

CS-453

**Concurrent algorithms**

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Cursus	Sem.	Type
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
<b>Hours</b>	<b>5 weekly</b>
Courses	3 weekly
Exercises	1 weekly
TP	1 weekly
<b>Number of positions</b>	

**Summary**

With the advent of multiprocessors, it becomes crucial to master the underlying algorithmics of concurrency. The objective of this course is to study the foundations of concurrent algorithms and in particular the techniques that enable the construction of robust such algorithms.

**Content****Model of a parallel system**

A multicore architect  
Processes and objects  
Safety and liveness

**Parallel programming**

Automatic parallelism  
Mutual exclusion and locks  
Non-blocking data structures

**Register Implementations**

Safe, regular and atomic registers  
General and limited transactions  
Atomic snapshots

**Hierarchy of objects**

The FLP impossibility  
The consensus number  
Universal constructions

**Transactional memories**

Transactional algorithms  
Opacity and obstruction-freedom

**Keywords**

Concurrency, parallelism, algorithms, data structures

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

ICC, Operatings systems

**Recommended courses**

This course is complementary to the Distributed Algorithms course.

**Important concepts to start the course**

Processes, threads, data structures

**Learning Outcomes**

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

- Reason in a precise manner about concurrency
- Design a concurrent algorithm
- Prove a concurrent algorithm
- Implement a concurrent system

**Teaching methods**

Lectures, exercises and practical work

**Expected student activities**

Midterm and final exam

Project

**Assessment methods**

With continuous control, midterm final exams and project

**Supervision**

Office hours	Yes
Assistants	Yes
Forum	No

**Resources****Notes/Handbook**

Concurrent Algorithms, R. Guerraoui and P. Kouznetsov

**Websites**

- <http://lpd.epfl.ch/site/education>