UNIVERSIDAD DE CASTILLA - LA MANCHA
GUÍA DOCENTE

Course: DATA STRUCTURES
Type: CORE COURSE
Degree: 347 - DEGREE PROGRAMME IN COMPUTER SCIENCE ENGINEERING (CR)
Center: 108 - SCHOOL OF COMPUTER SCIENCE OF C. REAL
Year: 2

Main language: English
Use of additional languages: Use of English as main language for the bilingual group and Spanish for the rest of courses
Web site: https://campusvirtual.uclm.es

Code: 42312
ECTS credits: 6
Academic year: 2021-22

Group(s): 20 21 22 23
Duration: First semester
Second language: Spanish
English Friendly: N

Bilingual: Y

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2. Pre-Requisites

Basic knowledge of maths: Logic, Functions theory, Algebraic structure, a minimum of abstraction capability and mathematical expression. It is enough to have passed the subjects of "**Algebra**" and "**Cálculo**".

Basic knowledge of Java programming language, fundamentals of information systems and development environments. It is enough to have passed the subjects **Programming Funtamentals** (I & II) and **Sistemas de Información**.

It is recommended the student is studying: **Lógica** (1st semester) and **Programming methodology** (2nd semester).

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

Data structures belongs to the subject of Programming, and is part of the **Común a la Rama de Informática** module from **Grado en Ingeniería Informática**

This subject could be seen as a continuation of **Programming Fundamentals II**, studying new data structures from new viewpoints, in addition to its use, formal definition and implementation; with the advantage of adding the implemented data structures as external libraries.

Furthermore, **Programming methodology** could be seen as a continuation of this subject, in which each algorithmic scheme might have an immediate application on new data structures (ordering of lineal structures, greedy explorations or tree dynamics, optimal routes in graphs, etc.). Also, in the subject **Programación declarativa** (intensificación de **Computación**), apart from being required certain acquired knowledge (lists, recursive techniques, etc.), it will be deepend in the definition of all previously learned data structures taking into account important features related to efficiency and optimization (inheritance, higher order, infinite structures, ...).

Finally, during all these studies and also in the professional life, software apps should be implemented making use of complex data structures. Programming language provide aproppriate structures (lists, queues, etc.). The detailed analysis of these data structures is important to understand their working. In other cases, languages do not provide them (e.g. trees and graphs), and we need to add them. On the other hand, the use of data structures from a design and analysis viewpoint provide us a proper abstraction level and will boost our programming skills (recursion, modularization, etc.), which are needed in software development.

4. Degree competences achieved in this course

Course competences

Code	Description
BA04	Basic knowledge about the uses and programming of computers, operating systems, data bases, and digital programmes with applications in engineering.
CO06	Knowledge and application of basic algorithms in digital technologies for the development of solutions, analysing their appropriateness and complexity.
CO07	Knowledge, design, and efficient use of types of data and structures which arise as most appropriate in problem solving.
CO08	Ability to analyse, design, build and maintain applications in a strong, safe, and efficient manner by selecting the most appropriate paradigms and programming languages.
INS01	Analysis, synthesis, and assessment skills.
INS04	Problem solving skills by the application of engineering techniques.
PER01	Team work abilities.
PER02	Ability to work in multidisciplinary teams.
PER04	Interpersonal relationship skills.
PER05	Acknowledgement of human diversity, equal rights, and cultural variety.
SIS01	Critical thinking.
SIS03	Autonomous learning.
UCLM02	Ability to use Information and Communication Technologies.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Ability to manage types of data, data structures, and abstract tupes of data in an appropriate manner regarding their problems, as well as their formal specifications, implementations, and use of abstract types of lineal and non-lineal data

6. Units / Contents

Unit 1: General concepts

Unit 2: Stacks

Unit 3: Queues

Unit 4: Lists

Unit 5: Graphs

Unit 6: Trees

ADDITIONAL COMMENTS, REMARKS

In laboratory sessions, practical exercises with linear and non-linear data structures will be done.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	BA04 CO06 CO07 CO08	0.72	18	N	-	Teaching of the subject matter by lecturer (MAG)
Individual tutoring sessions [ON-SITE]		BA04 CO06 CO07 CO08 UCLM02	0.18	4.5	N	-	Individual or small group tutoring in lecturer¿s office, classroom or laboratory (TUT)
Study and Exam Preparation [OFF-SITE]	Self-study	BA04 CO06 CO07 CO08 SIS01 SIS03	2.1	52.5	N	-	Self-study (EST)
Other off-site activity [OFF-SITE]	Practical or hands-on activities	BA04 CO06 CO07 CO08 INS01 INS04 PER01 PER02 PER04 PER05 SIS03	0.6	15	N	-	Lab practical preparation (PLAB)
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	BA04 CO06 CO07 CO08 PER01 PER02 PER04 PER05 SIS01 SIS03 UCLM02	0.6	15	Y	N	Worked example problems and cases resolution by the lecturer and the students (PRO)
Writing of reports or projects [OFF-SITE]	Self-study	BA04 CO06 CO07 CO08 INS01 INS04 PER01 PER02 PER04 PER05 SIS03	0.9	22.5	Y	N	Preparation of essays on topics proposed by lecturer (RES)
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	BA04 CO06 CO07 CO08 INS04 PER01 PER02 PER04 PER05	0.6	15	Y	Y	Realization of practicals in laboratory /computing room (LAB)
Final test [ON-SITE]	Assessment tests	BA04 CO06 CO07 CO08 INS01 INS04	0.3	7.5	Y	Y	Final test of the complete syllabus of the subject (EVA)

