

69154 - Programming and Architecture of Computing Systems

Syllabus Information

Academic year: 2024/25

Subject: 69154 - Programming and Architecture of Computing Systems

Faculty / School: 110 - Escuela de Ingeniería y Arquitectura

Degree: 615 - Máster Universitario en Robótica, Gráficos y Visión por Computador / Robotics, Graphics and Computer Vision

ECTS: 6.0

Year: 1

Semester: First semester

Subject type: Compulsory

Module:

1. General information

The main objective of the course is to provide students with knowledge about computer systems from hardware to software, with special emphasis on the most important aspects for robotics, graphics, and computer vision applications. Specifically, the different levels of abstraction will be studied including applications, libraries and runtimes, operating systems. Also, students will learn some knowledge on hardware design, including the differences between devices such as CPUs, GPUs, FPGAs, or ASIC accelerators. The course will present analytical models of the most relevant metrics in computing and how to use them for analyzing performance or energy consumption, among other fundamental aspects, as well. Another important objective is to train students to know how to efficiently use different programming models according to their needs and notions of parallelism and heterogeneous computing, in addition to knowing different program optimization techniques and analysis tools.

2. Learning results

Upon completion of the course, students must be able to:

- Know the main characteristics of the different computing devices
- Know the main programming models in heterogeneous systems
- Evaluate the benefits of a computer system in terms of performance and energy
- Understand computer solutions (hardware and software) for problems with requirements such high computation intensity, latency, power ...
- Choose the most suitable device and programming model for different types of problems in vision, robotics, and graphics applications
- Design conscious algorithms of computing devices, performance, and energy consumption

3. Syllabus

The course will cover the following topics:

1. Computer Systems
 1. Main elements (Application, Libraries, Operating System, Hardware ...)
 2. Basic tools (compiler, debugger ...)
2. General purpose processor architecture, graphic processors (rendering and computation), Programmable devices (FPGAs) and specific accelerators (ASICs)
3. Efficiency analysis and metrics in heterogeneous systems (performance and energy)
4. Efficiency oriented programming
5. Heterogeneous programming models (CUDA, OpenCL ...) and High-Level Synthesis for FPGAs
6. Domain Specific Languages for Computer Vision, Robotics, and Graphics

4. Academic activities

The course includes the following training activities:

- Lectures, 30 hours
- Problem solving and cases, 6 hours
- Laboratory practices, 12 hours
- Special practices, 2 hours
- Practical application or research work, 40 hours
- Personalized teacher-student tutoring, 5 hours
- Study, 50 hours
- Assessment tests, 5 hours

5. Assessment system

In accordance with the regulations of the University of Zaragoza, the evaluation of this subject is established in continuous and global modalities.

The continuous evaluation will be based on three tests:

- P1. Theoretical-practical written tests (weighting 60%).
- P2. Delivery of work and laboratory tests (weighting 30%).
- P3. Presentations and debates (weighting 10%).

The students will be able to make regular deliveries of works and/or laboratory tests, requested by the teaching staff. In this case, if the student wishes, he/she may be exempted from the final laboratory test.

The global evaluation will be based on two tests:

- P1. Theoretical-practical written tests (weighting 60%).
- P2. Delivery of work and laboratory tests (weighting 40%).

Passing the course requires obtaining a grade equal to or higher than 5 out of 10 points in the weighted sum of the parts and a grade equal to or higher than 4.5 in each of the individual parts. Failure to meet any of the requirements will result in a maximum final grade lower or equal to 4.5. The grade of each of the parts can be kept for successive exams within the same academic year.

6. Sustainable Development Goals

- 7 - Affordable and Clean Energy
- 9 - Industry, Innovation and Infrastructure