EPFL

CS-456	**Artificial neural networks**

Gerstner Wulfram

Cursus	Sem.	Type
Biocomputing minor	E	Opt.
Computer science	MA2	Opt.
Data Science	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

Since 2010 approaches in deep learning have revolutionized fields as diverse as computer vision, machine learning, or artificial intelligence. This course gives a systematic introduction into the main models of deep artificial neural networks: Supervised Learning and Reinforcement Learning.

Content

- *Simple perceptrons for classification*
- *BackProp and Multilayer Perceptron*
- *Deep Learning 1: Introduction*
- *Deep Learning 2: regularization and Tricks of the Trade*
- *Deep Learning 3: Theory*
- *Autoencoders and unsupervised learning*
- *Reinforcement Learning 1: TD Learning*
- *Reinforcement Learning 2: Q learning, SARSA*
- *Reinforcement Learning 3: Policy gradient*
- *Deep reinforcement learning*
- *Applications*
- *Outlook: Can the Brain implement Deep Learning?*

Keywords

Deep learning, artificial neural networks, reinforcement learning, TD learning, SARSA,

Learning Prerequisites

Required courses

CS 433 Pattern Classification and Machine Learning (or equivalent)
Calculus, Linear Algebra (at the level equivalent to first 2 years of EPFL in STI or IC, such as Computer Science, Physics or Electrical Engineering)

Recommended courses

stochastic processes
optimization

Important concepts to start the course

- *Regularization in machine learning,*
- *Training base versus Test base, cross validation.*
- *Gradient descent. Stochastic gradient descent.*
- *Expectation, Poisson Process, Bernoulli Process.*

Learning Outcomes

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

- Apply learning in deep networks to real data
- Assess / Evaluate performance of learning algorithms
- Elaborate relations between different mathematical concepts of learning
- Judge limitations of algorithms
- Propose algorithms and models for learning in deep networks

Transversal skills

- Continue to work through difficulties or initial failure to find optimal solutions.
- Manage priorities.
- Access and evaluate appropriate sources of information.
- Write a scientific or technical report.

Teaching methods

ex cathedra lectures and miniproject

Expected student activities

work on miniproject
attend all lectures
read book chapters and relevant tutorials
solve all exercises

Assessment methods

written exam (70 percent) and miniproject (3 percent)

Resources

Bibliography

- Textbook: Deep Learning by Goodfellow, Bengio, Courville
- Landmark papers

Links to videos of presentations given by people in deep learning

Ressources en bibliothèque

- Deep Learning / Goodfellow