



EP235U Deep Neural Networks

5.0 credits

Djupa neuronnät

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

The course syllabus is valid from Spring 2026 according to the faculty board decision: HS-2026-0101.

Grading scale

P, F

Education cycle

Second cycle

Main field of study

Computer Science and Engineering

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

Course contents

1. Data-limited scenarios

- Relevant non-linear transformations
- Kernel tricks and kernel regression
- Connection with Support Vector Machine
- Random features and neural network
- Few-shot learning

2. Implementation issues and strategies in deep neural network

- Non-convex problem, gradient search and backpropagation,
- Training issues in DNNs, vanishing and exploding gradient problems
- Training using different optimization methods, e.g., SGD, RMSprop, AdaDelta, Adam, Dropout, data augmentation, etc.
- Unbalanced data problem and useful tricks, such as data augmentation
- Cross-validation techniques and model optimization to address over-fitting, for example, grid search, random search, k-fold, Stratified k-fold, early-stopping, drop out, bias-variance trade-off for model monitoring.

3. Structured deep neural networks

- AlexNet, VGG-16, U-Net, ResNet, DenseNet, SciNet, etc

4. Generative models.

- Implicit and explicit models
- Generative Adversarial Networks (GANs)
- Auto encoders, such as Variational auto-encoder (VAE), Denoising auto-encoder
- DC GAN, Cycle GAN
- Normalized flow models and likelihood computation
- Real NVP and Glow models
- Mixture flow model with expectation-maximization and gradient search

5. Deep neural networks for dynamic signals

- Recursive neural networks (RNN), e.g. LSTM, reservoir computing,
- Hidden Markov models (HMM)
- Normalised Flow networks based HMM
- Attention mechanism

6. Incremental learning, transfer learning

- Incremental learning, Learning without forgetting

- Transfer learning via pretraining, Transfer learning with GANs

Examination

- INL1 - Home assignments, 4.0 credits, grading scale: P, F
- DEL1 - Workshop, 1.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

Attendance and presentation at final workshop are compulsory to pass the course. The workshop is arranged in a virtual way. If a student can not participate in the workshop, they must send their presentation, and the teacher will make a short oral examination.