COMPUTER ENGINEERING (LM55)

(Lecce - Università degli Studi)

Teaching DECISION SUPPORT SYSTEMS

GenCod A003124

Owner professor GIANPAOLO GHIANI

Teaching in italian DECISION SUPPORT SYSTEMS

Course year 1

Teaching DECISION SUPPORT SYSTEMS

Language ENGLISH

SSD code MAT/09

Curriculum PERCORSO COMUNE

Reference course COMPUTER ENGINEERING

Course type Laurea Magistrale

Location Lecce

Credits 9.0

Semester First Semester

Teaching hours Front activity hours: 81.0

Exam type Oral

For enrolled in 2020/2021

Assessment Final grade

Taught in 2020/2021

Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

The course provides the theoretical foundations, the practical skills and the development tools to design and deploy intelligent systems that support or automate complex decisions. Applications include motion planning in robotics, designing non-player characters in video games, machine scheduling in the manufacturing sector, portfolio optimization in the financial industry, timetabling and crew rostering in transportation, ... Methodologies and algorithms taken from Operations Research, Statistics and Artificial Intelligence are analyzed and compared.

REQUIREMENTS

Calculus. Probability and Statistics. Linear Algebra. Programming skills.

COURSE AIMS

Knowledge and understanding. The course describes methods and models to design decision support/automation systems.

- Students will acquire the basic cognitive tools to think analytically, creatively, critically and in an inquiring way, and have the abstraction and problem-solving skills needed to cope with complex systems.
- They will have solid knowledge of decision support/automation systems.
- They will be able to design and develop complex systems to improve decision-making processes.

Applying knowledge and understanding. After the course the student should be able to:

- describe and use the main decision support/automation techniques;
- understand the differences among several algorithms solving the same problem and recognize which one is better under different conditions;
- tackle decision support/automation problems by selecting the appropriate methods and justifying his/her choices;
- tackle new decision support/automation problems by designing suitable algorithms and evaluating the results;
- explain experimental results to people without a computer science background.

Making judgements. Students must have the ability to assess a decision support/automation system and must arrive at original and autonomous ideas and judgments.. The course promotes the development of independent judgment in the appropriate choice of techniques/models and the critical ability to interpret the goodness of the results of the chosen models/methods.

Communication. It is essential that students are able to communicate with a varied and composite audience, not culturally homogeneous, in a clear, logical and effective way, using the methodological tools acquired and their scientific knowledge and, in particular, the specialty vocabulary. Students should be able to organize effective dissemination and study material through the most common presentation tools, including computer-based ones, to communicate the results of data analysis processes, for example by using visualization and reporting tools aimed at different types of audiences.

Learning skills. Students must acquire the critical ability to relate, with originality and autonomy, to the typical problems of data mining and, in general, cultural issues related to other similar areas. They should be able to develop and apply independently the knowledge and methods learnt with a view to possible continuation of studies at higher (doctoral) level or in the broader perspective of cultural and professional self-improvement of lifelong learning. Therefore, students should be able to switch to exhibition forms other than the source texts in order to memorize, summarize for themselves and for others, and disseminate scientific knowledge.

TEACHING METHODOLOGY

The course consists of lectures, classroom exercises and home assignments. Lectures aim at providing the methodological foundations. They are given using slides and/or a blackboard. Students are invited to participate by asking questions and presenting examples. The exercises and home assignments are about the solution of practical problems with software tools.

ASSESSMENT TYPE	The exam consists of two parts: ▪ a written test made up of 10 questions [10 marks]; ▪ an oral exam in which students must: 1. discuss a presentation of their own on an advanced course topic [10 marks]; 2. show their ability to use the software tools presented in the course (Python libraries for machine learning, STRIPS, AMPL, ...) [10 marks].
OTHER USEFUL INFORMATION	**Office Hours** By appointment. As a rule, on Thursdays at 11:00. Please contact the instructor by email or at the end of the lectures.
FULL SYLLABUS	PART I – DECISION-MAKING PROCESSES (4 hours) 1.1 Introduction. Data, information, knowledge, decisions. Taxonomy of decisions. Decision support methodologies. (2hours) 1.2 Intelligent agents. (2 hours) PART II – SIMULATION (10 hours) 2.1 Evaluation: experimentation, simulation and analitical methods (1 hour) 2.2 Pseudo-random number generation. (3 hours) 2.3 Monte Carlo simulation. Discrete-event simulation. Variance reduction techniques. (6 hours) PART III - KNOWLEDGE, REASONING AND PLANNING (28 hours) 3.1 Search. Uninformed and informed search. A* algorithm. (3 hours) 3.2 Basics of optimization. Optimization model review. Convex Optimization. Linear Optimization. (10 hours) 3.3 Local search. Simulated Annealing. Genetic Algorithms. (4 hours) 3.4 Adversarial search. Basics of Game Theory. (4 hours) 3.5 Propositional and first-order logic (recap) (4 hours) 3.5 Planning. The STRIPS language (3 hours) PART IV - PLANNING IN UNCERTAIN ENVIRONMENTS (13 hours) 3.1 Decision making under uncertainty (1 hour) 3.2 Decision making under risk (2 hours) 3.3 Sequential decision processes (4 hours) 3.4 Dynamic Programming (6 hours) PART IV – LEARNING (16 hours) 4.1 Introduction (1 hour) 4.2 Supervised learning: linear and polynomial regression, naive Bayes classifier, classification and regression trees, linear classification with hard threshold, linear classification with logistic regression, basics of neural networks (8 hours); non parametric classification; model selection (8 hours) 4.3 Unsupervised learning: clustering: k-means algorithm, determination of the number of clusters; rule mining: the a-priori algorithm (4 hours) 4.4 Reinforcement learning (3 hours)

REFERENCE TEXT BOOKS	Handouts (available on FormazioneOnLine at https://formazioneonline.unisalento.it/course/view.php?id=487). For consultation: ▪ Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited, 2016.