Course guide
270089 - ECSDI - Knowledge Engineering and Distributed Intelligent Systems

Last modified: 30/01/2024

Unit in charge: Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science.

Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: JAVIER BÉJAR ALONSO

Others: Segon quadrimestre:
JAVIER BÉJAR ALONSO - 11, 12

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, mantain 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.

Generical:
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 identifyin 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

Type	Hours	Percentage
Self study	84,0	56.00
Hours large group	30,0	20.00
Hours medium group	15,0	10.00
Hours small group	15,0	10.00
Guided activities	6,0	4.00

Total learning time: 150 h

CONTENTS

Introduction

Description:
Evolution of Distributed Computing: from SOA to RPCs. The 'Computation as interaction' concept. New trends: Cloud Computing and the Future Internet. The role of AI in SOA and the Future Internet.

Agent-Oriented Software Engineering

Description:
Introduction to Service Orientation and the W3C standard. Limitations of the model. Introduction to Agent orientation and the IEEE-FIPA standard. Basic concepts: Agent and Multiagent System. Agent-oriented design methodologies. Advantages.

Modeling context in distributed systems

Description:
Modeling context in SOA: service description languages, orchestration and choreography. Context representation: domain, domain model, knowledge, knowledge representation. Knowledge engineering applied to the development of distributed systems on the Web. Ontology-based representations. Semantic Web and Linked data as a representation model.

Dynamic service composition

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

Description:
Adaptation means learning. Basic concepts on profiling: individual and social profile. Inductive Learning, Recommender Systems and Reinforcement Learning..

Other AI applications to distributed systems

Description:
Governance through social models: reputation, norms. Social structures's models: teams, alliances, coalitions, organizations. Examples.

ACTIVITIES

Introduction to distributed computing

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

Full-or-part-time: 6h
Theory classes: 2h
Practical classes: 1h
Laboratory classes: 1h
Self study: 2h

Design of agent-oriented distributed applications

Description:
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

Related competencies :
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.

Full-or-part-time: 31h
Theory classes: 6h
Practical classes: 4h
Laboratory classes: 4h
Self study: 17h

Delivering the agent-oriented modeling assignment

Description:
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

Related competencies :
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.

Modeling context in distributed systems

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

Related competencies :
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.

Full-or-part-time: 35h
Theory classes: 7h
Practical classes: 4h
Laboratory classes: 3h
Self study: 21h

Delivering the ontology modeling practical assignment.

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

Related competencies :
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.

Full-or-part-time: 2h
Self study: 2h

Partial ECSDI exam

Description:
Partial exam on agent-oriented modeling and context modeling

Specific objectives:
5, 6, 7, 8, 9, 10, 11, 12

Related competencies :
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.

Full-or-part-time: 7h
Guided activities: 2h
Self study: 5h

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

Full-or-part-time: 44h
Theory classes: 6h
Practical classes: 4h
Laboratory classes: 7h
Self study: 27h

Adapting to the user. User Profiling

Description:
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.

Specific objectives:
16, 17, 18, 19

Full-or-part-time: 8h
Theory classes: 2h
Practical classes: 2h
Self study: 4h

Other AI applications for distributed systems

Description:
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.

Specific objectives:
3

Full-or-part-time: 5h
Theory classes: 3h
Self study: 2h

Delivering the Service Composition practical assignment.

Description:
Delivery of the report of the practical assignment on Service Composition that students have developed in the laboratory.

Specific objectives:
13, 14, 15

Full-or-part-time: 1h
Self study: 1h

Final ECSDI Exam

Description:
Final exam for all the course contents.

Specific objectives:
6, 7, 8, 10, 11, 12, 14, 15, 18, 19

Related competencies :
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.

Full-or-part-time: 11h
Guided activities: 2h
Self study: 9h

GRADING 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 int he final exam.

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

MARK = max ((PM*0.25 + FM*0.25),PM*0.15 + FM*0.35)) + LM*0.45 + Competence Grade

Competences' Assessment

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

BIBLIOGRAPHY

Basic:
- Erl, T. Service-oriented architecture: concepts, technology and design. Prentice Hall PTR, 2005. ISBN 9780131858589.
- Erl, T. SOA: principles of service design. Prentice Hall, 2008. ISBN 9780132344821.
- Erl, T. SOA design patterns. Prentice Hall, 2009. ISBN 978-0136135166.

Complementary:
- Erl, T.; Bennett, S.G.; Gee, C.; Laird, R.; Manes, A.T.; Schneider, R.; Shuster, L.; Tost, A.; Venable, C. SOA governance: governing shared services on-premise and in the cloud. Prentice Hall, 2011. ISBN 9780138156756.
- Russell, S.; Norvig, P. Artificial intelligence: a modern approach. 4th ed. Harlow: Pearson, 2022. ISBN 9781292401133.

RESOURCES

Hyperlink:
- https://www.youtube.com/channel/UClLXHUWjI3sSbPAY7Sh011g