	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 (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Final test	50.00%	50.00%	Compulsory activity that can be retaken (rescheduling) to be carried out within the planned exam dates of the final exam call (convocatoria ordinaria)
Theoretical papers assessment	15.00%	15.00%	Non-compulsory activity that can be retaken. To be carried out before end of teaching period
Assessment of active participation	10.00%	10.00%	Non-compulsory activity that can be retaken. To be carried out during the theory/lab sessions for students in the continuous assessment modality. The students of non-continuous modality will be evaluated of this activity through an alternative system in the final exam call (convocatoria ordinaria)
Laboratory sessions	25.00%	25.00%	Compulsory activity that can be retaken. To be carried out during lab sessions
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

In compulsory activities, a minimum mark of 40% is required in order to pass that activity and have the possibility to therefore pass the entire subject. The evaluation of the activities will be global and therefore must be quantified by means of a single mark. In the case of the activities that may be retaken (i.e., rescheduling), an alternative activity or test will be offered in the resit/retake exam call (convocatoria extraordinaria).

The final exam will be common for all the theory/laboratory groups of the subject and will be evaluated by the lecturers of the subject in a serial way, i.e., each part of the final exam will be evaluated by the same lecturer for all the students.

A student is considered to pass the subject if she/he obtains a minimum of 50 points out of 100, taking into account the points obtained in all the evaluable activities, and also has passed all the compulsory activities.
For students who do not pass the subject in the final exam call (convocatoria ordinaria), the marks of activities already passed will be conserved for the resit/retake examcall (convocatoria extraordinaria). If an activity is not recoverable, its assessment will be preserved for the resit/retake exam call (convocatoria extraordinaria) even if it has not been passed. In the case of the passed recoverable activities, the student will have the opportunity to receive an alternative evaluation of those activities in the resit/retake exam call and, in that case, the final grade of the activity will correspond to the latter grade obtained.

The mark of the passed activities in any call, except for the final exam, will be conserved for the subsequent academic year at the request of the student, provided that mark is equal or greater than 50% and that the activities and evaluation criteria of the subject remain unchanged prior to the beginning of that academic year.

The failure of a student to attend the final exam will automatically result in her/him receiving a "Failure to attend" (no presentado). If the student has not passed any compulsory evaluation activity, the maximum final grade will be 40%.

Non-continuous evaluation:

Students may apply at the beginning of the semester for the non-continuous assessment mode. In the same way, the student may change to the non-continuous evaluation mode as long as she/he has not participated during the teaching period in evaluable activities that together account for at least 50% of the total mark of the subject. If a student has reached this 50% of the total obtainable mark or the teaching period is over, she/he will be considered in continuous assessment without the possibility of changing to non-continuous evaluation mode.

Students who take the non-continuous evaluation mode will be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences), through the assessment systems indicated in the column "Non-continuous evaluation".

In the "non-continuous evaluation" mode, it is not compulsory to keep the mark obtained by the student in the activities or tests (progress test or partial test) taken in the continuous assessment mode.

Specifications for the resit/retake exam:
Evaluation tests will be conducted for all recoverable activities
Specifications for the second resit / retake exam:
Same characteristics as the resit/retake exam call

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Individual tutoring sessions [PRESENCIAL][]	4.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	52.5
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	15
Writing of reports or projects [AUTÓNOMA][Self-study]	22.5

Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]		15
Final test [PRESENCIAL][Assessment tests]		7.5

General comments about the planning: The subject is taught in 3 x 1,5 hour sessions per week

Unit 1 (de 6): General concepts

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1.5

Unit 2 (de 6): Stacks

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3.5

Unit 3 (de 6): Queues

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1.5

Unit 4 (de 6): Lists

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2.5

Unit 5 (de 6): Graphs

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2.5

Unit 6 (de 6): Trees

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3.5

Global activity

Activities	hours
Writing of reports or projects [AUTÓNOMA][Self-study]	22.5
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	15
Class Attendance (theory) [PRESENCIAL][Lectures]	18
Individual tutoring sessions [PRESENCIAL][]	4.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	52.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	15
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Final test [PRESENCIAL][Assessment tests]	7.5
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	City	ISBN	Year	Description
Martí Oliet, N., Ortega Mallén Y., Verdejo López J.A.	Estructuras de datos y métodos algoritmicos: ejercicios resueltos	Prentice Hall		978-84-205-3849-5	2004	
R. Sedgewick, K. Wayne	Algorithms, 4th Edition http://algs4.cs.princeton.edu/home/	Addison Wesley	New Jersey, USA	978-0321573513	2011	
Weiss, M.A.	Data Structures and Problem Solving Using Java (Fourth Edition) http://users.cs.fiu.edu/~weiss/	Addison-Wesley		0-321-54140-5	2010	
Weiss, M.A.	Data structures & algorithm analysis in Java (Third Edition) http://users.cs.fiu.edu/~weiss/#dsaajava3	Addison-Wesley		0-132-57627-9	2012	
Weiss, M.A.	Estructura de datos en Java (4ª edición)	Pearson		9788415552239	2014	
	Lenguaje de Programación JAVA http://www.java.com/es					
Goodrich, M.T., Tamassia R. , Goldwasser M.H.	Data structures and algorithms in Java http://bcs.wiley.com/he-bcs/Books?action=index&itemId=1118808576&bcsId=8950	Wiley		978-1-118-80836-8	2014	