# Concurrent Programming

## 1: Introduction

Fabrizio Montesi

<fmontesi@imada.sdu.dk>

SDU

DEPARTMENT OF MATHEMATICS
AND COMPUTER SCIENCE

# Concurrent systems

- Systems where multiple executions take place at the same time.
- Executions may interact with each other.
- Think:
  - Some applications may collaborate together.
  - A single application using multiple CPUs at the same time.

# Why concurrency?

- Two main motivations.
- Speed:
  - CPUs are not getting much faster every year…
  - ...but they are getting more cores!
- Networks:
  - Computers are not getting much faster every year…
  - ...but our networks are getting bigger!

# Concurrency is hard!

- Programming is difficult enough already.
- It gets harder when you think about *multiple* executions.
- So we need to equip ourselves with good *tools* and *methods*.

# From the field...

- Interpreter of the Jolie programming language (jolie-lang.org)
- Language meant for concurrency.
- Open source.

# Topic

- Techniques for designing and programming concurrent systems.

- Focus is on:
  - The key concepts behind concurrency.

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# Course Structure

- This course uses (a variant of) Flipped Classroom!

- You read the book and do exercises during the exercise classes.

- You then come to the frontal lectures with me:
  - I'll expect you to have read the book chapters I assigned.
  - Live coding and more practical insight.
  - Reflection (e.g., quizzes).

# Course Material

- Slides.
- **The Book:** Java Concurrency in Practice. *Brian Goetz et al. Addison-Wesley*.
- The book has a website: http://jcip.net/
- More resources during the lectures.

# What we will strive to learn

- Define concurrency.
- Design and implement concurrent programs.
- Reason about the efficiency of a concurrent program.
- Reason about the **correctness** of a concurrent program.

# The General Objective

- Understand how we can exploit having a lot of cores in our CPUs and a lot of devices connected together.

# Evaluation

- Final project with report:
  - You will all solve the same problem.
  - Internal censor, 7-point scale.
  - The problem will be given later during the course.
  - The structure of the report will also be given.

# Communication during the lectures

- Don't leave me alone, I'll bore myself.
- So there will be some quizzes.
- Also, I need to get feedback from you.
- The Humming feedback system!