VNIVERSITAT DE VALÈNCIA

Course Guide
36413 Data structures and algorithms

COURSE DATA

Data Subject	
Code	36413
Name	Data structures and algorithms
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1406 - Degree in Data Science	School of Engineering	1	Second term

Subject-matter

Degree	Subject-matter	Character
1406 - Degree in Data Science	3 - Informatics	Basic Training

Coordination

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

SUMMARY

The subject 36413 Data Structures and Algorithms is a compulsory subject of the first year of the Degree in Data Science. This subject deepens the knowledge and skills provided by the subject 36411 Foundations of programming, taught in the first four months of the course. The subject provides a more informed and advanced view of programming, improving the student's ability to analyse the cost of algorithms, the development of more complex algorithms and expanding the catalogue of types of data that can be used in different areas of application.

Theory lessons will be taught in Spanish and practical and laboratory lessons as according to the information sheet available on the web page of the degree.

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 completed the subject 36411 Fundamentals of programming. The previous knowledge and skills required in this subject are the following:
- To analyse simple problems, designing algorithms that allow their resolution through a computer.
- To know and know how to apply the fundamental elements of the Python programming language to develop programs: control structures (sequence, condition, iteration), data types, objects and basic data structures.

OUTCOMES

1406 - Degree in Data Science

- (CG01) Knowledge of basic subjects and technologies that enable students to learn new methods and technologies, and to provide them with versatility to adapt to new situations.
- (CG06) Ability to access and manage information in different formats for subsequent analysis in order to obtain knowledge from data.
- (CT03) Ability to defend your own work with rigor and arguments and to expose it in an adequate and accurate way with the use of the necessary means.
- (CT05) Ability to evaluate the advantages and disadvantages of different methodological and / or technological alternatives in different fields of application.
- (CE02) To methodologically know and apply the programming techniques and the algorithms necessary for the efficient processing of information and the computer resolution of problems that use large volumes of data.
- (CE06) Ability to represent and visualise data sets for the extraction of knowledge.
- (CB2) Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- (CB4) Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

The subject, according to the title verification memory, provides the following learning outcomes:
1) To design algorithms and analyse their suitability and complexity for the efficient resolution of problems:
- To calculate the temporal cost of an algorithm in the best and worst case. (Competencies CB02, CG01, CG06, CT03, CT05, CE02)
- To express the cost in asymptotic notation. (Competencies CB04, CG01, CG06, CT03, CT05, CE02)
2) To know, select and use the most appropriate data structures according to the problem to solve:
- To understand the advantages and limitations of different alternative data structures and be able to select the best option in a particular case, distinguishing between lists, stacks, tails, trees and graphs. (competences B02, CG01, CT03, CT05, CE06)
3) To develop, maintain and adapt codes that adequately use the properties of modular programming:
- To propose solutions to programming problems using an object-oriented programming methodology with Python language. (competences CB02, CB04, CG01, CT03, CE02, CE06)
- To use classes (and objects), inheritance and overload of operators in the implementation of programs (competences CB02, CG01, CG06, CT05, CE02, CE06).

DESCRIPTION OF CONTENTS

1. Algorithm efficiency

1.1 Complexity measure.
1.2 Cases analysis: better, worse and average cases.
1.3 Asymptotic notation: O, o and omega notation.
1.4. Case studies: Searching and sorting.

2. Object oriented programming

2.1. The concepts of class and object.
2.2. Information encapsulation.
2.3. Operator overloading.
2.4. Inheritance.
2.5. Polymorphism.

3. Sequences.

Specification, implementation, efficiency of operations and applications of the main types of sequences:
3.1. Lists.
3.2. Stacks.
3.3. Queues.
3.4. Applications.

4. Trees

4.1. Foundations.
4.2. Binary trees.
4.3. Binary trees traversal.
4.4. Search binary trees.
4.5. Heaps.
4.6. k-degree Trees.

5. Dictionaries and sets

5.1 Foundations.
5.2 Implementation in Python.
5.3 Applications.

6. Graphs

6.1 Foundations.
6.2 Implementation.
6.3 Graph traversal.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	28,00	100
Laboratory practices	20,00	100
Classroom practices	12,00	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

MD1 - Theoretical activities. Expositive development of the subject (CG01) with the participation of the student in the resolution of specific issues (CB04, CT03). Conducting individual evaluation questionnaires (CB02, CT03).

In the in class theoretical activities, the topics of the subject will be developed, providing a global and integrating vision, analysing in greater detail the key aspects and of greater complexity, encouraging, at all times, the participation of students (CB04, CT03).

MD2 - Practical activities. Learning by solving problems, exercises and case studies through which competences are acquired on the different aspects of the subject (CB02, CG06, CE02, CE06).

The theoretical activities are complemented by practical activities with the aim of applying the basic concepts and expanding them with the knowledge and experience that are acquired during the realisation of the proposed works.

MD4 - Lab work and / or computer classroom. Learning through activities developed individually or in small groups and carried out in laboratories and / or computer rooms (CB02, CG06, CT03, CT05, CE02, CE06).

In addition to in class activities, students must perform personal tasks (outside the classroom) on: issues and problems (CB02, CE02), as well as the preparation of classes and exams (study) (CG01). These tasks will be carried out mainly individually, in order to enhance autonomous work, but will also include work, especially the preparation and resolution of laboratory practices, which require the participation of small groups of students (2-3) to promote capacity for integration in work groups (CB04, CT03).

The e-learning platform (Virtual Classroom) of the Universitat de València will be used as a communication support with the students. Through it the didactic material used in class, as well as the problems and exercises to solve can be accessed.

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.

In any case, the assessment of the subject will be done in accordance with the assessment and qualification Regulation of the University of Valencia for degrees and masters:

https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639

REFERENCES

Basic

- Data Structures and Algorithms with Python; Kent D. Lee, Steve Hubbard; Undergraduate Topics in Computer Science, Springer Verlag (2015). https://link.springer.com/book/10.1007%2F978-3-319-13072-9
- Python Data Structures and Algorithms; Benjamin Baka; Packt Publishing (2017) https://ebookcentral.proquest.com/lib/univalencia/detail.action?docID=4868549
- Python Programming Fundamentals (second edition); Kent D. Lee; Undergraduate Topics in Computer Science, Springer Verlag (2015) https://link.springer.com/book/10.1007%2F978-1-4471-6642-9