IPG Polytechnic of Guarda School of Technology and Management	**SUBJECT DESCRIPTION**	MODELO PED.013.02

Course	**Computer Science**			*Academic year*	2016/2017		
Subject	**Algorithms and Data Structures**			ECTS	5		
Type of course	**Compulsory**						
Year	**1st**	*Semester*	**1st semester**	*Student Workload:*			
Professor(s)	**Paulo Jorge Costa Nunes**			*Total*	168	*Contact*	105
Area Coordinator	Noel Lopes (Programming and Multimedia)						

Planned

1. LEARNING OBJECTIVES

Upon completion of the UC, students should be able to:

1. Write algorithms using pseudo code and the symbology of flowcharts
2. Differentiate data structures and choose the best for each specific algorithm
3. Carry out complexity analyses of algorithms
4. Explain and apply sorting and searching algorithms

2. PROGRAMME

1. Introduction to the development of algorithms
    1. Algorithm concept
    2. Steps of development of algorithms

2. Algorithmic language
    1. Importance, syntax
    2. Flowchart and pseudo language
    3. Scalar variables types and structured variables types
    4. Input and output instructions
    5. Control structures

3. Flowcharts
    1. Symbology
    2. Applications

4. Pseudo languages
    1. Introduction
    2. Pseudo code examples

5. Data Structures
    1. Strings
    2. Records and files
    3. Vectors

4. Arrays
5. Linked lists
6. Queues
7. Stacks
8. Trees

6. Complexity analysis algorithms
    1. Spatial and temporal complexity
    2. Complexity and efficiency
    3. Notations "Big O" and "Little O"
    4. Growth functions

7. Sorting and searching
    1. Sequential and binary search
    2. Sorting algorithms
    3. Concepts of sorting algorithms
    4. Complexity analysis of some sorting algorithms
    5. Sorting algorithm comparison

3. COHERENCE BETWEEN PROGRAMME AND OBJECTIVES

Contents 1, 2 3 and 4 are consistent with the objective 1 because they define the concept of algorithm, present the steps required to develop algorithms, describe the algorithmic language elements and present two ways to write algorithms using pseudo codes and flowcharts.

Content 5 is consistent with objective 2, "Differentiate data structures and choose the best for each specific algorithm" because they present the fundamental data structures used in the algorithms.

Contents 6 and 7.4 are consistent with objective 3 because they present the concepts on complexity and asymptotic efficiency of algorithms, notation analysis "Big O" and “Little o" and describe a comparative analysis of sorting algorithm complexity.

Content 7 is consistent with objective 4 because in that chapter sorting algorithms are described and compared and searching methods are presented.

4. MAIN BIBLIOGRAPHY

Mandatory:

[1] Nunes Paulo (2011) “Manual de Algoritmos e Estruturas de Dados – Engenharia Informática”. Guarda, IPG.

[2] Vasconcelos, J.B. and Carvalho, J. V. (2005). Algoritmia e estrutura de Dados – Programação nas Linguagens C e JAVA. Lisboa: Centro Atlântico.

[3] Manzano, J.A. and Oliveira, J.F. (2005). Algoritmos – Lógica para desenvolvimento de Programação de Computadores. 17th ed. São Paulo: Érica.

Recommended:

[1] Magri, J.A. (2003). Lógica de Programação – Ensino Prático. São Paulo: Érica.
[2] Lopes, A. and Garcia, G. (2002). Introdução à Programação – 500 Algoritmos Resolvidos. 5th ed. Rio de Janeiro: Elsevier.
[3] Knuth, Donald E. (1998). "The Art of Computer Programming – VOLUME 1- Fundamentals Algorithms". Third Edition, ADDISON – WESLEY.
[4] Knuth, Donald E. (1993). The Art of Computer Programming – VOLUME 3 - Sorting and Searching. Third Edition, Prentice Hall.
[5] Goodman, S.E. and Hedetniemi, S.T. (1993). Introduction to the Design and Analysis of Algorithms. Prentice Hall.

5. TEACHING METHODOLOGIES (INCLUDING EVALUATION)

Teaching methodologies: Lecture, interactive lesson, problem solving, individual work and group work.

Evaluation methodologies:

Continuous evaluation

1. Written test (50%) – on date set by the Director of ESTG.
2. Individual project (20%) – Format: zip + pdf Presentation: 17-10-2016
   - Development of an algorithm.
   - Presentation (PowerPoint) and oral presentation.
3. Group work (30%) Format: zip + pdf, presentation: 09-01-2017
   - Resolution of a problem.
   - Maximum two students;
   - Program;
   - Presentation (PowerPoint) and oral presentation.

Exam evaluation

1. Written test (100%)

Final exam evaluation

1. Written test (100%)

6. COHERENCE BETWEEN TEACHING METHODOLOGIES AND OBJECTIVES

Lectures are consistent with the objectives because of the need to present the theoretical knowledge of the course to the students.

Algorithms are presented evidencing all aspects of each written step, the data structures used, the searching and sorting methods and analysis complexity. Students may question the teacher about any element of the algorithm and exchange ideas, enriching and increasing student knowledge individually in a collective setting.

Problem solving is consistent with the objectives because it allows the students to apply theoretical knowledge to writing algorithms where they have to choose the most

appropriate data structures, carry out complexity analysis and, in some cases, the application of sorting and searching algorithms. Problem solving is assisted by a web application, provided by the teacher, in order to facilitate the writing of algorithms in algorithmic language properly documented.

Individual work is consistent with the objectives because the work consists in developing an algorithm, documentation of all development steps, and preparation of a presentation (slides), which allows students to solidify their knowledge acquired in the course and develop their individual ability to solve problems in general by writing algorithms.

Group work is consistent with the objectives because it allows students to develop their ability to work together and recognize its advantages. Through group work, the students have to solve a rather difficult problem for which it is necessary to develop different algorithms with all the implicit steps. In this project the students are required to apply all the knowledge acquired.

Students are encouraged to choose subjects for their work in other courses (Algebra and Analytic Geometry, Introduction to Physics, Introduction to Programming), choosing any other topic. The individual and group work is accompanied by the teacher in tutorial lessons. The students present their projects in the classroom, which allows students to see the application of theoretical knowledge and extend their ability to solve similar problems.

7. ATTENDANCE

There are no minimum requirements.

8. CONTACTS AND OFFICE HOURS

Nome	E-Mail	Telephone	Office #	Office hours
Paulo Nunes	pnunes@ipg.pt	1220	20	

Date: 19/09/2016

Noel Lopes
Area Coordinator

Paulo Jorge Costa Nunes
Professor

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