Laboratory overview

Rico Krueger

Transport and Mobility Laboratory
School of Architecture, Civil and Environmental Engineering
École Polytechnique Fédérale de Lausanne

23 February 2021

Laboratories

Aims:

- Become familiar with simulation and optimization approaches
- Apply statistical techniques and heuristic algorithms
- Use simulation-based optimization methods

How:

- Guided exercises in Python
- Group project to solve a real world problem

Schedule

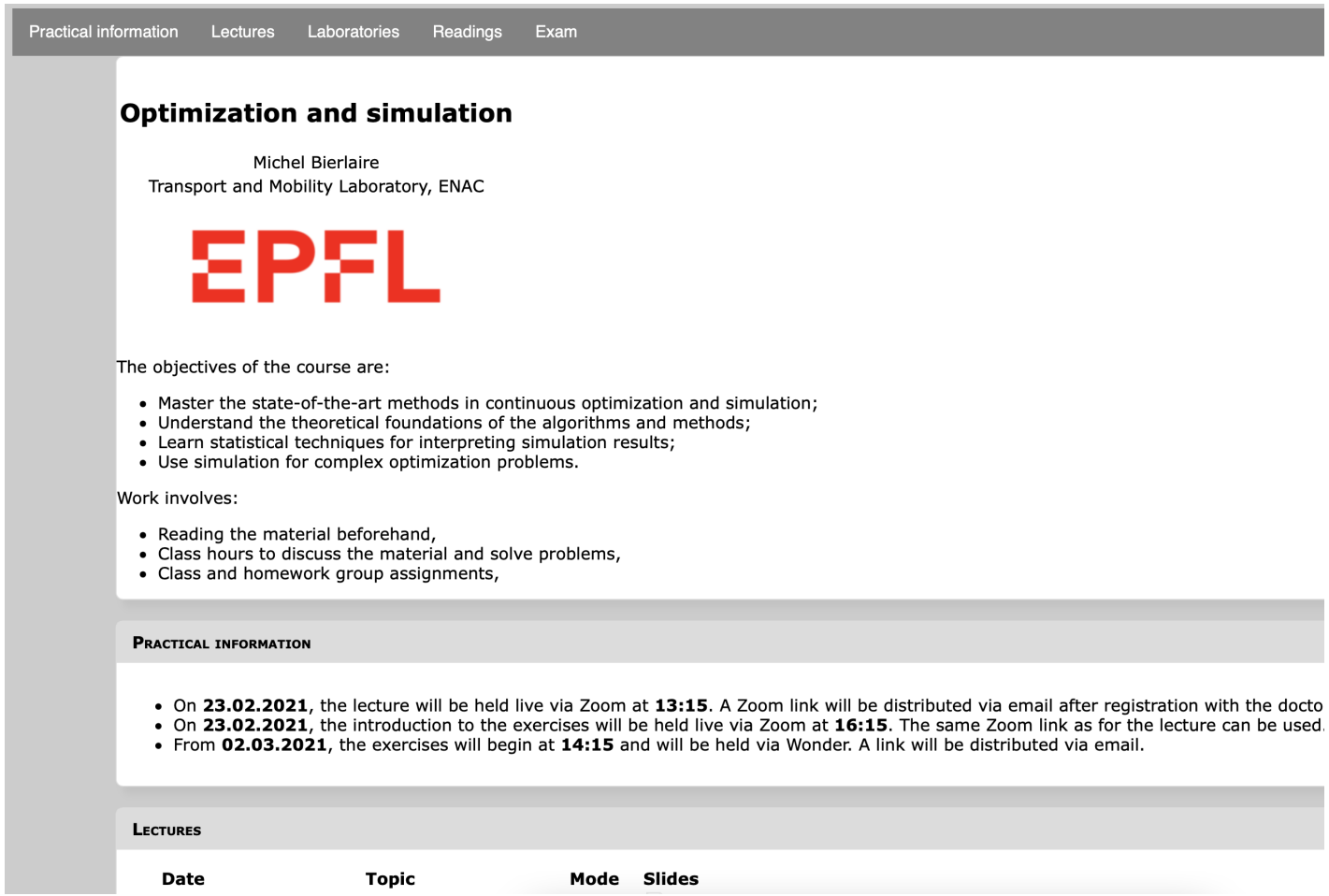
Laboratories

Date	Topic	Mode	Material
23.02.2021	Overview	Zoom	
02.03.2021	Random number generation, Poisson process	Wonder	
	Discrete event simulation		
09.03.2021	Statistical analysis and bootstrapping	Wonder	
	Introduction to group project		
16.03.2021	Variance reduction	Wonder	
	Simulation project		
23.03.2021	Markov chain Monte Carlo methods	Wonder	
	Simulation project		
30.03.2021	Simulation project	Wonder	
06.04.2021	~~ Spring break ~~		
13.04.2021	Simulation project	Wonder	
20.04.2021	Optimization exercises	Wonder	
27.04.2021	Optimization exercises	Wonder	
	Introduction to optimization project	Wonder	
04.05.2021	Optimization project	Wonder	
11.05.2021	Optimization project	Wonder	
18.05.2021	Optimization project	Wonder	
25.05.2021	Written exam	Take home	
01.06.2021	Project presentations	Zoom	

- **Laboratories**:
  - 7 weeks for **simulation**
  - 6 weeks for **optimization**
- **Exam:**
  - 25 May 2021
- **Presentation exam:**
  - 30 minutes presentation + Q&A
  - 1 June 2021

Laboratory materials

- Find on the webpage.
- Material will be uploaded before the class.



