INSTITUTO POLITÉCNICO
DE BRAGANÇA

Course Unit	Algorithms and Data Structures	Field of study	Computer Science
Bachelor in	Informatics Engineering	School	School of Technology and Management
Academic Year	2023/2024	Year of study	2
Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	1
Code	9119-706-2101-00-23		

Workload (hours)	162	Contact hours	T	-	TP	60	PL	-	TC	-	S	-	E	-	OT	-	O	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Paulo Duarte Ferreira Gouveia, Adilia Isabel Domingues Cruz Alves, Helder Francisco Silva Vieira, Jose Paulo Machado Da Costa

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. demonstrate a good domain of the Java programming language;
2. understand and use the Java collections standard library;
3. evaluate the efficiency of the algorithms;
4. design the data structures of computer applications;
5. implement data structures and algorithms for linked lists, stacks, queues, binary search trees and heaps;
6. develop and implement abstract data types, using an object oriented language;
7. define and implement iterators for different types of data structures;

Prerequisites

Before the course unit the learner is expected to be able to:
program in an object-oriented language.

Course contents

The Java programming language; Java collections framework; analysis of algorithms; elementary rules of data structures design; the abstract data types (ADTs) stack, queue, deque, priority queue, map and decision tree; implementation of linear and nonlinear data structures that realize the ADTs (linked lists, binary search trees, heaps).

Course contents (extended version)

1. The Java language
    - java compiler and technologies;
    - java versus C++;
    - value and reference types;
    - creating and using objects;
    - strings, wrappers, and arrays types;
    - simple input and output;
    - packages and imports;
    - javadoc documentation;
    - creating, testing and debugging.
2. POO in Java
    - abstract data types;
    - interfaces and abstract classes;
    - Object superclass and its main methods;
    - inheritance and constructors;
    - generics;
    - exceptions.
3. Java collections framework (JCF)
    - iterators;
    - Iterable and Iterator interfaces;
    - the classes and interfaces architecture of JCF;
    - Set, List, Queue, Deque and Map interfaces;
    - the ordination of the JCF concrete collections;
    - Comparable and Comparator interfaces.
4. Analysis of algorithms
    - algorithmic efficiency;
    - standard reference functions for algorithm analysis;
    - asymptotic algorithm analysis;
    - big-Oh notation.
5. Defining and implementing linear data structures
    - singly and doubly linked lists;
    - array-based stack;
    - linked list-based stack;
    - circular array-based queue;
    - linked list-based queue;
    - circular array-based deque;
    - doubly linked list-based deque;
    - sorted array-based map;
    - sorted doubly linked list-based map;
    - implementation of iterators.
6. Trees
    - defining and implementing binary trees;
    - tree traversal algorithms;
    - decision trees;
    - binary search trees;
    - AVL trees;
    - heap-based priority queue.

Recommended reading

1. "Data Structures and Algorithms in Java - 6th edition", M. T. Goodrich, R. Tamassia, and M. H. Goldwasser, Wiley, 2014.
2. "Estruturas de Dados e Algoritmos em Java", António Adrego da Rocha, FCA, 2011.
3. "Projetos de POO em Java", F. Mário Martins, FCA, 2014.

Recommended reading

4. "Java6 e Programação Orientada pelos Objectos", F. Mário Martins, FCA, 2009.
5. "Thinking in Java - 4th Edition", Bruce Eckel, Prentice-Hall, 2006.

Teaching and learning methods

This course is composed by theoretical-practical lectures, divided into two kinds of periods: - expository periods during which the theoretical contents are presented and explained based on practical examples; - implementation periods during which the students put in practice the knowledge acquired in the expository periods. Non-presence periods are aimed to study and implement practical works.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary)
   - Practical Work - 60% (two practical works)
   - Final Written Exam - 40% (minimum grade of 5 points)
2. Alternative 2 - (Regular, Student Worker) (Special)
   - Final Written Exam - 100%

Language of instruction

1. Portuguese
2. English

Electronic validation

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04-10-2023	07-10-2023	16-10-2023	31-10-2023

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