

**1. General information****Course:** PROGRAMMING METHODOLOGY**Type:** CORE COURSE**Degree:** 346 - DEGREE IN COMPUTER SCIENCE AND ENGINEERING**Center:** 604 - SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (AB)**Year:** 2**Main language:** Spanish**Use of additional languages:****Web site:****Code:** 42316**ECTS credits:** 6**Academic year:** 2019-20**Group(s):** 10 11 12**Duration:** C2**Second language:** English**English Friendly:** N**Bilingual:** Y

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2. Pre-Requisites

- Polynomials roots calculating
- Limits calculating
- Successions and series
- Iterative and Recursive programming strategies
- Identifying and using the appropriate data structure that implements any algorithm

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

- It provides appropriate methodology for solving complex / real problems that require more abstract approaches than those provided by the subjects of Programming Fundamentals.
- It contributes to get specific skills [BA3, CO6, CO7]
- It follows the learning program developed in both "Programming Fundamentals" and "Data Structures", and will be followed by both "Design of algorithms" and "Software Engineering" subjects

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

Code	Description
BA3	Ability to understand basic concepts about discrete mathematics, logic, algorithms, computational complexity, and their applications to solve engineering problems.
CO6	Knowledge and application of basic algorithms in digital technologies for the development of solutions, analysing their appropriateness and complexity.
CO7	Knowledge, design, and efficient use of types of data and structures which arise as most appropriate in problem solving.
INS1	Analysis, synthesis, and assessment skills.
INS4	Problem solving skills by the application of engineering techniques.
SIS1	Critical thinking.

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

Description

Design of solutions for problems by the analysis of appropriateness and complexity of suggested algorithms.

Resolution of problems throughout basic techniques of algorithm design.

Additional outcomes

Choosing and implementing the computationally cheapest methodology that solves a given problem

Sorting algorithms according to their complexity

6. Units / Contents**Unit 1: Algorithmic complexity****Unit 1.1** Definition. Temporal complexity

Unit 1.2 Asymptotic complexity orders

Unit 1.3 Basic calculations

Unit 1.4 Real examples and Recursive Equations: Characteristic Equation. Non-homogeneous equations. Variable changes. Domain changes.

Unit 2: Greedy Algorithms

Unit 2.1 Overall technique

Unit 2.2 Basic features

Unit 2.3 Examples: Coins, the knapsack problem, scheduling, minimum spanning tree, single-course shortest paths problem

Unit 3: Dynamic Programming

Unit 3.1 Overall technique

Unit 3.2 Basic features

Unit 3.3 Examples: Coins, the knapsack problem, banks, optimal binary search trees, all-pairs shortest path problem, optimal binary search trees, disk space, ...

Unit 4: Backtracking

Unit 4.1 Overall technique

Unit 4.2 Basic features

Unit 4.3 Examples: Generation of combinatorial objects, chess, graph colorings, cliques, Hamiltonian cycles, Sudoku, ...

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	R	Description
Progress test [ON-SITE]	Assessment tests	BA3 CO6 CO7 INS1 INS4 SIS1	0.2	5	Y	N	Y	[EVA] Tests of theory (individual)
Final test [ON-SITE]	Assessment tests	BA3 CO6 CO7 INS1 INS4 SIS1	0.12	3	Y	N	N	[EVA] Extraordinary assessment test.
Class Attendance (theory) [ON- SITE]	Lectures	BA3 CO6 CO7 SIS1	1	25	N	-	-	[MAG] Strategies for analyzing the resolution of the problem and the theoretical basis necessary for its resolution are provided
In-class Debates and forums [ON- SITE]	Project/Problem Based Learning (PBL)	BA3 INS1 SIS1	0.4	10	N	-	-	[PRO] The correction and/or suitability of the proposed solutions is analyzed in class (in groups)
Class Attendance (practical) [ON- SITE]	Project/Problem Based Learning (PBL)	BA3 CO6 CO7 SIS1	0.8	20	N	-	-	[LAB] The problems of the subject are solved on paper and the solutions are verified through their implementation/correction in the laboratory (in groups)
Writing of reports or projects [OFF- SITE]	Project/Problem Based Learning (PBL)	BA3 INS1 INS4	0.8	20	N	-	-	[RES] Theoretically unsolvable problems arise with the competences that are supposed to the student and their resolution is entrusted to them (in a group)
On-line debates and forums [OFF- SITE]	Group tutoring sessions	BA3 INS1 SIS1	0.4	10	N	-	-	[TUT] Forum where the correctness and suitability of the proposed solutions is discussed, both from a theoretical point of view and its implementation in the laboratory (individual)
Writing of reports or projects [OFF- SITE]	Combination of methods	BA3 CO6 CO7 INS1 INS4 SIS1	0.8	20	Y	N	N	[RES] Practical works are elaborated on the methodologies described in the chapters 2, 3 and 4 (in group)
Study and Exam Preparation [OFF- SITE]	Combination of methods	BA3 CO6 CO7 INS1 INS4 SIS1	1.48	37	N	-	-	[EST] Preparation/study of theory and practical tests (individual)
Total:			6	150				
Total credits of in-class work: 2.52			Total class time hours: 63					
Total credits of out of class work: 3.48			Total hours of out of class work: 87					

