High-performance Modelling and Simulation 2015/2016

Code: 43354
ECTS Credits: 6

Degree	Type	Year	Semester
4314660 Computer Engineering	OT	2	1

Contact

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Use of languages

Principal working language: english (eng)

Teachers

Emilio Luque Fadón

Prerequisites

User knowledge of computer systems and (recommended) some knowledge of a programming language but not essential.

Objectives and Contextualisation

The present course aims to introduce students to the modelling and simulation techniques used in multidisciplinary areas. After completing this module, students will be able to:

1. Analyze and develop a model of the system as equivalent representation.
2. Analyze and define what inputs are necessary and adapted to the specific needs of the case study.
3. Choose the output data analysis methodologies and ability to define the procedures to draw conclusions or make performance analysis.
4. Design and develop simulation models and verify/validate the simulation tools according to scientific criteria.

Skills

- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
- Communicate orally and in writing in English.
- Continue the learning process, to a large extent autonomously
- Define and communicate results, guaranteeing high levels of performance and quality.
- Design and evaluate operating systems and servers and applications and systems based on distributed computing.
- Display a spirit of enterprise and innovation and a wide-ranging vision in the search for new areas to explore in a specific field of the computer engineering profession.
- Integrate and apply the knowledge acquired and solve problems in new or little-known situations within broader (or multidisciplinary) contexts.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Model, design, and define architectures, implement, manage, operate and maintain computer applications, networks, systems, services and content.

- Propose, calculate and design products, processes and installations in all areas of computer engineering.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Understand and apply advanced knowledge of high-performance computing and numerical or computational methods to engineering problems.
- Undertake mathematical modelling, calculation and simulation in technological centres and engineering companies, especially in research, development and innovation tasks in all areas related to computer engineering.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Learning outcomes

1. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
2. Communicate orally and in writing in English.
3. Continue the learning process, to a large extent autonomously
4. Define and communicate results, guaranteeing high levels of performance and quality.
5. Display a spirit of enterprise and innovation and a wide-ranging vision in the search for new areas to explore in a specific field of the computer engineering profession.
6. Identify and relate scientifically the main elements of significant information for the activity concerned, using development tools and environments for creating useful simulation models.
7. Integrate and apply the knowledge acquired and solve problems in new or little-known situations within broader (or multidisciplinary) contexts.
8. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
9. Plan and develop research projects with content related to high-performance modelling and simulation.
10. Propose, calculate and design products, processes and installations in all areas of computer engineering.
11. Solve multidisciplinary problems in the field of system modelling and simulation.
12. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
13. Undertake mathematical modelling, calculation and simulation in technological centres and engineering companies, especially in research, development and innovation tasks in all areas related to computer engineering.
14. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Content

Presentation: Objectives, methodology and course content.

Section 1: Modeling

- Introduction to modeling.
- Classifications of models.
- Development, debugging, verification and validation of the model.
- Development tools and test models.

Section 2: Simulation.

- Introductory Concepts of simulation.
- Design, development and debugging simulation models.
- Parallel & distributed simulation.

Section 3: Analysis of simulation data.

- Importance of analysis

- Analysis techniques applied to simulation data.
- Applications and analysis of practical results.

Section 4. Introduction to numerical simulation

Section 5: Case Study.

- **Modeling and simulation of biological systems.**
- **Simulation of social and health systems.**
- **Modelling and simulation of network systems.**

Methodology

The course will be developed in classes, lab sessions and seminars.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Lectures	44	1.76	6, 7, 8, 9, 11, 12, 14
Type: Supervised			
Lab	12	0.48	7, 9, 10, 11, 12, 13
Type: Autonomous			
Collaborative work	90	3.6	1, 2, 3, 4, 5, 8

Evaluation

The evaluation will be made by developing the proposed case studies using the tools presented in the lectures sessions and laboratory. Group work and interaction will also be considered.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Case Study: Analysis & Development	55	3	0.12	3, 7, 8, 9, 10, 11, 12, 13, 14
Public presentation of the developed work	45	1	0.04	1, 2, 3, 4, 5, 6, 14

Bibliography

- Bernard P. Zeigler. Theory of Modeling and Simulation. Academic Press. 2000
- Sheldon Ros. Simulation. Academic Press. 2012.
- Angela B. Shiflet, George W. Shiflet (Author). Introduction to Computational Science: Modeling and Simulation for the Sciences. Princeton University Press.2014.
- Byoung Kyu Choi, DongHun Kang. Modeling and Simulation of Discrete Event Systems. Wiley. 2013.
- Nigel Gilbert and Klaus Troitzsch. Simulation for the Social Scientist. Open University Press. 2005.

Websites:

- Netlogo: https://ccl.northwestern.edu/netlogo/
- Jarp: Petrinets Analizer, http://jarp.sourceforge.net/us/index.html
- Jpetrinet: Tool to model, analysis conventional Petri Nets and to simulate Timed Petri Nets, http://jpetrinet.sourceforge.net/
- Petri .NET Simulator: Tool for modelling and simulation of Petri nets and analysis of their behaviour http://www.petrinetsimulator.com/
- SMPL Simulation Toolkit: http://ece.ut.ac.ir/Classpages/S86/ECE462/#Software
- SMPL Examples, Source & complementary material: http://www.csee.usf.edu/~christen/tools/toolpage.html
- SMPL API description: http://people.cs.vt.edu/~irchen/5214/pdf/p1-23.pdf