Microprocessor architecture

Lecturer
Dragomir MILOJEVIC (Coordinator)

Course mnemonic
ELEC-H473

ECTS credits
5 credits

Language(s) of instruction
English

Course period
Second term

Course content

C and assembly language. CMOS scaling and limits of it when applied to computers. Multi-processors and their limits (Amdahl's law). Von Neumann and Harvard architectures. Instruction Set Architecture. CISC/RISC computers. Pipeline execution. Execution hazards and solutions. In and out-of-order execution. Super-scalar architectures. Memory technologies (CMOS). Memory hierarchy. Cache memory & control. Virtual memory. SIMD execution model and program vectorization at compiler level. SIMD on Intel processors. Practical implementation of SIMD programs: image processing algorithms for SIMD. Parallel computing and programming models. Multi-threaded programming. Simultaneous multi-threading. Analysis of current Intel/SPARC/ARM architectures. Power & thermal management.

Objectives (and/or specific learning outcomes)

In-depth analysis of state-of the art microprocessor architectures for both high-performance and low-power applications. Students will master theoretical knowledge required to understand current trends in both CPU hardware design and practical usage at software level. Practical exercises are focusing on CPU modeling on various abstraction levels (C language but also assembly) and demonstrate advanced programming techniques (SIMD) that target architecture dependent optimizations and implementations.

Pre-requisits and co-requisits

Course having this one as pre-requisit

STAG-H502 | Internship (40 days) | 6 crédits

Teaching method and learning activities

Ex-cathedra lectures + labs with computers for simulation & programming

Contribution to the teaching profile

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- Correctly report on research or design results in the form of a technical report or in the form of a scientific paper
- Collaborate in a (multidisciplinary) team
- Work in an industrial environment with attention to safety, quality assurance, communication and reporting
- Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
- A creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- A critical attitude towards one's own results and those of others
- The flexibility and adaptability to work in an international and/or intercultural context
- An attitude of life-long learning as needed for the future development of his/her career
- Has an active knowledge of the theory and applications of electronics, information and communication technology, from component up to system level.
- Has a broad overview of the role of electronics, informatics and telecommunications in industry, business and society.
- Is able to analyse, specify, design, implement, test and evaluate individual electronic devices, components and algorithms, for signal-processing, communication and complex systems.

References, bibliography and recommended reading

Multiple references that cover specific topic are given throughout the lectures.- J.L. Henessey, D.A. Peterson, Computer Architecture- J. Yiu, Definitve guide to ARM Cortex Processors- Intel documentation

Other information

Contact(s)

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Evaluation method(s)

Other

Evaluation method(s) (additional information)

Written exam is split into theoretical exam (closed book) and practical exam (closed book).

Determination of the mark (including the weighting of partial marks)

Each of the two parts will contribute to 50% of the final score.

Main language(s) of evaluation

English

Programmes

Programmes proposing this course at the Brussels School of Engineering

MA-IREL | Master of science in Electrical Engineering | finalité electronics and information technologies/unit 1 and MA-IRIF | Master of science in Computer Science and Engineering | finalité Professional/unit 1

Programmes proposing this course at the faculty of Sciences

MA-INFO | Master in Computer science | finalité Professional/unit 1 and MA-SECU | Master in cybersecurity | finalité Cryptalalysis and Forensics/unit 2