

Exam questions for the course “Deep Learning”, Autumn 2020

1. Stochastic optimization methods: SGD, Adagrad, RMSprop, ADAM.
2. Feed-forward neural networks: multi-layer perceptron and autoencoder. Automatic differentiation on computational graphs: forward and backward modes.
3. Convolutional neural networks, different convolution operations. Calculation of derivatives through convolutional layer. Architectures AlexNet, VGG, Inception, ResNet.
4. Semantic image segmentation. Models U-net, LinkNet, PSPNet.
5. Object localization and detection on images. Models Faster R-CNN, SSD, CenterNet.
6. Image style transfer. On-line and off-line models.
7. Recurrent neural networks, vanishing gradient problem. Models LSTM, GRU. Application of recurrent neural networks for applied problems.
8. Machine translation problem. Model Seq2seq. Attention mechanism. Models Transformer, BERT.
9. Reparameterization trick. Variational autoencoder, its training procedure.
10. Generative Adversarial Networks. Models DCGAN, Wasserstein GAN, Pix2Pix, CycleGAN.
11. Multi-armed bandits. UCB approach. Thompson sampling.
12. Reinforcement learning. Examples of applied problems. Q-learning, DQN model.
13. Policy gradient methods in RL. Algorithms Reinforce, A2C.
14. Implicit reparameterization trick. Its application for LDA model.

Theoretical minimum

The questions from this part cover basic mathematical notions and algorithms used actively within the course. A student should be ready to answer any of these questions without preparation. A poor answer to these questions leads to exam failing grade.

1. Derivative calculation in terms of differentials.
2. Scheme of stochastic gradient descent.
3. Backpropagation algorithm.
4. Standard neural network models: fully-connected network, convolutional network, LSTM.
5. Drop-out and batch normalization procedure.
6. A model for neural style transfer.
7. EM-algorithm for training probabilistic models with hidden variables.
8. Log-derivative trick and reparameterization trick.
9. Gumbel-Softmax trick.
10. Q-learning scheme.
11. GANs.