Course Unit Description - (ALGEN)

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(Mestrado em Engenharia Electrotécnica e de Computadores)

Academic year: 2009/2010

Subject group: Automação e Robótica

	Semestral	**Compulsory**		
Mode of study	Diurno	**Hours/Week**	**T-**Teórica	2
Year	1º		**PL-**Prática-Laboratorial	2
Semester	1º		**OT-**Orientação Tutorial	1

ECTS 6

Objectives

This course introduces the theory and the fundamentals of Evolutionary Computation, particularly the genetic algorithms, providing the basics for students to be able to develop tools for optimization problems.

General objectives:
At the end of this course the student should be able to develop tools for optimization of functions and engineering problems in general.
The student should be able to interpret different types of problems and finding solutions to address them.
The student must also be able to develop their knowledge in the field of Evolutionary Computation.

Course Contents

Theoretical Program:
1. Evolutionary Computation: Introduction, Historical Development of Evolutionary Computation, Evolutionary Computation Features, Advantages of Evolutionary Computation, Applications of Evolutionary Computation

2. Genetic Algorithms: Introduction, Biological Principles, What is Genetic Algorithm?, Genetic Algorithms Optimization versus Classical Optimization, A Simple Genetic Algorithm, Advantages and Limitations of Genetic Algorithms, Applications of Genetic Algorithms

3. Terminology and Operators of GA: Introduction and Essential Elements, Individuals, Genes, Fitness Function, Population, Data Structures, Research Strategies, Coding, evolution: selection, crossover, mutation and replacement, Convergence Criteria, Why do Genetic Algorithms Work?, Evaluation of the Solution, Research Refinement, Restrictions

4. Classification of Genetic Algorithms: Introduction, Simple Genetic Algorithm, Parallel and Distributed Genetic Algorithm, Hybrid Genetic Algorithm, Adaptive Genetic Algorithm, Fast Messy Genetic Algorithm, Sampling Independent Genetic Algorithm

5. Applications of Genetic Algorithms: Introduction, Electrical Engineering, Machine Learning, Image Processing

6. Swarm Intelligence: Introduction, Particle Swarm Optimization, Ant Colonies Optimization

Practical Program:
1. Optimization of functions using the Matlab Optimization toolbox

2. Optimization of functions using the Genetic Algorithm and Direct Search Toolbox Matlab

3. Implementation of Genetic Algorithms in MATLAB

4. Practical assignments

Recommended reading

Genetic Algorithms in Search, Optimization & Machine Learning, David E. Goldberg, Addison Wesley, 1989

An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 1997

Handbook of Genetic Algorithms, Lawrence Davis, Van Nostrand Reinhold, New York, 1991

Genetic Algorithms + Data Structures = Evolution Programs, Z. Michalewicz, Springer-Verlag, 1994

Swarm Intelligence, Kennedy, Eberhart, Morgan Kaufmann Publishers, 2001

Teaching Methods

Theoretical classes: exposition and development of the course contents, by presenting the themes and giving real scenarios wherever possible. It is expected the involvement of students in the teaching-learning process through classes in the form of dialogue, using reformulations in which students are prompted to intervene.

Laboratory classes: resolution of exercises of proposed optimization problems using the following software: Matlab, Matlab

Optimization Toolbox and Genetic Algorithm and Direct Search Toolbox Matlab. Practical assignments in groups of two students, with individual oral presentation at the end of the semester.

Tutorial classes: discussion of topics presented in the theoretical classes. Promoting the acquisition and development of attitudes towards research and thinking in students. Encourage the students to work in group and simultaneously to expand the individual skills, the ability to coordinate and expose, as well as the critical spirit.

Assessment methods

Assessment during the semester:
During the semester, students will be evaluated by a practical work that will result in a report delivered to the professor. The work will be performed by groups of two students and the topics will address topics presented in the course contents. The work will be the subject of an oral presentation.

Assessment at the final proof:
Students will do an exam that evaluates all of the course contents (PE).

The final classification is (xNFREQ YPE +) / x + y

where:

x = 0,5 Min NFREQ = 6
y = 0,5 Min PE = 6

Students are approved if the final classification is greater than or equal to 10.

Improvement of the course classification:
Through a written exam covering all the course content. The final classification will be the one obtained in this exam.

	Name
Teacher responsible:	Cecilia Maria do Rio Fernandes Moreira Reis (CMR)
Lecturer:	Cecilia Maria do Rio Fernandes Moreira Reis (CMR)