ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

105000439 - The Art Of Programming

DEGREE PROGRAMME

10II - Grado En Ingenieria Informatica

ACADEMIC YEAR & SEMESTER

2021/22 - Semester 1

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1. Description

1.1. Subject details

Name of the subject	105000439 - The Art Of Programming
No of credits	6 ECTS
Type	Optional
Academic year ot the programme	Third year
Semester of tuition	Semester 5
Tuition period	September-January
Tuition languages	English
Degree programme	10II - Grado en Ingenieria Informatica
Centre	10 - Escuela Tecnica Superior De Ingenieros Informaticos
Academic year	2021-22

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Lars-ake Fredlund	D2309	larsake.fredlund@upm.es	M - 10:00 - 13:00 Th - 10:00 - 13:00
Julio Mariño Carballo	D2308	julio.marino@upm.es	Tu - 15:00 - 17:00 W - 10:00 - 12:00 W - 15:00 - 17:00
Angel Herranz Nieva	D2309	angel.herranz@upm.es	W - 16:00 - 19:00 F - 09:00 - 12:00

Clara Benac Earle (Subject coordinator)	D2302	clara.benac@upm.es	W - 10:00 - 12:00 F - 10:00 - 14:00
Santiago Tapia Fernandez	D2307	santiago.tapia@upm.es	Tu - 10:00 - 13:00 W - 10:00 - 13:00

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

- Algoritmos Y Estructura De Datos

3.2. Other recommended learning outcomes

The subject - other recommended learning outcomes, are not defined.

4. Skills and learning outcomes *

4.1. Skills to be learned

CG-1/21 - Capacidad de resolución de problemas aplicando conocimientos de matemáticas, ciencias e ingeniería.

CG-19 - Capacidad de usar las tecnologías de la información y la comunicación.

CG-2/CE45 - Capacidad para el aprendizaje autónomo y la actualización de conocimientos, y reconocimiento de su necesidad en el área de la informática.

CG-24/25/26/27 - Capacidad para trabajar en el contexto internacional, comunicándose en lengua inglesa y adaptándose a un nuevo entorno.

Ce 19/20 - Conocimiento de los tipos apropiados de soluciones, y comprensión de la complejidad de los problemas informáticos y la viabilidad de su solución.

4.2. Learning outcomes

RA278 - Desarrollar la solución matemática y algorítmica mas apropiada a un problema informático que requiera un tratamiento especialmente complejo, analizando y exponiendo su viabilidad.

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The goal of this subject is to discuss several well known algorithms for solving efficiently complex problems. In particular, the following techniques will be studied: combinatorial searching, backtracking, heuristic searching, divide-and-conquer, greedy algorithms, dynamic programming, approximation algorithms and randomized/probabilistic algorithms. The teaching methodology consists of theoretical lectures followed by practical sessions where a number of exercises will be proposed for the students to work on.

5.2. Syllabus

1. Course introduction
2. AED Review: Complexity and Data Structures
3. NP-completeness
4. Combinatorial searching. Backtracking
5. Heuristic searching
6. Divide-and-conquer
7. Greedy algorithms
8. Dynamic Programming
9. Approximation Algorithms
10. Randomized/probabilistic algorithms

6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	**Tema 1** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 1** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	
2	**Tema 2** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 2** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	
3	**Tema 3** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 3** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	
4	**Tema 4** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 4** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	**Weekly Exercises** Individual work Continuous assessment Not Presential Duration: 12:00
5	**Tema 5** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 5** Duration: 02:00 Lecture **Tema 5** Duration: 02:00 Lecture	
6	**Tema 6** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 6** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	**Weekly Exercises** Individual work Continuous assessment Not Presential Duration: 12:00

7	**Tema 7** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 7** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	
8	**Tema 8** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 8** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	**Weekly Exercises** Individual work Continuous assessment Not Presential Duration: 12:00
9	**Tema 9** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 9** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	
10	**Tema 10** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class		**Tema 10** Duration: 02:00 Lecture **Exercises** Duration: 02:00 Problem-solving class	**Weekly Exercises** Individual work Continuous assessment Not Presential Duration: 12:00
11	**Resolución de problemas** Duration: 02:00 Problem-solving class **Exercises** Duration: 02:00 Problem-solving class		**Resolución de problemas** Duration: 02:00 Problem-solving class **Exercises** Duration: 02:00 Problem-solving class	
12	**Resolución de problemas** Duration: 02:00 Problem-solving class **Exercises** Duration: 02:00 Problem-solving class		**Resolución de problemas** Duration: 02:00 Problem-solving class **Exercises** Duration: 02:00 Problem-solving class	**Weekly Exercises** Individual work Continuous assessment Not Presential Duration: 12:00
13	**Resolución de problemas** Duration: 02:00 Problem-solving class **Exercises** Duration: 02:00 Problem-solving class		**Resolución de problemas** Duration: 02:00 Problem-solving class **Exercises** Duration: 02:00 Problem-solving class	
14	**Resolución de problemas** Duration: 02:00 Problem-solving class **Exercises** Duration: 02:00 Problem-solving class		**Resolución de problemas** Duration: 02:00 Problem-solving class **Exercises** Duration: 02:00 Problem-solving class	

