

Academic Year: (2020 / 2021)

Review date: 04-01-2021

Department assigned to the subject: Computer Science and Engineering Department

Coordinating teacher: SEGURA BEDMAR, ISABEL

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester : 2

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Programming
- Calculus

OBJECTIVES

CB1.Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study

CB2.Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study

CB3.Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues

CB4.Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences

CB5.Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy

CG1 - Students are able to demonstrate knowledge and understanding of concepts in mathematics, statistics and computation and to apply them to solve problems in science and engineering with an ability for analysis and synthesis.

CG3 - Students can solve computationally with the help of the most advanced computing tools mathematical models coming from applications in science, engineering, economy and other social sciences.

CG4 - Students are able to show that they can analyze and interpret, with help of computer science, the solutions obtained from problems associated to real world mathematical models, discriminating the most relevant behaviors for each application.

CG6 - Students can search and use bibliographic resources, in physical or digital support, as they are needed to state and solve mathematically and computationally applied problems arising in new or unknown environments or with insufficient information.

CE10 - Students have shown that they know and understand the algorithmic procedures to design and build programs that solve mathematical problems paying special attention to performance.

CE12 -Students have shown that they know the main data structures, being able to use, design, and implement them determining its computational and storage complexity.

CE17 - Students know how to apply software verification techniques to determine if a software component fulfills its specifications, and that they are able to detect faults in those components.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to Abstract Data Type
2. Linear Abstract Data Types
 - b. Stacks
 - c. Queues.
 - d. Singly and doubly linked lists

3. Analysis of Algorithms.
 - a. Empirical Analysis.
 - b. Theoretical Analysis. Big-O functions. Best and worst cases.
4. Recursion I.
5. Trees
 - a. General concepts
 - b. Binary Trees
 - c. Tree Traversals
 - d. Search Binary Trees.
 - e. How to balance a tree.
6. Graphs
 - a. Implementations
 - d. Graph trasversals.
 - e. Dijkstra's algorithm (shortest path)
7. Recursion II: Divide and Conquer

LEARNING ACTIVITIES AND METHODOLOGY

1. Theory Lectures with the objective of acquire the cognitive specific competences.
 2. Academic activities guided by the teacher:
 - 2.1. With the teacher: to solve exercises devoted to analyze, design and implement cases with different level of complexity in collaboration with students. Some of the exercises will be carried out in computer laboratories.
 - 2.2. Student work: Homework, individually or cooperatively, with exercises, implementation cases and basic readings from bibliography proposed by the teacher.
- Moreover, these activities can be performed as:
- a. Individual work consisting on developing solutions to the problems and exercises posed by the teacher.
 - b. Working cooperatively developing solutions to the problems proposed by the teacher.
3. Mid-term partial exams and final exam.
 4. There will be a group tutorship for each small group to solve the queries and doubts of students.

ASSESSMENT SYSTEM

In addition to serve as formative activity, the exercises and examinations serve to be used as evaluation measure. Students should also try to solve a practical case study using the concepts learned during the course. The evaluation includes the assessment of the guided academic activities and practical work according to the following weighting:

Se seguirá un sistema de evaluación continua que incluye las siguientes pruebas:

FIRST MID-TERM EXAM (15%) (Po a, e, k)

- Lessons: 1,2,3 and 4.
- Type: face to face (small group)
- Value: 15% (15 points over 100).
- Week: 6 (8-12 Marzo)

SECOND MID-TERM EXAM (15%) (Po a, e, k)

- Lessons: 3, 4 and 5.
- Type: face to face (small group)
- Week: 12 (26-30 April)
- Value: 15% (15 points over 100).

LAB CASE (30%) (Po a, e, d, k).

- Type: lab case. It is individual work. It should be delivered via AulaGlobal.
- Three phrases:
 - Phase 1: Linear Data Structures. (10 points). Deadline and Oral Exam: week 10 in seminar face-to-fase session (2 teachers).
 - Phase 2: Trees. (10 points). Deadline and Oral Exam: week 14 (10-14 May) in seminar face-to-fase session (2 teachers).

Phase 3: Graphs. (10 points). Deadline and Oral Exam: week 14 (10-14 May) in seminar face-to-face session (2 teachers).

The lab case will be evaluated using unittests and the answers provided for each student in the oral exams for each phase. The oral exams are mandatory for all students. In these exams, the professor can ask questions about the solution. The student should be able to explain and discuss any detail of their solution. If the student does not attend to the oral exam, he/she will be evaluated as not presented.

FINAL EXAM (ORDINARY CALL). 40%. (Po a, e, d, k).

- Lessons: 1-7.
- Mandatory
- Type: exams with problems about data structures and their algorithms. It also contains questions about recursion and analysis of algorithms.
- Value: 40 points.
- Minimum mark: 16 points. The student should obtain at least 16 points in this exam in order to take into account the other marks of the continuous evaluation tests.

If the final exam takes place in person (it depends on covid-19), the solutions should be clear, clean and fully legible and understable. Those solutions that do not meet these criteria will not be evaluated.

The final mark for the course is obtained by summing all marks of the evaluation continuous system. To pass the course, it is necessary to obtain at least 50 points (over 100).

If a student decides not to follow the continuous assessment, he / she will be entitled to take a final exam (same date and place as the ordinary exam). The grade obtained in this exam is equivalent to 60% of the final grade.

Si el estudiante decide no seguir el sistema de evaluación continua, tendrá derecho a realizar un examen final (misma fecha y lugar que el examen ordinario). La nota final del estudiante será el 60% de la nota obtenida en dicho examen final.

In the extraordinary call, the final exam will be 100% of the grade. The continuous evaluation may be applied if it is more beneficial for the student (partial tests and 40% of the final exam grade).

A solution (for example, the implementations of data structures and their algorithms) will be considered correct only if it meets the following criteria:

- It satisfies the specifications described in the problem statement.
- Its implementation is correct. That is, in addition to not containing syntax errors, for each possible input it receives, it produces the correct output. The objective of unittests is that students can easily verify the correctness of their algorithms.
- The solution must be as efficient as possible, both in terms of temporal and spatial complexity.
- In the case of face-to-face exams that will be written by hand, they must be clean, legible and easy to understand. A solution that does not meet these criteria will not be evaluated.

% end-of-term-examination:	40
% of continuous assessment (assignments, laboratory, practicals...):	60

BASIC BIBLIOGRAPHY

- Karumanchi, N Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles. , CareerMonk Publications, 2015
- Michael T. Goodrich and Roberto Tamassia Data Structures and Algorithms in Python, , John Wiley & Sons, 2013

ADDITIONAL BIBLIOGRAPHY

- Isabel Segura Bedmar, Harith AlJumaily, Julian Moreno Schneider, Juan Perea & Nathan D. Ryan Algorithms and Data Structures, OCW-UC3M: <http://ocw.uc3m.es/ingenieria-informatica/algorithms-and-data-structures>, 2011

BASIC ELECTRONIC RESOURCES

- Isabel Segura Bedmar, Harith AlJumaily, Julian Moreno Schneider, Juan Perea & Nathan D. Ryan . ALGORITHMS AND DATA STRUCTURES: <http://ocw.uc3m.es/ingenieria-informatica/algorithms-and-data-structures>