DEGREE CURRICULUM

ADVANCED PROGRAMMING IN ARTIFICIAL INTELLIGENCE

Coordination: PLANES CID, JORDI

Academic year 2023-24

ADVANCED PROGRAMMING IN ARTIFICIAL INTELLI... 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>ADVANCED PROGRAMMING IN ARTIFICIAL INTELLIGENCE</td></tr>
<tr><td>Code</td><td>102064</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Computer Engineering</td><td>3</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Computer Engineering</td><td>3</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>7.5</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
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<tr><th>Activity type</th><th>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>3</td><td>1.5</td><td>3</td></tr>
<tr><td>Number of groups</td><td>1</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>PLANES CID, JORDI</td></tr>
<tr><td>Department</td><td>COMPUTER ENGINEERING AND DIGITAL DESIGN</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>English</td></tr>
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ADVANCED PROGRAMMING IN ARTIFICIAL INTELLI... 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ORTIZ SANCHEZ, MARCEL	marcel.ortiz@udl.cat	2,7	
PLANES CID, JORDI	jordi.planes@udl.cat	3,6	
TORRENT BUREU, NIL	nil.torrent@udl.cat	2,7	

Subject's extra information

This course will delve into aspects of computing (Computational Science, ACM-IEEE CV-2008) and artificial intelligence (Intelligent Systems, ACM-IEEE CV-2008), guiding to an applied aspect, since each lesson will work with a different tool, solving problems.

To follow this subject properly some previous knowledge on computer programming, logics, and artificial intelligence are recommended.

Learning objectives

- Understanding the different techniques and algorithms that are more commonly used in local search.
- Identifying problems where they can apply the local search techniques efficiently.
- Designing and implement local search algorithms for the Satisfiability and Maximum Satisfiability problems.
- Understanding how to evaluate the several implementations of algorithms to solve some problem in a neutral way.
- Knowing the different techniques and systematic search algorithms.
- Identifying problems which apply systematic search techniques.
- Designing and implement systematic search algorithms for Boolean satisfiability problem and maximum satisfiability .

Competences

Strategic Competences of the UdL

CT2. Mastering a foreign language, especially English.
CT3. Training Experience in the use of the new technologies and the information and communication technologies.

Cross-disciplinary competences

EPS6. Capacity of analysis and synthesis.

Specific competences

GII-C3. Capacity to evaluate the computational complexity of a problem, to know the algorithmic strategies that can drive to its solving and recommend, develop and implement the one which guarantee the best performance in accordance with the requirements.
GII-C4. Capacity to understand the basics, paradigms and techniques of the intelligent systems and analyse,

design and build systems, services and computer applications that use these techniques in any field of application.
GII-C5. Capacity to acquire, obtain, formalise and represent the human knowledge in a computable form to solve problems by means of a computer system in any field of application, particularly in the ones related with computation, perception and performance in environments or intelligent surroundings.
GII-C6. Capacity to develop and evaluate interactive systems and of presentation of complex information and its application to solve problems of design of computer-person interaction.
GII-C7. Capacity to know and develop techniques of computational learning and design and implement applications and systems that use them, including the ones devoted to automatic extraction of information and knowledge from big volumes of data.

Subject contents

Part 1

1. Preliminaries
1.1. Reminder SAT and MaxSAT

2. Local Search
2.1. Sistematic and non-sistematic algorithms
2.2. SAT local search
2.3. Neighborhood search
2.4. Genetic algorithms
2.5. Problem generation
2.6. SAT sistematic search

3. The MaxSAT problem
3.1. Branch and bound
3.2. Oracle-based solving

4. Constraint programming
4.1. Bucket elimination
4.2. Consistency
4.3. Optimization

Part 2

1. Data Treatment
1.1. Data Cleansing
1.2. Data Integration
1.3. Feature Extraction
1.4. Transformation Pipelines

2. Machine Learning
2.1. Introduction to ML paradigm
2.2. Traditional ML algorithms
2.3. Learning & Evaluation techniques
2.4. Optimization algorithms
2.5. Use Cases

3. Deep Learning
3.1. Introduction to Deep Learning
3.2. Most common architectures
3.3. Learning & Evaluation techniques
3.4. Optimization algorithms
3.5. Use Cases

The contents will be taught in Class and Laboratory (LAB) format.

Methodology

Large groups

Lectures: exposition of subject contents orally by the teacher and with the help of notes and/or slides.

Problems: presentation of complex problems that the student tries to solve, followed by the solution proposed by the teacher.

Practices: application, on a practical level, of the contents given in the course.

Written tests: presential written test.

Development plan

Week	Description	On-site Activity Class	On-site Activity LAB	Classroom/independent work
1	Lecture and problems	Lesson 3.1	Lesson 1.1	4h/6h
2	Lecture and problems	Lesson 3.2	Lesson 1.2	4h/6h
3	Lecture and problems	Lesson 3.2	Lesson 1.3	4h/6h
4	Lecture and problems	Lesson 3.2	Lesson 1.4	4h/6h
5	Lecture and problems	Lesson 3.3	Lesson 2.1	4h/6h
6	Lecture and problems	Lesson 3.3	Lesson 2.2	4h/6h
7	Lecture and problems	Lesson 3.4	Lesson 2.3	4h/6h
8	Practices	Presentation of practices		4h/6h
9	Written tests	First mid-term exam		2h/3h
10	Lecture and problems	Lesson 3.5	Lesson 2.4	4h/6h
11	Lecture and problems	Lesson 3.5	Lesson 2.5	4h/6h
12	Lecture and problems	Lesson 3.5	Lesson 2.5	4h/6h
13	Lecture and problems	Lesson 3.5	Lesson 2.5	4h/6h
14	Lecture and problems	Lesson 3.5	Lesson 2.5	4h/6h
15	Lecture and problems	Lesson 3.5	Lesson 2.5	4h/6h
16	Oral tests	Defense of the project		2h/3h
17	Oral tests	Defense of the project		
18		Study week		
19	Written tests	Recovery		

Evaluation

Blocks	Evaluation activities	Weighting	Minimum score	Group work	Compulsory	Recoverable
P1	Practice 1	35%	3	Yes	Yes	Yes (*)
T1	Theoretical evaluation 1	15%	No	No	No	No
P2	ML Project	40%	3	Yes	Yes	Yes (*)
T2	Theoretical evaluation 2	10%	No	No	Yes	No
(*) Recoverable activity with penalty						

Nota Final = P1 * 0.35 + T1 * 0.15 + P2 * 0.4 + T2 * 0.1

Theoretical Assessment 2 can include questions relating to the project (Block P2) if it is considered necessary for the validation of its authorship.

In order to pass the subject, the minimum mark for all activities with weight 30% or more must be greater than or equal to 3 (out of 10).

In case of reatking an activity, the maximum grade will be 8 out of 10.

Bibliography

Basic bibliography

- Armin Biere, Marijn Heule, Hans van Maaren, Toby Walsh (Eds.): Handbook of Satisfiability. Frontiers in Artificial Intelligence and Applications 185 IOS Press 2009
- Rina Dechter: Constraint processing. Elsevier Morgan Kaufmann 2003
- Stuart Russell, Peter Norvig. Artificial Intelligence: A Modern Approach, 4th ed. 2021.