

CS-476

Embedded system design

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Cursus	Sem.	Type
Computer science	MA2, MA4	Opt.
Cybersecurity	MA2, MA4	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Robotics	MA2, MA4	Opt.
SC master EPFL	MA2, MA4	Opt.

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	During the semester
Workload	180h
Weeks	14
Hours	4 weekly
Courses	2 weekly
Lab	2 weekly
Number of positions	

Summary

Hardware-software co-design is a well known concept in embedded system design. It is also a concept required in designing FPGA-accelerators in data-centers. This course teaches how to transform algorithms in smart hardware-software solutions.

Content

High-level architectures:

- FIFO's, LIFO's, ring-buffers, and ping-pong buffers.
- FSM-D (finite state machine data-path) structures.
- Stream processing.

Acceleration methods:

- Custom instruction set extensions.
- Hardware accelerators
- Compiler optimizations.

Implementation methods:

- Hardware-software co-design.
- Timing closure.
- Virtual prototyping.
- Bare metal versus usage of an RTOS.

Learning Prerequisites**Required courses**

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Recommended courses

- Architecture-aware programming
- CS-200 Computer Architecture or CS-208 Computer Architecture I and CS-209 Computer Architecture II

Important concepts to start the course

- C/C++ programming skills
- Verilog/VHDL description skills

Learning Outcomes

By the end of the course, the student must be able to:

- Design buffers to account for different read and write behaviors
- Understand the concept of FSM-D's and use this concept to design accelerators
- Understand the concept of stream processing and be able to implement a stream processor
- Design and optimize an embedded system on FPGA given a set of prerequisites

Teaching methods

- First 9 weeks : theory with small projects and reports
- Last 5 weeks : mini project in groups of 2 students with final demonstration and presentation

Expected student activities

- Perform in groups of two students small projects to put the theory into practice
- Optimize a real world problem in a final project, explain the choices made, and present the results

Assessment methods

- Lab reports : 50%
- Final mini-project : 50%

Supervision

Office hours	No
Assistants	Yes
Others	Electronic forum and Moodle

Resources**Moodle Link**

- <https://go.epfl.ch/CS-476>