Artificial neural networks

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 Perceptrons for deep learning
- Statistical Classification by deep networks
- Regularization and Tricks of the Trade in deep learning
- Error landscape and optimization methods for deep networks
- Convolutional networks
- Sequence prediction and recurrent networks
- Reinforcement Learning 1: Bellman equation and SARSA
- Reinforcement Learning 2: variants of SARSA, Q-learning, n-step-TD learning
- Reinforcement Learning 3: Policy gradient
- Deep reinforcement learning: applications
- Reinforcement learning and the brain

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
solve all exercises
attend all lectures and take notes during lecture, participate in quizzes.
If you cannot attend a lecture, then you must read the recommended book chapters

Assessment methods
written exam (70 percent) and miniproject (30 percent)

Supervision
Office hours No
Assistants Yes
Forum Yes
Others TAs are available during exercise sessions.
Professor is available during the breaks of class.
Some of the exercises are run as 'integrated exercises' during the lecture

Resources
Bibliography
• Textbook: Deep Learning by Goodfellow, Bengio, Courville (MIT Press)
• Textbook: Reinforcement Learning by Sutton and Barto (MIT Press)
Pdfs of the preprint version for both books are available online

**Ressources en bibliothèque**
- Deep Learning / Goodfellow

**Moodle Link**