

Advanced Deep Learning Techniques

Course code: MLC_ADV

The course is intended for people who are looking for a deeper understanding of artificial neural networks, especially so called deep learning. We will build on the basic knowledge of machine learning principles on the level of our course Introduction to machine learning. We will pay special attention to the topic of machine learning model interpretability and explainability.

Who is the course for

The course is intended for people who are looking for a deeper understanding of artificial neural networks, especially so called deep learning.

Required skills

- basic knowledge of programming in Python
- high school level of mathematics
- Basics of machine learning on the level of our course Introduction to machine Learning

Course outline

- Neural network architectures (feed-forward, recurrent, convolutional, generative, autoencoders, Unet, GAN, attention layer)
- Optimizers and their evolution (Steepest Gradient Descent, Stochastic Gradient Descent, Mini-Batch Gradient Descent, Nesterov Accelerated Gradient, Adagrad, AdaDelta, Adam, Learning rate tuning)
- Loss functions and their properties (Mean squared error, Mean absolute error, Negative, Log Likelihood – cross entropy)
- Regularization in Neural Networks (Dropout, Early stopping, Data augmentation, Batch and layer normalization)
- Initialization (Gradient vanishing problem, Zero initialization, He initialization, Xavier initialization)
- Semi-supervised learning (Pseudo Labeling, Mean-Teacher, PI-Model)
- Practical examples of semi-supervised techniques applications
- Confidence estimation (Logit analysis, Confidence networks)
- Practical examples of confidence estimation
- AutoML approaches (Hyper-parameter optimization, grid search, Bayesian optimization, Meta-Learning, Neural network search)
- Practical examples with the AutoKeras
- ML Explainability (Interpretable models, Partial Dependence Plot, Permutation feature importance, Surrogate models, Activation Maximization, Grad CAM)

GOPAS Praha
Na Strži 2097/63
140 00 Praha 4 - Krč
Tel.: +420 226 201 390
info@gopas.cz

GOPAS Brno
Nové sady 996/25
602 00 Brno
Tel.: +420 530 513 590
info@gopas.cz

GOPAS Bratislava
Dr. Vladimíra Clementisa 10
Bratislava, 821 02
Tel.: +421 902 903 132
info@gopas.sk



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