VNIVERSITAT Ġ ID VALÈNCIA

COURSE DATA

Data Subject	
Code	36413
Name	Data structures and algorithms
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

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.

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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.

LEARNING OUTCOMES

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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	

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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 applying the following three criteria:

1) Criterion 1 (C1): Individual objective tests. Various written tests will be carried out throughout the theoretical-practical course (evaluation of skills CB02, CB04, CG01, CG06, CT03, CT05, CE02, CE06). There will be two types of tests with the following weight:

C1a (70%): Exam of the subject at the end of teaching.

C1b (30%): Intermediate controls carried out during the teaching period.

2) Criterion 2 (C2): Evaluation of the practical activities carried out both in the laboratories and in practical written exercises (evaluation of competences CB02, CB04, CG01, CG06, CT03, CT05, CE02, CE06). These tests will be carried out in groups of (maximum) 2 people and include the following activities:

C2a (70%): Evaluation of laboratory practices.

C2b (30%): Completion of practical written exercises in intermediate controls carried out during the teaching period.

3) Criterion 3 (C3): Continuous evaluation of each student, based on the participation and degree of involvement of the student in the teaching-learning process. The following aspects will be considered (evaluation of competences CB02, CB04, CG01, CT03): Resolution of exercises proposed during the teaching period; Public resolution of issues and problems discussed in class; Participation in the proposed activities.

The final grade for the subject will be calculated as the weighted average of sections C1 (60%) and C2 (40%). Criterion C3 will be considered an extra score of up to 10% over the previous grade, but only if it is greater than or equal to 4.5.

Particular considerations about the evaluation:

1) Non-recoverable sections: The criteria that evaluate the follow-up of the subject during the school period are not recoverable later. These are: C1b, C2b and C3. Criterion C2a (laboratory practices) will be recoverable, only in the 2nd call, through an individual practical exam carried out in the laboratory under conditions equivalent to those of a laboratory practice, but with a limitation of time and access to support materials.

2) Sections that require a minimum grade: To pass the subject, it is required to obtain a minimum grade of 3 (out of 10) in sections C1a and C2a.

3) Those students who have completed all the periodical exams of the subject (C1b, C2b) and whose weighted average score in these controls (C1b (70%), C2b (30%)) is greater than or equal to 5 will be exempted from the C1a test (final exam). Additionally, it will be necessary to have obtained a grade greater than or equal to 3 in both C1b and C2b. In these cases, the grade for section C1a will be assigned the weighted average score of the periodic intermediate controls (C1b (70%), C2b (30%)).

In any case, the evaluation of the subject will be done in accordance with the Regulations for evaluation and qualification of the University of Valencia for bachelor's and master's degrees approved by the Governing Council on May 30, 2017 (ACGUV 108/2017).

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