CS-451

# Distributed algorithms

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| Cursus | Sem. | Type |
|---|---|---|
| Computer and Communication Sciences | | Obl. |
| Computer science minor | H | Opt. |
| Computer science | MA1, MA3 | Obl. |
| Cybersecurity | MA1, MA3 | Obl. |
| Data Science | MA1, MA3 | Opt. |
| Quantum Science and Engineering | MA1, MA3 | Opt. |
| SC master EPFL | MA1, MA3 | Obl. |

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|---|---|
| Language of teaching | English |
| Credits | 8 |
| Session | Winter |
| Semester | Fall |
| Exam | Written |
| Workload | 240h |
| Weeks | 14 |
| **Hours** | **6 weekly** |
| Courses | 2 weekly |
| Exercises | 1 weekly |
| Lab | 3 weekly |
| **Number of positions** | |

## Summary

Computing is nowadays distributed over several machines, in a local IP-like network, a cloud or a P2P network. Failures are common and computations need to proceed despite partial failures of machines or communication links. This course will study the foundations of reliable distributed computing.

## Content

Reliable broadcast
Causal Broadcast
Total Order Broadcast
Consensus
Non-Blocking Atomic Commit
Group Membership, View Synchrony
Terminating Reliable Broadcast
Shared Memory in Message Passing Systems
Byzantine Fault Tolerance
Self Stabilization
Population protocols (models of mobile networks)
Bitcoin, Blockchain
Distributed Machine Learning
Gossip

## Keywords

Distributed algorithms, checkpointing, replication, consensus, atomic broadcast, ditributed transactions, atomic commitment, 2PC, Machine Learning

## Learning Prerequisites

### Required courses

Basics of Algorithms, networking and operating systems

### Recommended courses

The lecture is orthogonal to the one on concurrent algorithms: it makes a lot of sense to take them in parallel.

## Learning Outcomes

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

- Choose an appropriate abstraction to model a distributed computing problem
- Specify the abstraction
- Present and implement it
- Analyze its complexity
- Prove a distributed algorithm
- Implement a distributed system

## Teaching methods

Ex cathedera
Lectures, exercises and practical work

## Assessment methods

Final exam (theory)
Project (practice)

## Resources

### Ressources en bibliothèque

- Find the references at the Library

### Notes/Handbook

Reliable and Secure Distributed Programming
Springer Verlag
C. Cachin, R. Guerraoui, L. Rodrigues

### Moodle Link

- https://go.epfl.ch/CS-451