Practical information Lectures Laboratories Readings Exam

Optimization and simulation

Michel Bierlaire
Transport and Mobility Laboratory, ENAC

EPFL

The objectives of the course are:

- Master the state-of-the-art methods in continuous optimization and simulation;
- Understand the theoretical foundations of the algorithms and methods;
- Learn statistical techniques for interpreting simulation results;
- Use simulation for complex optimization problems.

Work involves:

- Reading the material beforehand,
- Class hours to discuss the material and solve problems,
- Class and homework group assignments,

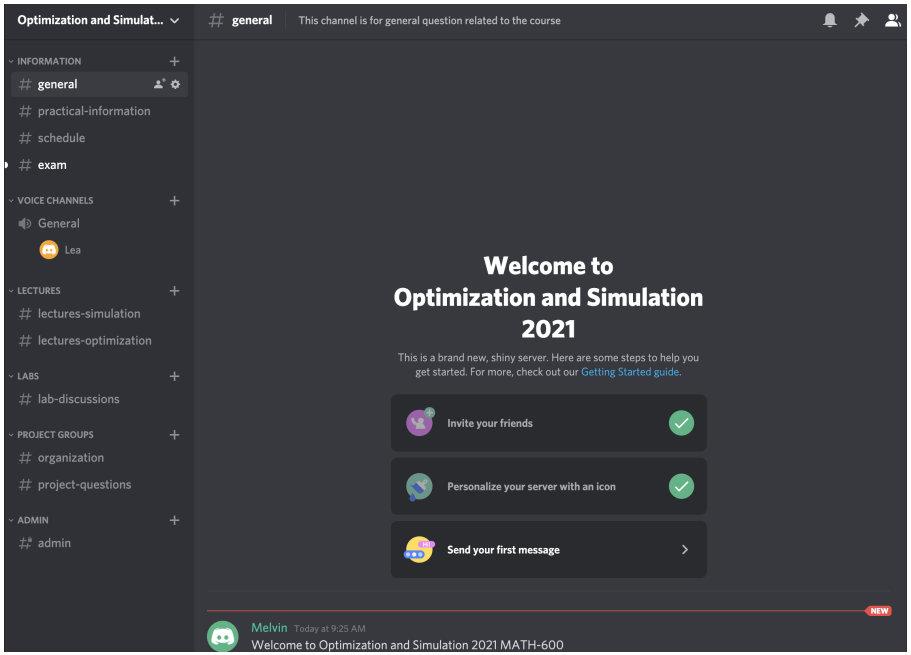
PRACTICAL INFORMATION

- On **23.02.2021**, the lecture will be held live via Zoom at **13:15**. A Zoom link will be distributed via email after registration with the docto
- On **23.02.2021**, the introduction to the exercises will be held live via Zoom at **16:15**. The same Zoom link as for the lecture can be used.
- From **02.03.2021**, the exercises will begin at **14:15** and will be held via Wonder. A link will be distributed via email.

LECTURES

Date	Topic	Mode	Slides

Discord



- Communication and collaboration platform.
- Announcements.
- Ask questions about lectures, labs and group projects.
- Organize collaboration on exercises and projects.
- Invitation sent by email.

Evaluation

1. **Project presentation**
   - Both simulation and optimization parts must be presented.
   - The evaluation criteria, group and project description will be announced in the third lab on 9 March 2021.
   - **Everyone must be present on 1 June 2021**.
2. **Exam**
   - Exam date: 25 May 2021.
   - The exam accounts for 25% of the final grade.
   - The exam is in English.
   - Details will be announced later.
3. Class & group involvement
4. Quality of the code, it should:
   - Work properly.
   - Be neat and clearly commented.

Simulation laboratories

- Exercises:
  1. Random number generation
  2. Poisson process
  3. Discrete event simulation
  4. Statistical analysis and bootstrapping
  5. Variance reduction techniques
  6. Markov Chain Monte Carlo methods
- Simulation project:
  - Announced on 9 March 2021 (at the end of the third laboratory).

Textbooks for simulation

- Ross (2012). Simulation. Fifth Edition. Academic Press.
- Gelman et al. (2013) Bayesian Data Analysis. CRC Press.

Python

- You should have some basic knowledge of Python to follow the course.
  - Python is used in the computer labs.
  - Projects should be produced using Python.
- Software
  - Anaconda distribution: Jupyter, Spyder (to be installed locally).
  - Google Colab (cloud-based and interactive).

Python

- Python self-study tutorials prepared by Tim Hillel (TRANSP-OR, EPFL):
  - Github repo: `https://github.com/th389/DAStudents`
  - Fundamentals: `https://mybinder.org/v2/gh/th389/DAStudents/master?filepath=python_fundamentals.ipynb`
  - Further techniques: `https://mybinder.org/v2/gh/th389/DAStudents/master?filepath=python_further_techniques.ipynb`

Any
Questions?