**Summary**

The objective of this course is to provide a complete introduction to deep machine learning. How to design a neural network, how to train it, and what are the modern techniques that specifically handle very large networks.

**Content**

The course aims at teaching the required skills to use deep learning methods on applied problems. It will show how to design and train a deep neural network for a given task, and the sufficient theoretical basis to go beyond the topics directly seen in the course.

The planned content of the course:

- What is deep learning, introduction to tensors.

- Basic machine-learning, empirical risk minimization, simple embeddings.

- Linear separability, multi-layer perceptrons, back-prop.


- Initialization, optimization, and regularization. Drop-out, activation normalization, skip connections.

- Deep models for Computer Vision.

- Analysis of deep models.

- Auto-encoders, embeddings, and generative models.

- Recurrent models and Natural Language Processing.

- Pytorch tensors, deep learning modules, and internals.

Concepts will be illustrated with examples in the pytorch framework (http://pytorch.org).

**Keywords**

machine learning, neural networks, deep learning, computer vision, python, pytorch

**Learning Prerequisites**

**Required courses**
- Linear algebra (vector, matrix operations, Euclidean spaces).
- Differential calculus (Jacobian, Hessian, chain rule).
- Python programming.
- Basics in probabilities and statistics (discrete and continuous distributions, normal density, law of large numbers, conditional probabilities, Bayes, PCA)

**Recommended courses**
- Basics in optimization (notion of minima, gradient descent).
- Basics in algorithmic (computational costs).
- Basics in signal processing (Fourier transform, wavelets).

**Teaching methods**
Ex-cathedra with exercise sessions and mini-projects. Invited speakers from the industry will present how deep learning is used in practice for their applications.

**Assessment methods**
Two mini-projects by groups of three students, and one final written exam.

**Resources**
- Notes/Handbook
  Not mandatory: http://www.deeplearningbook.org/