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	
Test	70.00%	0.00%	[ESC] There will be 2 controls (progress tests) of theory throughout the course. An extraordinary exam will be scheduled for those students who have not passed the theory in the progress tests.
Assessment of active participation	30.00%	0.00%	[LAB 10%] + [INF 10%] + [PRES 10%]: Various aspects related to participation and use in the theoretical and practical classes are evaluated: performance and defense of the internship work, deliverables during the course, class participation, ...

Total:	100.00%	0.00%	
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Evaluation criteria for the final exam:

Continuous assessment, without final term exam. In order to pass the subject it is necessary to pass the theoretical exam (or having a global mark of 50% in the progress tests) in addition to have passed according to the assesment criteria described above. The student who does not pass the theoretical exam will have a grade not higher than 4.00 even if the overall mark obtained is another, including more than 5.00.

Specifications for the resit/retake exam:

In order to pass the subject it is necessary to pass the theoretical exam in addition to have passed according to the assesment criteria. The student who does not pass the theoretical exam will have a grade not higher than 4.00 even if the overall mark obtained is another, including more than 5.00.

Specifications for the second resit / retake exam:

Written test: 70% and Practice: 30%. The same conditions apply as in the extraordinary exam sessions.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Progress test [PRESENCIAL][Assessment tests]	3
Final test [PRESENCIAL][Assessment tests]	37
Class Attendance (theory) [PRESENCIAL][Lectures]	3
On-line debates and forums [AUTÓNOMA][Group tutoring sessions]	20
Writing of reports or projects [AUTÓNOMA][Combination of methods]	10
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	20
General comments about the planning: This course schedule is APPROXIMATE. It could vary throughout the academic course due to teaching needs, bank holidays, etc. A weekly schedule will be properly detailed and updated on the online platform (Campus Virtual). Note that all the lectures, practice sessions, exams and related activities performed in the bilingual groups will be entirely taught in English. This tentative scheduling could be modified due to unexpected issues. The subject is taught in three weekly sessions of 1.5 hours. The activities of evaluation or recovery of classes can be planned, exceptionally, in the afternoon.	
Unit 1 (de 4): Algorithmic complexity	
Activities	Hours
Progress test [PRESENCIAL][Assessment tests]	2
Class Attendance (theory) [PRESENCIAL][Lectures]	10
In-class Debates and forums [PRESENCIAL][Project/Problem Based Learning (PBL)]	4
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	5
Unit 2 (de 4): Greedy Algorithms	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5
In-class Debates and forums [PRESENCIAL][Project/Problem Based Learning (PBL)]	3
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	5
Unit 3 (de 4): Dynamic Programming	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5
In-class Debates and forums [PRESENCIAL][Project/Problem Based Learning (PBL)]	3
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	5
Unit 4 (de 4): Backtracking	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5
In-class Debates and forums [PRESENCIAL][Project/Problem Based Learning (PBL)]	3
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	5
Global activity	
Activities	hours
Progress test [PRESENCIAL][Assessment tests]	5
Class Attendance (theory) [PRESENCIAL][Lectures]	28
In-class Debates and forums [PRESENCIAL][Project/Problem Based Learning (PBL)]	13
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	20
On-line debates and forums [AUTÓNOMA][Group tutoring sessions]	20
Writing of reports or projects [AUTÓNOMA][Combination of methods]	10
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	20
Final test [PRESENCIAL][Assessment tests]	37
Total horas: 153	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Aho, Alfred V.	The design and analysis of computer algorithms	Addison-Wesley		0-201-00029-6	1974	
Brassard, Gilles	Fundamentos de algoritmia	Prentice-Hall		978-84-89660-00-7	2006	
Guerequeta García, Rosa	Técnicas de diseño de algoritmos	Servicio de Publicaciones e Intercambio Científ		84-7496-784-8	2000	
Horowitz, Ellis	Fundamentals of computer algorithms	Computer Science Press		0-914894-22-6	1978	

Kernighan, Brian W.	La práctica de la programación	Pearson Educación	968-444-418-4	2000
Parberry, Ian	Problems on algorithms	Pearson Hall	0-13-433558-9	1995
Sedgewick, Robert (1946-)	An introduction to the analysis of algorithms	Addison-Wesley	978-0-321-90575-8	2013