Computer Systems' Architecture

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The primary goal of the subject is the study the principles of computer architectures and the presentation of design methodologies. The methods of increasing performance for all components will be presented, as well as a comparison between different types of existing architectures, including special architectures.

In lab classes, the students will design a custom RISC processor in VHDL, that will be implemented on a FPGA platform.

This is a ***compulsory subject***, thought to the Automatics and Computers sections, in the 5th semester.

The most relevant data about this subject is presented in the following table:

	Course	Seminar	Lab	Project
Nr. of hours/week	2	-	2	-

Further we enumerate some of the most representative chapters of this subject:

- Computer architecture. von Neumann architecture. Structure of sequential computers. Data-types. Instruction format. Addressing mechanism. Instruction execution.
- Design of the Central Processing Unit. Internal structure of the CPU. Design of the internal bus. Design of Arithmetical and Logical Units. Floating point arithmetical unit. Pipeline-type arithmetical unit. Micro-programmed logic.
- Memory management. Random Access Memory. Serial Access Memory. Extension of address range. Management of the operative memory. Page-based virtual memory. Segment-structured memory. Cache memory.
- I/O operations. External bus. Parallel handshake protocol. Establishing priorities in case of simultaneous bus access. Interrupts. Direct Memory Access. I/O Processors. Serial Communication.
- Comparison of different types of architectures. Comparison of RISC and CISC Architectures. Internal Set-up. Instruction sets. Memory management. Multitasking and protection mechanisms. I/O operations. Interrupt management. Performance parameters.
- Vector processor architectures.

Laboratory class topics:

1. Introduction to FPGA Circuits, VHDL Programming using Xilinx development tools.
2. Design of the processor's instruction set, each with micro-step disassembling.
3. Implementation of the processor's registers in VHDL
4. Set-up of the Arithmetical Logical Unit
5. Design and implementation of the Micro-programmed Command Unit
6. Simulation and test of the built processor
7. Direct video memory programming in text and graphic modes
8. Hardware and software interrupts