DEGREE CURRICULUM

LANGUAGES, AUTOMATA AND GRAMMARS

Coordination: MIRET BIOSCA, JOSE MARIA

Academic year 2023-24

LANGUAGES, AUTOMATA AND GRAMMARS 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>LANGUAGES, AUTOMATA AND GRAMMARS</td></tr>
<tr><td>Code</td><td>102062</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>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Double bachelor's degree: Degree in Computer Engineering and Degree in Business Administration and Management</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>4.5</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>1.5</td><td>3</td></tr>
<tr><td>Number of groups</td><td>2</td><td>1</td></tr>
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<tr><td>Coordination</td><td>MIRET BIOSCA, JOSE MARIA</td></tr>
<tr><td>Department</td><td>MATHEMATICS</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>4,5 ECTS correspond to a workload of 45 h of lectures and assesment and 67 h of autonomous study work for each student.</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Preferably in Catalan. Lectures can be given in Spanish or English, if required.</td></tr>
<tr><td>Distribution of credits</td><td>Theoretical lectures are combined with problem solving sessions.

On-line lectures will take 2 hours per week. There will be 2 face-to-face groups, with 1 hour of classroom activities each.</td></tr>
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LANGUAGES, AUTOMATA AND GRAMMARS 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
MESSEGUE BUISAN, ARNAU	arnau.messegue@udl.cat	3	
MIRET BIOSCA, JOSE MARIA	josepmaria.miret@udl.cat	3	

Subject's extra information

Previous knowledge on the subjects *Algebra, Computational Logics* and *Discrete Mathematics* is recommended.

This subject is scheduled in the second semester of the 2nd year

The knowledge and competencies adquired in this subject will be useful to follow other subjects in the specialisation on *Computing*, and in particular for the subjects *Computational Models and Complexity* and *Language Processing Algorithms*.

Learning objectives

- Understand the concept of language, know how to describe it properly and perform operations between languages.
- Recognize the language accepted by a finite automata.
- Be able to minimize and determinize a finite automata.
- Adequately use regular expressions to represent a regular language.
- Recognize the language generated by a context free grammar.
- Know how to simplify a context free grammar.
- Recognize the language accepted by a pushdown automata.
- Know how to design finite automata, context free grammars and pushdown automata which recognize/generate a given language.

Competences

GII-FB3. Capacity to understand and master the basic concepts of discreet mathematics, logical, algorithmic and computational complexity, and its application to solve engineering problems.
EPS5. Capacity of abstraction and of critical, logical and mathematical thinking.

Subject contents

1. Alphabets and languages

- Alphabets, words and languages.
- Concatenation of words.
- Universal language.
- Operations with languages.
- Kleene star of a language.

2. Finite Automata

- Deterministic finite automata.
- Accepted language by a deterministic finite automata.
- Indeterministic finite automata.
- Determinization of finite automata.
- Minimizacion of finite automata.
- Operations with regular languages.
- Regular Expressions.

3. Context free grammars

- Generated language by a context free grammar.
- Operations with context free languages.
- Ambiguous grammars.
- Elimination of null productions, unit productions and useless symbols.
- Chomsky normal form.
- Regular grammars.

4. Pushdown automata

- Deterministic pushdown automata.
- Indeterministic pushdown automata.
- Accepted language by a pushdown automata.

Methodology

Theoretical and practical contents are mixed for the sake of combining basical aspects with illustrative examples and problem solving. Problem solving combines joint resolution on the blackboard or individual resolution. Some sessions will be devoted to group problem solving.

Development plan

Week	Lesson	Activities	student workload
1	Introduction. Lesson 1	Lectures	2 hours. Study and problem solving.
2	Lesson 1	Lectures and problem sessions	3 hours. Study and problem solving.
3	Lesson 2	Lectures and problem sessions	3 hours. Study and problem solving.
4	Lesson 2	Lectures and problem sessions	3 hours. Study and problem solving.
5	Lesson 2	Lectures and problem sessions	3 hours. Study and problem solving.
6	Lesson 2	Lectures and problem sessions	3 hours. Study and problem solving.
7	Lesson 2	Lectures and problem sessions	3 hours. Study and problem solving.
8	Lesson 3	Lectures and problem sessions	6 hours. Study for exams.
9		Partial 1 assessment	8 hours. Study for exams.
10	Lesson 3	Lectures and problem sessions	3 hours. Study and problem solving.
11	Lesson 3	Lectures and problem sessions	3 hours. Study and problem solving.
12	Lesson 3	Lectures and problem sessions	3 hours. Study and problem solving.
13	Lesson 3	Lectures and problem sessions	3 hours. Study and problem solving.

14	Lesson 4	Lectures and problem sessions	3 hours. Study and problem solving.
15	Lesson 4	Lectures and problem sessions	6 hours. Study for exams.
16		Tutorization	6 hours. Study for exams.
17		Partial 2 assessment	8 hours. Study for exams.
18		Tutorization	
19		Final assessment	

Evaluation

Acr.	Assessment activities	Weight	Minimum mark	Resit
P1	*Partial 1. Lessons 1, 2*	4.5 points	1 point	Yes
P2	*Partial 2. Lessons 3, 4*	4.5 points	1 point	Yes
AC	Complementary activitities : Implementation of an algorithm studied in class	1 point	No	No
PCL	*Active participation* or attending conferences or exhibitions on related topics	0.5 points	No	No

Final Mark = P1 + P2 + AC+ PCL
A student with final mark below 5 or who has not reached the minimum marks required, can resit either P1, P2 or both. Up to 0.5 additional points can be assigned, according to participation in the classroom and delivered problems.
Students who have been authorized to follow the alternative assessment (see requirements and procedure in the assessment regulations), will follow the following assessment procedure:
* Student will be assessed for 100% of the grade in a single exam on the date set for the additional exams.
* This exam will consist of two parts P1 and P2 (with an assessment of 5 points each). In order to pass, you will have to obtain an overall mark of more than 5 and a minimum mark for each of the parts of 2.5 points.
* If the student does not pass this unique assessment or does not reach the minimum mark in one of the parts, he will have the right to recover 100% of the mark under the same terms, on a date to be agreed with the teaching staff.

Bibliography

Basic bibliography:

RAFEL CASAS, LLUÍS MÁRQUEZ, Llenguatges, gramàtiques i autòmats,Curs bàsic. Aula Teòrica 58, Edicions UPC, 1997.

JOSEP M. MIRET, MAGDA VALLS, Recull de problemes de Llenguatges, Autòmats i Gramàtiques. Universitat de Lleida, 2002.

Complementary bibliography:

QUITI BORGES, JOAN SERRA, JOSEP M. ARQUES, Teoria d'autòmats. Materials 28, Servei de Publicacions UAB.

JOHN E. HOPCROFT, JEFFREY D. ULLMAN, Introduction to Automata Theory, Languages and Computation. Addison- Wesley, 1979.

DEAN KELLEY, Teoría de Autómatas y Lenguajes Formales. Prentice-Hall, 1995.

JAIRO ROCHA, FRANCESC ROSSELLÓ, Autòmats i Llenguatges: verificació, implementació i concurrència. Materials didàctics 107, Universitat de les Illes Balears, 2003.