

CS-470

**Advanced computer architecture**

Ienne Paolo

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

Language of teaching	English
Credits	8
Session	Summer
Semester	Spring
Exam	Written
Workload	240h
Weeks	14
<b>Hours</b>	<b>5 weekly</b>
Courses	3 weekly
Lab	2 weekly
<b>Number of positions</b>	

**Summary**

The course studies techniques to exploit Instruction-Level Parallelism (ILP) statically and dynamically. It also addresses some aspects of the design of domain-specific accelerators. Finally, it explores security challenges based on microarchitectural features and hardware isolation techniques.

**Content**

Pushing processor performance to its limits:

- Principles of Instruction Level Parallelism (ILP)
- Register renaming techniques
- Prediction and speculation
- Simultaneous multithreading
- VLIW and compiler techniques for ILP
- Dynamic binary translation

Domain specific architectures and accelerators:

- Specificities of embedded vs. general computing processors
- Overview of DSPs and related compilation challenges
- High-Level Synthesis and accelerators

Hardware security:

- Information leakage through the microarchitecture
- Trusted Execution Environments
- Physical side-channel attacks

**Keywords**

Processors, Instruction Level Parallelism, Systems-on-Chip, Embedded Systems, High-Level Synthesis, Hardware Security.

**Learning Prerequisites****Required courses**

- CS-208 Computer Architecture I

### Recommended courses

- CS-209 Computer Architecture II

### Important concepts to start the course

Undergraduate knowledge of digital circuit design and of computer architecture

### Learning Outcomes

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

- Design strategies to exploit instruction level parallelism in processors.
- Contrast static and dynamic techniques for instruction level parallelism.
- Design effective processor (micro-)architectures for which efficient compilers can be written.
- Develop hardware accelerators competitive to best commercial processors
- Defend against security threats based on microarchitectural processor features

### Teaching methods

Courses, labs, and compulsory homeworks.

### Assessment methods

Homeworks (30%)

Final exam (70%)

### Supervision

Forum                      Yes

### Resources

#### Virtual desktop infrastructure (VDI)

No

### Bibliography

- John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufman, 6th edition, 2017.

### Ressources en bibliothèque

- [Computer Architecture / Hennessy](#)

### Moodle Link

- <https://go.epfl.ch/CS-470>

### Prerequisite for

- CS-471 Advanced Multiprocessor Architecture