DEGREE CURRICULUM

DATA STRUCTURES

Coordination: GARRIDO NAVARRO, JUAN ENRIQUE

Academic year 2022-23

DATA STRUCTURES 2022-23

Subject's general information

<table>
<tr><td>Subject name</td><td>DATA STRUCTURES</td></tr>
<tr><td>Code</td><td>102010</td></tr>
<tr><td>Semester</td><td>1st Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Computer Engineering</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Double bachelor's degree: Degree in Computer Engineering and Degree in Business Administration and Management</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRALAB</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>3</td><td>3</td></tr>
<tr><td>Number of groups</td><td>3</td><td>2</td></tr>
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<tr><td>Coordination</td><td>GARRIDO NAVARRO, JUAN ENRIQUE</td></tr>
<tr><td>Department</td><td>COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>Work on-site class (20%)
Work online (20%)
Autonomous class (60%)</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Catalan and Spanish</td></tr>
<tr><td>Distribution of credits</td><td>Juan Enrique Garrido (GG): 3 ECTS
Xavier Domingo (L1 and L2): 6 ECTS
Juan Manuel Gimeno (L3): 3 ECTS</td></tr>
</table>

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Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
DOMINGO ALBIN, JAVIER JUAN	xavier.domingo@udl.cat	6	
GARRIDO NAVARRO, JUAN ENRIQUE	juanenrique.garrido@udl.cat	6	
GIMENO ILLA, JUAN MANUEL	juanmanuel.gimeno@udl.cat	3	

Subject's extra information

Data Structures is a second year course (first semester) within the degree of Software Engineering at University of Lleida. To follow this subject properly, some previous knowledge/skills on programming, Java, and object-oriented programming are recommended.

Data Structures is designed to follow up on Programming II by delving into Object Oriented Programming. Java will be the OOP language used throughout the course.

Data Structures aims to deepen and widen Algorithms and Complexity by discussing algorithms related to data structures in terms of the “Big-Oh” notation.

Data Structures is designed to keep the student’s workload as constant as possible throughout the course.

Learning objectives

- To be conversant with the main types of data structures: sequential access, trees, and tables.
- To delve into object oriented programming: design and develop interfaces, abstract classes, and generics in data structures by using the Java Collections Framework.
- To analyse operations and algorithms by using Big Oh notation, and develop more efficient algorithms.
- To delve into recursion; design and develop recursive methods to traverse tree and turn these methods into iterative ones.
- To design and develop classes which make use of several data structures and aspects related to object oriented programming in order to solve problems.

Competences

Cross-disciplinary Competences

- **EPS1**. Capacity to solve problems and prepare and defence arguments inside the area of studies.
- **EPS5**. Capacity of abstraction and of critical, logical and mathematical thinking.

Specific Competences

- **GII-FB3**. Capacity to understand and master the basic concepts of discreet mathematics, logical, algorithmic and computational complexity, and its application to solve engineering problems.
- **GII-CRI6.** Knowledge and application of the basic algorithmic procedures of the computer technologies to design problem solving, analysing the suitability and complexity of the algorithms proposed.
- **GII-CRI7**. Knowledge, design and efficient use of the types and data structure more suitable for solving a problem.
- **GII-CRI8**. Capacity to analyse, design, build and keep safety and efficiency in applications, choosing the paradigm and the most suitable programming languages.

Subject contents

1. Introduction to the Analysis of Algorithms

- 1.1 Introduction to algorithm analysis for data structures
- 1.2 Asymptotic notation

2. Object Oriented Programming Concepts
   - 2.1 Types, inheritance, abstract classes and interfaces
   - 2.2 JCF: Guided introduction
   - 2.3 Conversions and type checks
   - 2.4 Generics and Wildcards
   - 2.5 JCF: Guided introduction (extension)
3. Sequential Data Structures
   - 3.1 Data structures
   - 3.2 Stacks
   - 3.3 Lists
   - 3.4 Queues
   - 3.5 Comparison of the cost of main operations
4. Arborescent Data Structures
   - 4.1 Definition and notation
   - 4.2 Binary trees
   - 4.3 M-ary search trees and B trees
5. Direct Access Data Structures: Tables
   - 5.1 Introduction
   - 5.2 Specification of tables
   - 5.3 Implementation of tables

Methodology

Big-size Group: Theory (3 crèdits)

- Theory: Classes supported by handnotes.
- Practice: Always working on examples.

Mid-size Groups: LAboratory (3 crèdits)

- Practice on exercises and projects (groups of two).
- Personalized monitoring.
- Use of an Integrated Development Environment (IntelliJ).

Autonomous Work:

- Study.
- Project completion.

Development plan

Week	Big-size Group	Mid-size Group	Autonomous Work
1	1. Analysis of Algorithms	Introduction to the laboratory	Study and project
2	1. Analysis of Algorithms	Introduction to the laboratory	Study and project
3	2. OOP Aspects	Laboratory 1	Study and project

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Week	Big-size Group	Mid-size Group	Autonomous Work
4	2. OOP Aspects	Laboratory 1	Study and project
5	3. Sequential DS	Laboratory 1	Study and project
6	3. Sequential DS	Laboratory 2	Study and project
7	3. Sequential DS	Laboratory 2	Study and project
8	3. Sequential DS	Laboratory 2	Study and project
9	First Midterm		
10	4. Arborescent DS	Solution of Exam	Study and project
11	4. Arborescent DS	Laboratory 3	Study and project
12	4. Arborescent DS	Laboratory 3	Study and project
13	5. Direct Access DS	Laboratory 4	Study and project
14	5. Direct Access DS	Laboratory 4	Study and project
15	5. Direct Access DS	Laboratory 4	Study and project
16	Second Midterm		Study
17	Second Midterm		Study
18	Tutories		Study and project
19	Recovery Exams		Study

Evaluation

Acr	Description	Weight	Minimum Grade	Mandatory	Recoverable	Ind/Grup
Par1	First Midterm Exam • Chapters 1, 2 and 3 • Laboratory 1 • Laboratory 2	30%	4,0	Yes	Yes	Ind
Par2	Second Midterm Exam • Chapters 4 and 5 • Laboratory 3 • Laboratory 4	30%	4,0	Yes	Yes	Ind
Lab1	Laboratory 1	10%	No	No	No	2
Lab2	Laboratory 2	10%	No	No	No	2
Lab3	Laboratory 3	10%	No	No	No	2
Lab4	Laboratory 4	10%	No	No	No	2

Final grade = 0,3 * Par1 + 0,3 * Par2 + 0,1 * Lab1 + 0,1 * Lab2 + 0,1 * Lab3 + 0,1 * Lab4

- If the minimum grade is not reached in one of the partial exams, the maximum grade that will appear in the minutes will be 4, regardless of whether the application of the indicated percentages may lead to a higher result.
- Passed grades will be maintained for the same course but not after it.
- The evolution of the student will also be taken into account when computing the final grade.
- **To pass the subject all mandatory activities have to be passed.**

Bibliography

Josep Maria Ribó. Apropament a les estructures de dades del del programari lliure. Edicions de la Universitat de Lleida. 2018.

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William Collins. Data Structures and the Java Collections Framework. Third edition. John Wiley & Sons, 2010. USA.

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Thomas H. Cormen, Charles E. Leiserson, Ronald L. Riverst, Clifford Stein. Introduction to Algorithms. Third Edition. The Massachusetts Institute of Technology Press. 2009.

Maurice Naftalin, Philip Wadler. Java Generics and Collections. O'reilly, 2007. USA.

John Lewis, Joseph Chase. Java Software Structures: Designing and Using Data Structures. Addison Wesley. 2005.