VNIVERSITAT DE VALÈNCIA

Course Guide
36483 Algorithms and data structures

COURSE DATA

Data Subject	
Code	36483
Name	Algorithms and data structures
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1407 - Degree in Multimedia Engineering	School of Engineering	2	First term

Subject-matter

Degree	Subject-matter	Character
1407 - Degree in Multimedia Engineering	20 - Estructuras de Datos y Algoritmos	Obligatory

Coordination

Name	Department
ALBERT BLANCO, JESUS V.	240 - Computer Science

SUMMARY

The subject "Data Structures and Algorithms" is a compulsory subject of the second year of the Degree in Multimedia Engineering. This subject deepens in the knowledge and skills provided by the courses of the basic subject "Computer Science" ("34831 Informatics" and "34852 Programming"), taught in the first year. The subject provides a more grounded and advanced view of programming, improving the student's ability to analyze the cost of algorithms, in the development of more complex algorithms and expanding the catalog of data types seen in the first year, especially with non-linear data types.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is very convenient that students have taken and passed the courses 34831 Informatics and 34852 Programming, of the first year of the Degree in Multimedia Engineering.
The previous knowledge and skills required in this subject are the following:
- Algorithm analysis (better and worse cases).
- Object oriented programming in C ++.
- Programming with linear data structures (stacks, queues, lists).

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1407 - Degree in Multimedia Engineering

- G6 - Know the basic subject areas and technologies that serve as a basis to learn and develop new methods and technologies and those that provide versatility to adapt to new situations.
- I1- Know and be able to apply basic computer algorithmic procedures to design solutions to problems, by analysing the suitability and complexity of the proposed algorithms.
- I2 - Know, design and make an efficient use of the data types and data structures that are most suited to solving a problem.
- MM28 - Be able to solve problems with initiative, decision-making and creativity and to communicate and transmit the knowledge, abilities and skills of a multimedia engineer.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

At the end of the course, the student will have acquired sufficient knowledge and skills to:

- Understand and be able to define function specifications by using preconditions and postconditions.

- Identify the temporal and spatial complexity of simple programs: calculate the temporal cost of an algorithm in different situations and express it using asymptotic notation.

- Analyze recursive programs.

- Understand the advantages and limitations of different alternative data structures and be able to select the best option in a particular case: select areas of application of trees, tables and graphs.

DESCRIPTION OF CONTENTS

1. Algorithm specification

1.1 Introduction.
1.2 States, asserts.
1.3 Pre/Post specification (Hoare triplet).
1.4 ADT specification (Abstract Data Type).

2. Algorithm efficiency

2.1 Complexity measure
2.2 Cases analysis: better, worse and average cases.
2.3 Asymptotic notation: O, o and omega notation.

3. Recursive algorithm design

3.1 Recursive design.
3.2 Mathematical Induction and recursion.
3.3 Temporal complexity. Recurrence resolution. Characteristic equation.
3.4 "Divide and conquer" paradigm. Quick sort algorithms review.

4. Advanced data types I: Trees

4.1 Foundations.
4.2 Binary trees. Representation.
4.3 Binary trees traversal.
4.4 Special binary trees: search binary trees and heaps.
4.5. k-degree-Trees.

5. Advanced data types II: Tables (maps or dictionaries)

5.1 Foundations.
5.2 Representation.
5.3 Representation using C++/STL.
5.4 Applications.

6. Advanced data types III: Graphs

6.1 Foundations.
6.2 Representation.
6.3 Graph traversal.

7. Greedy algorithms

7.1 General outline.
7.2 Minimum spanning tree. Prim algorithm.
7.3 Minimum path problem. Dijkstra algorithm.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	10,00	0
Study and independent work	20,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	25,00	0
Preparation of practical classes and problem	20,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Theoretical classroom activities will develop themes of the subject by providing a global view and integrating, analysing the key aspects in detail and greater complexity, encouraging the participation of the student body at all times. These activities are complemented with practical activities in order to apply the basic concepts, extend them with the knowledge, and experience which will be acquired during the implementation of the proposed work. They include the following kinds of classroom activities:

-Classes of problems and issues in classroom.

