:

Description:

Other AI applications to distributed systems
| Degree competences to which the content contributes: |
| Description: |
Governance through social models: reputation, norms. Social structures's models: teams, alliances, coalitions, organizations. Examples.
### Planning of activities

<table>
<thead>
<tr>
<th>Area</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 distributed computing</strong></td>
<td>6h</td>
<td>2h</td>
<td>1h</td>
<td>1h</td>
<td>0h</td>
<td>2h</td>
</tr>
<tr>
<td><strong>Design of agent-oriented distributed applications</strong></td>
<td>32h</td>
<td>7h</td>
<td>4h</td>
<td>4h</td>
<td>0h</td>
<td>17h</td>
</tr>
<tr>
<td><strong>Delivering the agent-oriented modeling assignment</strong></td>
<td>2h</td>
<td>Guided activities: 2h</td>
<td>0h</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Modeling context in distributed systems</strong></td>
<td>37h</td>
<td>9h</td>
<td>4h</td>
<td>3h</td>
<td>0h</td>
<td>21h</td>
</tr>
</tbody>
</table>

**Description:**
- Students learn about the origins and foundations of Distributed Computing and the latest trends for the future.
- To reinforce learning, the student must read an article from the European Commission on “Future Internet”, available online.

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

- Students not only need to attend the teacher lectures, but also practical exercises on agent-oriented modeling, and participate in discussions with the teacher and their peers about which is the best way to model distributed problems. In the laboratory students will apply what they learned in a moderate problem.

**Specific objectives:**
- 4, 5, 6, 7, 8

- Delivery of the report on the agent-oriented modeling practical assignment that students have done in the lab sessions.

**Specific objectives:**
- 5, 6, 7, 8
## Delivering the ontology modeling practical assignment.

**Description:**
Students not only should attend the teacher lectures, but also do exercises on context modeling 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:**
9, 10, 11, 12

<table>
<thead>
<tr>
<th>Hours</th>
<th>Guided activities: 1h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Self study: 0h</td>
</tr>
</tbody>
</table>

## Partial ECSDI exam

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

**Specific objectives:**
9, 10, 11, 12

<table>
<thead>
<tr>
<th>Hours</th>
<th>Guided activities: 1h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self study: 5h</td>
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</tbody>
</table>

## Dynamic service composition

**Description:**
Students not only should attend the teacher lectures, but also do exercises on on service description and composition and discuss with the teacher and other students on the issues related to service composition. In the laboratory students will apply what they learned in a moderate problem.

**Specific objectives:**
13, 14, 15

<table>
<thead>
<tr>
<th>Hours</th>
<th>Theory classes: 6h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Practical classes: 4h</td>
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<tr>
<td></td>
<td>Laboratory classes: 7h</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 0h</td>
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<tr>
<td></td>
<td>Self study: 25h</td>
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<tr>
<td>Activity</td>
<td>Hours:</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Adapting to the user. User Profiling</td>
<td>8h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>Students not only should attend the teacher lectures, but also do exercises on the use of basic Machine Learning algorithms for user profiling and participate in discussions with the teacher and other students on how to use these algorithms.</td>
<td></td>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>16, 17, 18, 19</td>
<td></td>
</tr>
<tr>
<td>Other AI applications for distributed systems</td>
<td>4h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>Students not only should attend the teacher lectures, but also participate in discussions with the professor and the other students on the potential impact Artificial Intelligence techniques may have in the Future Internet.</td>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>Delivering the Service Composition practical assignment.</td>
<td>1h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>Delivery of the report of the practical assignment on Service Composition that students have developed in the laboratory.</td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>Final ECSDI Exam</td>
<td>11h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>Final exam for all the course contents.</td>
<td></td>
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</tbody>
</table>
Specific objectives:
6, 7, 8, 10, 11, 12, 14, 15, 18, 19

Qualification system

The student assessment will consist of a partial exam mark, a final exam mark 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 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

\[
\text{MARK} = \max((\text{PM} \times 0.2 + \text{FM} \times 0.4), \text{FM} \times 0.6) + \text{LM} \times 0.4
\]

Competences' Assessment

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

Bibliography

Basic:

Complementary: