DOCTORAL SCHOOL OF INFORMATICS
COMPLEX EXAM SUBJECT

Neural Computations (recommended subject)

1. Neural network structures
   1.1. Models: self-organized and supervised learning
   1.2. Principles of Hebbian learning, roles of graceful degradation, forgetting, normalization
   1.3. The basis of the variational principle (parametric approximation)
2. Special networks
   2.1. Perceptron and its types (sigmoid, ReLU, etc.)
   2.2. Autoencoder, recurrent networks
   2.3. Hopfield network
   2.4. Generative networks
3. Learning and training
   3.1. Stacked autoencoder, denoising autoencoder
   3.2. Backpropagation as a modified Hebbian learnings
   3.3. Against overtraining: dropout, validation early stopping, and testing
4. Other networks
   4.1. Support vector machines
   4.2. Sparse representations
   4.3. Convolutional neural networks, the role of convolution and pooling, connection to sparsity and to Self-Organizing Maps
5. Optimization methods
   5.1. Types of cost functions
   5.2. Detection, Classification
   5.3. Function approximation
   5.4. Clustering and low dimensional embedding

Literature:

Goodfellow, I, Bengio, Y, and Courville, A. (2016) Deep Learning, MIT Press, Cambridge, MA. ISBN-10: 0262035618

Murphy, Kevin P. (2012) Machine Learning: A Probabilistic Perspective. MIT Press, Cambridge, MA. ISBN 978-0-262-01802-9

Haykin, S. (1999) Neural Networks: A Comprehensive Foundation, Prentice Hall, ISBN 0-13273350-1

Online materials:

http://deeplearningbook.org
https://github.com/terryum/awesome-deep-learning-papers
https://www.coursera.org/learn/neural-networks