Universitat Autònoma de Barcelona

2022/2023

High-Performance Simulation

Code: 104424
ECTS Credits: 6

Degree	Type	Year	Semester
2503740 Computational Mathematics and Data Analytics	OT	4	2

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Gemma Sanjuan Gomez
Verònica Vidal Canedo
Carles Carrillo Jordan

Prerequisites

Although it is not a mandatory prerequisite, it is advisable to have taken the third year subjects "High performance Computing" and "Modeling and Simulation".

Objectives and Contextualisation

This subject aims to introduce students to simulation techniques used in multidisciplinary areas. Learn to use simulation tools from different areas and learn to analyze their computing needs in order to make a good choice of the execution environment.

Competences

- Apply a critical spirit and rigour for the validation or rejection of your own arguments and those of others.
- Apply basic knowledge on the structure, use and programming of computers, operating systems and computer programs to solve problems in different areas.
- Implement and optimise applications based on the functions and structure of parallel, distributed and cloud systems, computer networks and internet.
- Make effective use of bibliographical resources and electronic resources to obtain information.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.

- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Work cooperatively in a multidisciplinary context assuming and respecting the role of the different members of the team.

Learning Outcomes

1. Adapt the execution of the simulation to measures of benefits.
2. Apply a critical spirit and rigour for the validation or rejection of your own arguments and those of others.
3. Describe the distinct components of a system and the interactions between them.
4. Identify the parameters that determine system operation.
5. Make effective use of bibliographical resources and electronic resources to obtain information.
6. Model and simulatecomplex systems taking computational aspects into account.
7. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
8. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
9. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
10. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
11. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
12. Work cooperatively in a multidisciplinary context, taking on and respecting the role of the distinct members in the team.

Content

Theme 0.- Introduction to High Performance Simulation.

Theme 1.- Non-coupled simulations:

- Forest Fire spread simulators.

- Wind field simulators.

- Atmosphere evolution simulations (weather forecast)

Theme 2.- Coupled simulations:

- Coupling atmosphere and chemistry to assess air quality

- Coupling urban models to assess air quality in cities.

- Coupling atmosphere and forest fire spread.

Methodology

The subject is planned to be carried out in person, if for reasons beyond the programming of the subject, the teaching methodology had to be changed, and the classes would be carried out in a telepresencial way, that is, in synchronous sessions following the schedule established by the coordination of the degree

The subject will be developed in theoretical and practical classes. The distribution of the sessions throughout the semester will be available on the first day of class in the Virtual Campus of the subject.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theoretical Lectures	25	1	3, 4, 6, 12
Type: Supervised			
Practical sessions	25	1	11, 10, 7, 8
Type: Autonomous			
Group work to develop and/or analyse the model and simulators functioning	50	2	1, 2, 3, 4, 6, 11, 7, 8, 12
Study on models and simulators	40	1.6	3, 4, 6, 11, 7, 8

Assessment

The evaluation will be carried out developing and presenting the proposed case studies using the tools presented in the theoretical sessions. Group work and interaction will also be assessed.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1.- Practical exercise of Simulation considering Non-coupled models	40	4	0.16	2, 4, 6, 11
2.- Practical Exercises of Simulation including Coupled models	40	4	0.16	2, 3, 9, 7, 8, 12, 5
3.- Computational Performance Analysis of Simulator	20	2	0.08	1, 2, 4, 10, 5

Bibliography

WRF user's guide: https://www2.mmm.ucar.edu/wrf/users/docs/user_guide_v4/contents.html

WRF-Chem documentation: https://ruc.noaa.gov/wrf/wrf-chem/

FARSITE documentation: https://www.firelab.org/project/flammap

WindNinja documentation: https://www.firelab.org/project/windninja

Software

VirtualBox

WRF

WRF-Chem

FARSITE

WindNinja