-Session for discussion and resolution of problems and exercises previously worked for the students.

-Laboratory practice.

-Realization of individual questionnaires for evaluation in the classroom with the presence of the teacher.

In addition to classroom activities, students must perform personal tasks (out of the classroom) on: targeted bibliographic search, issues and problems, as well as the preparation of lessons and tests. These tasks will be carried out primarily on an individual basis, in order to promote self-employment, but in addition will include jobs that require the participation of small groups of students (2-4) for capacity-building for integration into working groups.

It will use the e-learning platform (Virtual Classroom) from the University of Valencia as a medium of communication with the students. Through it have access to the materials used in class, as well as problems and exercises to solve.

EVALUATION

The subject will be evaluated by:

SE1 - Objective test, consisting of one or several exams that consist of both theoretical-practical issues and problems.

SE2 - Evaluation of practical activities based on the preparation of papers/reports and/or oral presentations.

SE3 - Continuous evaluation of each student, based on the participation and degree of involvement of the student in the teaching-learning process, considering the regular attendance at the planned face-to-face activities and the resolution of issues and problems proposed periodically.

In each of these tests the following considerations will be considered:

1) SE1: Several individual tests will be carried out throughout the course, which will include theoretical-practical questions as well as problems (evaluation of competencies CB02, CB04, CG01, CG06, CT03, CT05, CE02, CE06). There will be two types of tests with the following weight:

SE1a (70%): Exam of the subject at the end of teaching.

SE1b (30%): Intermediate exams made during the teaching period.

2) SE2: Evaluation of the practical activities carried out both in the laboratories, and in written exercises (evaluation of competences CB02, CB04, CG01, CG06, CT03, CT05, CE02, CE06). These tests will be carried out in groups of 2 people and contemplate the following activities:

SE2a (70%): Evaluation of laboratory practices based on documentation (and deadlines) required in each of them.

SE2b (30%): Completion of practical written exercises in intermediate exams made during the teaching period.

SE3: Continuous evaluation of each student to measure their degree of participation and involvement in classroom activities. The following aspects will be considered (evaluation of competencies CB02, CB04, CG01, CT03): Resolution of exercises proposed during the teaching period; Public resolution of issues and problems discussed in class; Active participation in the proposed activities.

The final grade for the course will be calculated as the weighted average of sections SE1(60%) and SE2(40%). The SE3 criterion will be considered as an extra score over the previous grade, but only if it was greater than or equal to 4.5. In addition, the increase will be limited to a maximum of 10% of the grade obtained from SE1 and SE2.

Particular considerations on the evaluation:

1) Non-recoverable sections: The criteria that evaluate the follow-up of the subject during the school term are not recoverable later. These are: SE1b, SE2b and SE3. The SE2a criterion will be recoverable, only in the second call, through an individual practical examination carried out in the laboratory under conditions equivalent to those of a laboratory practice, but with a limited time and access to support materials.

2) Sections that require a minimum grade: It is required to obtain a minimum grade of 3 (out of 10) in each of the following evaluation sections to pass the subject: SE1a and SE2a.

3) Students who have completed all the periodical exams of the subject (SE1b, SE2b) and whose weighted average score in these controls (SE1b (70%), SE2b (30%)) will be exempted from the SE1a test (final exam). %)) is greater than or equal to 5. In addition, it will be necessary to have obtained a score greater than or equal to 3 in all controls (both individual and in pairs). In these cases, the weighted average grade of the periodic intermediate controls will be assigned as qualification in section SE1a.

REFERENCES

Basic

- F. Ferri, J. Albert, G. Martín, Introducció a lanàlisi i disseny dalgorismes, Universitat de Valencia, 1999.
- L.R. Nyhoff, TADs Estructuras de datos y resolución de problemas con C++, Prentice Hall, 2ª Ed., 2005.
- M.A. Weiss, Data Structures and Algorithm Analysis in C++, 4ª Ed., Pearson (Addison-Wesley), 2014 https://www.dawsonera.com/abstract/9780273775386

Additional

- R. Peña, Diseño de programas. Formalismo y abstracción, Prentice-Hall, 3ª Ed., 2005.