EPFL

CS-522   **Principles of computer systems**

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Cursus	Sem.	Type
Computer and Communication Sciences		Obl.
Computer science	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	7
Session	Winter
Semester	Fall
Exam	During the semester
Workload	210h
Weeks	14
Hours	**4 weekly**
Courses	4 weekly
Number of positions	

Summary

This advanced graduate course focuses on key design principles underlying successful computer and communication systems, and teaches how to solve real problems using ideas, techniques, and algorithms from operating systems, networks, databases, programming languages, and computer architecture.

Content

A modern computer system spans many layers: applications, libraries, operating systems, networks, and hardware devices. Building a good system entails making the right trade-offs (e.g., between performance, durability, and correctness) and understanding emergent behaviors - the difference between great system designers and average ones is that the really good ones make these trade-offs in a principled fashion, not by trial-and-error.
In this course we develop such a principled framework for system design, covering the following topics:

- Modularity, Abstraction, and Layering
- Indirection and Naming
- Locality
- End-to-end / State partitioning
- Virtualization
- Atomicity and Consistency
- Redundancy and Availability
- Interpretation, Simulation, Declarativity
- Laziness vs. Speculation
- CAP Theorem, DQ Principle, Harvest/Yield
- Least Privilege, Minimum TCB

Learning Prerequisites

Required courses

Principles of Computer Systems (POCS) is targeted at students who wish to acquire a deep understanding of computer system design or pursue research in systems. It is an intellectually challenging, fast paced course, in which mere survival requires a solid background in operating systems, databases, networking, programming languages, and computer architecture. The basic courses on these topics teach how the elemental parts of modern systems work - POCS picks up where the basic courses leave off and focuses on how the pieces come together to form useful, efficient systems. To do well in POCS, a student must master the material of the following courses:

- COM-208 Computer networks

- CS-208 Computer architecture
- CS-210 Functional programming
- CS-305 Software engineering
- CS-322 Introduction to database systems
- CS-323 Operating systems

Recommended courses

The following EPFL courses cover material that significantly help students' understanding of POCS concepts; however, these courses are not strictly required:
- CS-320: Computer language processing
- CS-470: Advanced computer architecture
- CS-422: Database systems
- COM-407: TCP/IP networking

Learning Outcomes

By the end of the course, the student must be able to:
- Design computer and communication systems that work well
- Make design trade-offs (e.g., performance vs. correctness, latency vs. availability)
- Anticipate emergent system behaviors (e.g., failure cascades, security vulnerabilities)
- Integrate multiple techniques, ideas, and algorithms from different fields of computing/communication into a working system

Teaching methods

- Online video lectures
- Ex cathedra
- Small-group discussions and exercises
- Projects

Expected student activities

- Complete assigned reading and writing assignments
- Assimilate online video lectures
- Attend recitations and plenary sessions
- Participate actively in class (physically and online)
- Work in a team on design projects

Assessment methods

Throughout semester
- 20% homework
- 40% design projects
- 40% exam during semester

Supervision

EPFL

Office hours	Yes
Assistants	Yes
Forum	Yes
Others	See http://pocs.epfl.ch/

Resources

Bibliography

See http://pocs.epfl.ch for up-to-date bibliography.

Ressources en bibliothèque

• Principles of computer system design : an introduction / Saltzer

Websites

• http://pocs.epfl.ch