

**1. General information****Course:** COMPILERS**Type:** CORE COURSE**Degree:** 346 - DEGREE IN COMPUTER SCIENCE AND ENGINEERING**Center:** 604 - SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (AB)**Year:** 4**Main language:** Spanish**Use of additional languages:****Web site:****Code:** 42349**ECTS credits:** 6**Academic year:** 2019-20**Group(s):** 15**Duration:** First semester**Second language:** English**English Friendly:** Y**Bilingual:** N**Lecturer:** JUAN JOSE PARDO MATEO - Group(s): 15

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2. Pre-Requisites

This module builds on the skills and knowledge acquired in other subjects in the curriculum:

Automaton and Computer Theory.
Data Structure.
Programming Fundamentals I and II.
Programming Methodology.
Structure of Computers.

Therefore, in order to assimilate and conveniently make the most of the contents that will be taught in the course, it is recommended to have passed them.

3. Justification in the curriculum, relation to other subjects and to the profession

This module is included in the Specific Technology of Computation and it provides an overview of the principles of operation of compilers and interpreters, and the role they play within the context of computer science engineering.

The concepts of language processors also find application outside the field of compilation. Some of these fields are the following: design of programming languages and programming aid tools, processing of text files with structured information, word processors, symbolic calculation, database management systems, etc.

The practical importance of language processors in computing is mainly shown in the daily use of compilers and interpreters by professional programmers.

Currently, compilation is considered a traditional area of computer science, which has a deep theoretical base and a systematized design process. The future of language processors is linked to the development of their multiple application areas.

Therefore, a deep knowledge of the principles and techniques of language processors is fundamental in the university training of computer specialists, mainly if they have chosen the Specific Technology of Computation.

4. Degree competences achieved in this course**Course competences**

Code	Description
CM2	Ability to know the theoretical fundamentals of programming languages, and their associated techniques for lexical, syntactic, and semantic processes, along with their application in the creation, design, and language processing.
INS1	Analysis, synthesis, and assessment skills.
INS4	Problem solving skills by the application of engineering techniques.
UCLM3	Accurate speaking and writing skills.

5. Objectives or Learning Outcomes**Course learning outcomes**

Description

Knowledge of what a programming language consists of and an integrated vision of the functioning and structure of a language processor.

Ability to build applications based on processors for domain-specific languages.

Additional outcomes**6. Units / Contents****Unit 1: Structure of compilers and interpreters**

Unit 1.1 Introduction

Unit 1.2 Steps in the translation process

Unit 1.3 Interpretation

Unit 1.4 Real structure of compilers and interpreters

Unit 2: Lexical Analysis

Unit 2.1 Introduction

Unit 2.2 Lexical categories

Unit 2.3 Lexical categories specification

Unit 2.4 Finite state automata

Unit 2.5 Lexical analyser implementation

Unit 2.6 Applications of lexical analyser

Unit 3: Syntax Analysis

Unit 3.1 Introduction

Unit 3.2 Context-free grammars

Unit 3.3 Some constructions of the programming languages

Unit 3.4 Extensions of context-free grammars

Unit 3.5 Top-down parsing

Unit 3.6 Bottom-up parsing

Unit 3.7 Syntax analyser implementation

Unit 4: Semantic Analysis

Unit 4.1 Introduction

Unit 4.2 Syntax driven translation

Unit 4.3 Abstract syntax tree

Unit 4.4 Semantic checks

Unit 4.5 Interpretation

Unit 5: Intermediate Code Generation

Unit 5.1 Introduction

Unit 5.2 Intermediate code

Unit 5.3 Real memory organization and management

Unit 5.4 Code generation for expressions

Unit 5.5 Code generation for control structures

Unit 5.6 Code generation for function calls

Unit 5.7 Machine code generation

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	R	Description
Class Attendance (theory) [ON-SITE]	Lectures	CM2	0.56	14	N	-	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CM2 INS1 INS4	0.56	14	N	-	-	
Laboratory practice or sessions [ON-SITE]	Group Work	CM2 INS1 INS4	0.72	18	Y	Y	Y	
Final test [ON-SITE]	Assessment tests	CM2 INS1 INS4 UCLM3	0.24	6	Y	Y	Y	
Project or Topic Presentations [ON-SITE]	Group Work	INS1 INS4 UCLM3	0.32	8	Y	Y	Y	
Study and Exam Preparation [OFF-SITE]	Self-study	CM2 INS1 INS4 UCLM3	1.64	41	N	-	-	
Study and Exam Preparation [OFF-SITE]	Group Work	CM2 INS1 INS4	0.8	20	N	-	-	
Writing of reports or projects [OFF-SITE]	Self-study	CM2 INS1 INS4 UCLM3	0.48	12	Y	Y	Y	
Practicum and practical activities report writing or preparation [OFF-SITE]	Group Work	CM2 INS1 INS4 UCLM3	0.68	17	N	-	-	
Total:			6	150				
Total credits of in-class work: 2.4			Total class time hours: 60					
Total credits of out of class work: 3.6			Total hours of out of class work: 90					