15	**Resolución de problemas** Duration: 02:00 Problem-solving class		**Resolución de problemas** Duration: 02:00 Problem-solving class	
16				
17				**Examen** Online test Final examination Presential Duration: 02:00 **Examen** Online test Continuous assessment Presential Duration: 02:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
4	Weekly Exercises	Individual work	No Presential	12:00	8%	/ 10	CG-1/21 CG-2/CE45 CG-19 CG-24/25/26/27 Ce 19/20
6	Weekly Exercises	Individual work	No Presential	12:00	8%	/ 10	CG-1/21 CG-2/CE45 CG-19 CG-24/25/26/27 Ce 19/20
8	Weekly Exercises	Individual work	No Presential	12:00	8%	/ 10	CG-1/21 CG-2/CE45 CG-19 CG-24/25/26/27 Ce 19/20
10	Weekly Exercises	Individual work	No Presential	12:00	8%	/ 10	CG-1/21 CG-2/CE45 CG-19 CG-24/25/26/27 Ce 19/20
12	Weekly Exercises	Individual work	No Presential	12:00	8%	/ 10	CG-1/21 CG-2/CE45 CG-19 CG-24/25/26/27 Ce 19/20
17	Examen	Online test	Face-to-face	02:00	60%	4 / 10	CG-1/21 CG-2/CE45 CG-19 CG-24/25/26/27 Ce 19/20

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Examen	Online test	Face-to-face	02:00	100%	5 / 10	CG-1/21 CG-19 Ce 19/20 CG-2/CE45 CG-24/25/26/27

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Examen	Online test	Face-to-face	00:00	100%	5 / 10	CG-1/21 CG-19 Ce 19/20 CG-2/CE45 CG-24/25/26/27

7.2. Assessment criteria

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
The Algorithm Design Manual	Bibliography	Steven S. Skiena. The Algorithm Design Manual. Springer, London, 2008.
Programming Challenges: The Programming Contest Training Manual	Bibliography	Steven S. Skiena and Miguel Revilla. Programming Challenges: The Programming Contest Training Manual. Springer-Verlag, Berlin, Heidelberg, 2003.

The Art of Computer Programming, Volume 3: (2nd Ed.) Sorting and Searching.	Bibliography	Donald E. Knuth. The Art of Computer Programming, Volume 3: (2nd Ed.) Sorting and Searching. Addison Wesley Longman Publishing Co., Inc., USA, 1998.
The Art of Computer Programming: Combinatorial Algorithms, Part 1.	Bibliography	Donald E. Knuth. The Art of Computer Programming: Combinatorial Algorithms, Part 1. Addison-Wesley Professional, 2011.
Guide to Competitive Programming: Learning and Improving Algorithms Through Contests.	Bibliography	Antti Laaksonen. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests. SDpringer Verlag, 2017.

9. Other information

9.1. Other information about the subject

La situación sanitaria causada por la pandemia COVID-19 obliga a restringir el aforo de las aulas y por ello se ha decidido que la docencia de este semestre sea de presencialidad mixta. Se establecerán turnos de presencialidad dentro de los grupos, de forma que cada semana un turno asistirá a clase en el aula (columna "actividad en el aula" del cronograma), mientras el resto de los turnos se conectarán a la clase en remoto (columna "tele-enseñanza). Y cada semana será un turno diferente el que acuda al aula.

Si mejoraran las condiciones sanitarias y se pudieran impartir clases presenciales con normalidad, todos los alumnos acudirán a las aulas a recibir las clases indicadas en la columna "actividad en el aula".

Si, por el contrario, empeoraran las condiciones sanitarias, todos los alumnos pasarían a conectarse a las clases en remoto de la columna "tele-enseñanza". En esta situación las pruebas de evaluación continua presenciales previstas se realizarían de forma online, sin necesidad de modificar esta guía.

La asignatura se relaciona con el ODS4.