Data structures and algorithms

Academic Year: (2023 / 2024) **Review date: 09-02-2024**

Department assigned to the subject: Computer Science and Engineering Department

Coordinating teacher: ABDULLA JASSIM, HARITH AL JUMAILY

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 (Course: 1 / Semester: 1)
- Calculus (Course: 1 / Semester: 1)

SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary 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 behaviours 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.
CE14. Students have shown that they know the theory of grammars, languages and automatas and they can apply it to programming languages and domain specific languages analyzers as well as that they understand the translation process for high-level languages and most common optimizations.
CE21. Students have shown that they understand the influence and usefulness of the mathematical foundations used in functional programming languages and the impact of the practical applications of those languages.

RA3. Students must have the capacity to gather and interpret data and information on which they base their conclusions, including where relevant and necessary, reflections on matters of a social, scientific, and ethical nature in their field of study.
RA5. Students must know how to communication with all types of audiences (specialized or not) their knowledge, methodology, ideas, problems and solutions in the area of their field of study in a clear and precise way.
RA6. Students must be capable of identifying their own education and training needs in their field of study and the work or professional environment and organize their own learning with a high degree of autonomy in all types of contexts (structured or not).

DESCRIPTION OF CONTENTS: PROGRAMME

1. Abstract Data Type
2. Linear Abstract Data Types: stacks, queues, linked lists.
3. Complexity of Algorithms.
4. Recursive Algorithms.
5. Trees
6. Graphs.
7. Divide and Conquer.

LEARNING ACTIVITIES AND METHODOLOGY

THEORETICAL-PRACTICAL CLASSES. [44 hours with 100% classroom instruction, 1.67 ECTS]
Knowledge and concepts students must acquire. Student receive course notes and will have basic reference texts to facilitate following the classes and carrying out follow up work. Students partake in exercises to resolve practical problems and participate in workshops and evaluation tests, all geared towards acquiring the necessary capabilities.

TUTORING SESSIONS. [4 hours of tutoring with 100% on-site attendance, 0.15 ECTS]
Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.

STUDENT INDIVIDUAL WORK OR GROUP WORK [98 hours with 0 % on-site, 3.72 ECTS]

WORKSHOPS AND LABORATORY SESSIONS [8 hours with 100% on site, 0.3 ECTS]

FINAL EXAM. [4 hours with 100% on site, 0.15 ECTS]
Global assessment of knowledge, skills and capacities acquired throughout the course.

METHODOLOGIES

THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject's main concepts are developed, while providing material and bibliography to complement student learning.

PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group.

TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with a teacher as tutor.

LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

EVALUATION SYSTEMS

SE1 - FINAL EXAM. [50 %]
Global assessment of knowledge, skills and capacities acquired throughout the course.

SE2 - CONTINUOUS EVALUATION. [50 %]
Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.

The evaluation includes the following tests:
Primer exercise of continuos assessment (topics 1, 2 y 3) (SE2): 15%.
Second exercise of continuos assessment (topics 3, 4 y 5) (SE2): 15%.
Lab Tests (SE2): Two Tests: Total 20%.
Final Exam (all the topics) (SE1): 50%. The maximum mark is 5 points. Minimum mark: 2 over 5.

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 (that is, he/she renounces the marks obtained in the continuous evaluation), 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 (that is, it is necessary to get 8.3 over 10 to pass the subject).

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 50% 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 should meet the specifications described in the problem statement.
- Its implementation should be robust and 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 should be as efficient as possible, both in terms of temporal and spatial complexity.
- The solution should be clear, clean and fully legible, and understandable. It should be easy to maintain. A solution that does not meet these criteria will not be evaluated. The implementation should follow the Zen of Python (https://peps.python.org/pep-0020/). The code should be refactored.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

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