Concurrent algorithms

Guerraoui Rachid

<table>
<thead>
<tr>
<th>Cursus</th>
<th>Sem.</th>
<th>Type</th>
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<tbody>
<tr>
<td>Informatique</td>
<td>MA1, MA3</td>
<td>Opt.</td>
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<td>SC master EPFL</td>
<td>MA1, MA3</td>
<td>Opt.</td>
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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, operating systems

**Recommended courses**
Algorithms, concurrency

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
• Implement a concurrent system
• Prove a concurrent algorithm

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