UNIVERSITY OF DEBRECEN
Doctoral School of Informatics

Complex exam minor subject	Machine Learning
Syllabus	Basic concepts of machine learning, Linear algebra. Information theory and statistics. Numerical computation. Data collection and preprocessing. Dimensionality reduction. Models of regression. Classification. Clustering. Supervised and unsupervised learning. Basic concepts of deep learning, Introduction into deep learning. Neural network. Feedforward network. Backpropagation algorithm. Methods of weight initialization. Regularization. Cost functions. Convolutional neural networks. Pooling and dropout layers, normalization. Representation learning. Visualization. Deep convolutional neural networks. Recurrent neural network. Ensemble methods.
Bibliography	1. W. McKinney: Python for Data Analysis (1 ed.). O'Reilly Media, Inc. 2012. 2. C. Bishop: Pattern Recognition and Machine Learning, Springer, 2006. 3. D. Conway, J.M. White: Machine Learning for Hackers, O'Reilly Media, Inc., 2012. 4. I. Goodfellow, Y. Bengio, A. Courville: Deep Learning, MIT Press, 2016. 5. Ludmila I. Kuncheva: Combining Pattern Classifiers: Methods and Algorithms, Second Edition, Wiley, 2014 6. Ian H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann, Burlington, MA, 4 edition, 2016.
Compulsory subjects for this minor subject	Machine learning
Recommended subjects for this minor subject	Mathematics of data science Big data processing Deep learning