CS-502

Deep learning in biomedicine

Brbic Maria

Cursus	Sem.	Type
Computational biology minor	H	Opt.
Computational science and Engineering	MA1, MA3	Opt.
Computer science	MA1, MA3	Opt.
Data Science	MA1, MA3	Opt.
Life Sciences Engineering	MA1, MA3	Opt.
Minor in life sciences engineering	H	Opt.
Neuro-X minor	H	Opt.
Neuro-X	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	6
Session	Winter
Semester	Fall
Exam	During the semester
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	2 weekly
Exercises	2 weekly
Practical work	1 weekly
Number of positions	

Summary

Deep learning offers potential to transform biomedical research. In this course, we will cover recent deep learning methods and learn how to apply these methods to problems in biomedical domain.

Content

The goal of this course is to cover recent deep learning methods and demonstrate how they can be applied to biomedical data. The course will cover ongoing advances in deep learning research for different input data types (e.g., convolutional neural networks for images, graph convolutional neural networks for graph structured data, transformers for sequence data). We will start with a standard supervised learning setting and then cover the ongoing developments in methodologies that allow us to learn using scarcely labeled datasets by transferring knowledge across tasks (e.g., transfer learning, meta-learning). These settings have particular importance in the biomedical domain in which it is often very difficult to obtain labeled datasets. Recent papers from the literature that apply these methods to problems in biomedicine will be presented and discussed.
In assignments, students will work with popular deep learning software frameworks. They will be evaluated on their ability to understand and implement the methods learned in a class. In the project, students will choose a real-world problem in the biomedical domain and develop a solution for the problem of their choice. They will be evaluated on the ability to propose and develop a suitable model to solve the task, propose suitable evaluation, provide analysis and extract insights from the developed models, write a project report and present project results.
This course is of interest to MS/PhD students interested in recent deep learning methods and their applications to real-world problems in the biomedical domain.

Learning Prerequisites

Required courses

CS-433 Machine learning

Recommended courses

CS-233 Introduction to machine learning

Important concepts to start the course

- Python programming
- Probability and statistics
- Linear Algebra

- Machine learning

Learning Outcomes

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

- Understand and implement deep learning methods covered in the course
- Understand benefits and shortcomings of the methods covered in the course
- Understand common problems in the biomedical domain and know which methods are suitable for solving these problems
- Review academic research papers and understand their contributions according to concepts covered in the course
- Complete a project that applies learned algorithms to a real-world problem in the biomedical domain

Teaching methods

- Lectures
- Paper reading
- Course project

Expected student activities

- Attend lectures and participate in class
- Complete homework assignments
- Complete a deep learning project in a group. This includes preparing a project proposal, implementing the method, submitting final project report and presenting project results

Assessment methods

- Assignments during the semester (50%)
- Project (50%)

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

Goodfellow, Bengio, Courville. Deep Learning. MIT Press (2016)

Ressources en bibliothèque

- Deep Learning / Goodfellow

Moodle Link

- https://go.epfl.ch/CS-502