COMPUTER ARCHITECTURE (9 CFU)

*Computer Engineering (*CE*) degree*

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The need to use online tools

can impose a reorganization of the course day by day.

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Topics selection:

- *Classes of computers, technology trends, power consumption, performance evaluation and benchmarks*
- *Memory hierarchy, cache memory and virtual memory*
- *Instruction Level Parallelism, dynamic scheduling, multiple issue, speculation and multithreading*
- *Vector architecture and Graphics Processing Unit (GPU)*
- *Symmetric shared-memory multiprocessors, distributed shared-memory multiprocessor, cache coherence and memory consistency*
- *Domain-Specific Architectures*

Goals:

- *Skills on the architecture of current microprocessors*
- *Skills on power consumption and processing performance*

- *Using of resources and features of current microprocessors*
- Sizing the resources of a computer according to the application features

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Exercise activities:
The goal is to understand the features of current computers.
The activities will be developed in groups of two or three students.
Each group will deepen 3 arguments concerning current computers and prepare the presentations.

1st presentation: microprocessor architecture, features of the instruction set, TLB and cache memory organization, microcontroller, DSP, ….

Goal: **verify that you have the basis for understanding the architectures of current computing systems**

2nd presentation: multiprocessor architecture, multicore organization, GPU, coherence protocols, memory consistency model, …

Examination (only spoken):
Evaluation of the presentations developed during the semester.
Questions about the course program.

1st presentation

- Arduino
- Computer Data Storage
- Simultaneous Multithreading
- Memory Management Unit
- General Purpose computing on Graphics Processing Units
- Samsung Galaxy Tab 2 7.0
- ARM: history, characteristics and the arm11 MPcore
- Multi Level Cache
- Java Processors
- AMD vs INTEL General purpose microprocessors comparison
- Hardware security solutions. Trust Zone technology in ARM architecture
- Cache performances
- Raspberry PI
- Journal papers

2nd presentation

- Intel-core-i7 Dynamic power-management
- PARALLELISM IN DATABASE SYSTEMS
- Arm Cortex A9
- Hardware / Software parallelism techniques for power reduction in ARM Cortex A11 MPCore
- Automatic Parallelization
- OpenCL: heterogeneous computing
- INTRODUCTION TO PROGRAMMING ON GPU AND MANAGING OF PARALLELISM
- Exploit Multicore and Multithreading CPU
- GPU: analysis of the memory subsystem
- Hyper-Threading
- Multicore CPU comparison
- Cache coherence in multicore processors
- Multicore programming: increasing performance through software multithreading
- C Parallel Programming: OpenMP

Team practices

Organization
Step 1: 1-5 March, define the team (2 or 3 students)
Step 2: 5 March, define the subject of presentation
Step 3: prepare the presentation
Step 4: show the presentation at the class

Completion of activities and presentation to the course attendees:

March 29th: Draft of first presentation and **verify that you have the basis for understanding the architectures of current computing systems**.
May 15th: Work begins on the second presentation.
May 24th: Presentation of both presentations.

Books

- **Computer Architecture, Fifth Edition: A Quantitative Approach,** John L. Hennessy, David A. Patterson

- **Advanced Computer Architecture and Computing,** S.S. Jadhav
- **Microprocessor Architecture: From Simple Pipelines to Chip Multiprocessors,** Jean-Loup Baer
- **Parallel computer organization and design,** M. Dubois, M. Annavaram, P. Stenstrom

PDF?

- Microsoft Teams

  – Please send me a mail by specifying:
    - The name
    - The student identifier “matricola”
    - The degree

TIMETABLE

1M Computer Eng

	Lu	Ma	Me	Gi	Ve
8:30/9:30	Internet of things ADI1 Formal method for secure systems ADI2	Cloud computing SI 5	Internet of things C31 Formal method for secure systems ADI2	Internet of things ADI1 Formal method for secure systems ADI2	Cloud computing A22
9:30/10:30	Internet of things ADI1 Formal method for secure systems ADI2	Cloud computing SI 5	Internet of things C31 Formal method for secure systems ADI2	Internet of things ADI1 Formal method for secure systems ADI2	Cloud computing A22
10:30/11:30	Computer architecture ADI1		Fondations of cybersecurity SI 7	Fondations of cybersecurity ADI1	Cloud computing A22
11:30/12:30	Computer architecture ADI1	Intelligent systems SI 3	Fondations of cybersecurity SI 7	Fondations of cybersecurity ADI1	Internet of things ADI1 Formal method for secure systems ADI2
12:30/13:30	Computer architecture ADI1	Intelligent systems SI 3	Fondations of cybersecurity SI 7		Internet of things ADI1 Formal method for secure systems ADI2
13:30/14:30	Fondations of cybersecurity ADI1			Intelligent systems F01	
14:30/15:30	Fondations of cybersecurity ADI1			Intelligent systems F01	Computer architecture ADI1
15:30/16:30	Fondations of cybersecurity ADI1	Cloud computing A21		Intelligent systems F01	Computer architecture ADI1
16:30/17:30		Cloud computing A21		Computer architecture ADI1	Computer architecture ADI1
17:30/18:30		Cloud computing A21		Computer architecture ADI1	

Theory lessons

Team practices

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