As: Assessable training activity

Com: Training activity of compulsory overcoming

R: Rescheduling training activity

8. Evaluation criteria and Grading System

Evaluation System	Grading System		Description
	Face-to-Face	Self-Study Student	
Laboratory sessions	45.00%	0.00%	Students must submit the practical project consisting of the development of a compiler for a small language that will be defined at the beginning of the course. During the course there will be several partial assignments of the project that will show the evolution of the students. Each assignment will have its corresponding presentation before the teacher. This element of evaluation is included in the LAB section (35%)

			and in the PRESS section (10%).
Test	30.00%	0.00%	Students will do two assessments test, one in the middle of the course and one at the end. These tests will be made of three or four exercises. This part is assessed in the ESC section.
Assessment of problem solving and/or case studies	20.00%	0.00%	Students will be required to submit a report where they will describe justified solutions for the exercises indicated as such in class. They will obtain marks in each exercise according to the following scale: - Correct exercise: Maximum score. - Partially correct exercise correct: Maximum score/2. - Incorrect exercise: 0 points. This section is included within Reports section (INF)
Assessment of active participation	5.00%	0.00%	Participation in classes, mainly problems and laboratory classes, will be valued. It shall have the following criteria: - Presentation of ideas to the group for the resolution of problems, in exercise and laboratory classes. -Participation in seminars presenting ideas an solutions to be taken. This section is graded within the presentation section (PRES)
Total:	100.00%	0.00%	

Evaluation criteria for the final exam:

In order to pass the subject in the ordinary call, the mark of each part(test, problems and laboratory) must be at least 5.

Below this minimum, the student will have to take the corresponding parts in the extra exam session.

The students who have passed the part of problems or practices in the previous course will be able to keep the grade obtained in that part in the previous course. Student must inform the teacher in the first two weeks of class.

Specifications for the resit/retake exam:

Students with marks below 5 out of 10 in any part in the regular call must take the corresponding parts. The marks of the other parts are saved.

If a student decides to repeat the evaluation of one of the passed parts in the regular call, the mark of that part will be the obtained in the extra call(higher or smaller)

Specifications for the second resit / retake exam:

In this call, students must do a single written exam, which is made up of some exercise related to the theory and practices.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3
Laboratory practice or sessions [PRESENCIAL][Group Work]	4
Final test [PRESENCIAL][Assessment tests]	6
Project or Topic Presentations [PRESENCIAL][Group Work]	8
Study and Exam Preparation [AUTÓNOMA][Self-study]	15
Study and Exam Preparation [AUTÓNOMA][Group Work]	20
Writing of reports or projects [AUTÓNOMA][Self-study]	12
Practicum and practical activities report writing or preparation [AUTÓNOMA][Group Work]	17
Unit 1 (de 5): Structure of compilers and interpreters	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1
Laboratory practice or sessions [PRESENCIAL][Group Work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	2
Unit 2 (de 5): Lexical Analysis	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Laboratory practice or sessions [PRESENCIAL][Group Work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Unit 3 (de 5): Syntax Analysis	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Laboratory practice or sessions [PRESENCIAL][Group Work]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Unit 4 (de 5): Semantic Analysis	
Activities	Hours

Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Laboratory practice or sessions [PRESENCIAL][Group Work]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Unit 5 (de 5): Intermediate Code Generation	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	4
Laboratory practice or sessions [PRESENCIAL][Group Work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Global activity	
Activities	hours
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	14
Laboratory practice or sessions [PRESENCIAL][Group Work]	18
Final test [PRESENCIAL][Assessment tests]	6
Project or Topic Presentations [PRESENCIAL][Group Work]	8
Study and Exam Preparation [AUTÓNOMA][Self-study]	41
Study and Exam Preparation [AUTÓNOMA][Group Work]	20
Writing of reports or projects [AUTÓNOMA][Self-study]	12
Practicum and practical activities report writing or preparation [AUTÓNOMA][Group Work]	17
Class Attendance (theory) [PRESENCIAL][Lectures]	14
Total horas: 150	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Aho, Alfred V.	Compiladores : principios, técnicas y herramientas	Addison-Wesley Iberoamericana		968-444-333-1	1998	
Aho, Alfred V.	Compiladores : principios, técnicas y herramientas	Pearson Educación		978-970-26-1133-2	2008	
Cooper, Keith D.	Engineering a compiler	Morgan Kaufmann Publishers		1-55860-699-8	2004	
Jiménez Millán, José Antonio	Compiladores y procesadores de lenguajes	Universidad de Cádiz		84-96274-39-X	2004	
Louden, Kenneth C.	Construcción de compiladores : principios y práctica	Thomson		970-686-299-4	2004	
Ruiz Catalán, Jacinto	Compiladores : teoría e implementación	RC Libros		978-84-937008-9-8	2010	
Scott ,Michael L.	Programming language pragmatics	Morgan Kaufmann		978-0-12-633951-2	2006	
Alfonseca, Manuel	Compiladores e intérpretes : teoría y práctica	Pearson Prentice Hall		978-84-205-5031-2	2006	
Aho, Alfred V.	Compilers : principles, techniques, and tools	Pearson/Addison Wesley		0-321-49169-6	2007	
Garrido Alenda, Alicia	Diseño de compiladores	Departamento de Lenguajes y Sistemas Informático		84-7908-700-5	2002	
Bal, Henri E. Grune, Dick	Diseño de compiladores modernos	McGraw-Hill/Interamericana de España		978-84-481-5656-5	2007	