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
• Optimized memory hierarchies and efficient virtualization
• 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
• Basic notions of High-Level Synthesis
• Statically and dynamically scheduled accelerators

Security concerns:
• Information leakage through the memory hierarchy
• Information leakage through the front-end (branch prediction)
• Hardware-based architectures for isolation (e.g., ARM TrustZone and Intel SGX)
• Power-analysis side-channel attacks

Keywords

Learning Prerequisites
Required courses
• CS-208 Architecture des ordinateurs or Computer Architecture I

Recommended courses
• CS-209 Architecture des systèmes-on-chip or 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
Labs, homeworks, and final exam.

Supervision
Office hours: No
Assistants: Yes
Forum: Yes

Resources
Virtual desktop infrastructure (VDI)
No

Bibliography

Ressources en bibliothèque
• Computer Architecture / Hennessy

Moodle Link
• https://moodle.epfl.ch/course/view.php?id=15017

Prerequisite for
• CS-471 Advanced Multiprocessor Architecture