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

• 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 Networks 1: BackProp and Multilayer Perceptrons
• Deep Networks 2: Regularization and Tricks of the Trade in deep learning
• Deep Networks 3. Error landscape and optimization methods for deep networks
• Deep Networks 4. Statistical Classification by deep networks
• Application 1: Convolutional networks
• Application 2: Sequence prediction and recurrent networks
• Deep reinforcement learning: Actor-Critic networks
• Deep reinforcement learning: applications

Keywords

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

Learning Prerequisites
Required courses
CS 433 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
• 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
• Apply Reinforcement Learning

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

Teaching methods
ex cathedra lectures and 2 miniprojects. Every week the ex cathedra lectures are interrupted for a short in-class exercise which is then discussed in classroom before the lecture continues. Additional exercises are given as homework. For the exercise sessions two time slots of 45 minutes will be offered, and students will sign up for one of the two.

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 Yes
Assistants: Yes
Forum: Yes
Others: TAs are available during exercise sessions.
Every week one of the exercises is run as 'integrated exercise' during the lecture.
Choice between two different exercise sessions

Resources

Bibliography
- Textbook: Reinforcement Learning by Sutton and Barto (MIT Press)

Pdfs of the preprint version for both books are available online

Ressources en bibliothèque
- Reinforcement Learning by Sutton and Barto
- Deep Learning by Goodfellow, Bengio, Courville