2EL2510 – Architecture and design of digital systems

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Department: DÉPARTEMENT ÉLECTRONIQUE ET ÉLECTROMAGNÉTISME
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 60
On-site hours (HPE): 35,00
Elective Category : Fundamental Sciences
Advanced level : No

Description

In a top-down approach, students will learn how to specify and design dedicated digital processing systems, with the goal of integration into an FPGA or ASIC.
The microelectronic back-end aspect (placement routing) will be reserved for students wishing to specialize in the field and studied in third year honors.
The course will lead to the creation of an application, for example a small processing processor, and will thus make it possible to understand the various concepts used in this one.

At the end of this course, students will be able to:
• Define and design the architecture of a digital processing chain
• Describe a model of this treatment in VHDL.
• Design a simple processor and program it

Quarter number

SG6

Prerequisites (in terms of CS courses)

Few knowledge in Digital Electronic

Syllabus

Class 1: Architecture of processing units: data path and sequencer - part. 1
Class 2: Architecture of processing units: data path and sequencer - part. 2
Class 3: VHDL Description
Class 4: Time Analysis of Synchronous Systems
Class 5: GPUs: Architectures and Data Path Part. 1
Class 6: GPUs: Architectures and Data Path Part. 2
Class_TD 1: Algorithmic Logic Units share. 1
Class_TD 2: The Algorithmic Logical Units part. 2
Class_TD 3: Registers, memories and pipeline part. 1
Class_TD 4: Registers, memories and pipeline part. 2
Class_TD 5: The instruction game

Class_TD 6: The instruction decoding part. 1
Class_TD 7: The cache and its strategies
Class_TD 8: The instruction decoding part. 2
Class_TD 9: Executions and conditional jumps
Cours_TD 10: The compiler

Class components (lecture, labs, etc.)

1 - Definition of the notion of a Cours PC:

This is a very strong interaction between a classical course and its almost immediate implementation, although here the approach is reversed: the exercises have as objectives to make realize where are the critical points without knowing the solution to there remedy. Once aware of the problem, the course brings the solution to students who are then much more sensitive. This approach is only possible under the condition that there is no clear cut between the course and the PC, hence the notion of Cours_TD.

ATTENTION: Absence from this part makes it almost impossible to fully understand the subject and therefore validate the course.

2 - Project to realize partially in homework and in team:

6 project sessions (EL) of 1h30 in the presence of a supervisor

- 21h homework (interspersed with previous project sessions).
- 1 session of 3H with oral presentation then demonstration in front of the group of the result

The department will provide each students with an FPGA-type board (the same ones used for the first-year course) that they will keep until the end of their project.

Grading

- Examen - Processor Design
- Project Report and presentation

Ratio: 70% examen - 30% Projet

Resources

DE0 FPGA Board From Altera

Learning outcomes covered on the course

The course "Architecture of Digital Systems" will provide students with the concepts necessary to:

Define a processing architecture

Architecture of processing units: data path and sequencer
Description of each of the above functions in VHDL
Time analysis of synchronous systems

Design of a processor (Project type approach)

ALU, records and pipeline
Building a processor core
Instructional game
Instruction Decoding, Jumps and Pipeline

Data processing on graphic processor

GPU architecture: data path
Parallel programming language via CUDA type library

Description of the skills acquired at the end of the course

C1.1 Study a problem in its entirety, the situation as a whole. Identify, formulate and analyze a problem in its scientific, economic and human dimensions.
C1.3: Solve the problem with a practice of approximation, simulation and experimentation.
C2.3 Identify and quickly acquire new knowledge and skills necessary in the relevant fields, whether technical, economic or other.
C2.5 Master the skills of one of the basic engineering professions (at the junior level).
C3.6: Evaluate the effectiveness, feasibility and robustness of the solutions proposed.
C6.3: Specify, design, produce and validate software.