Course title: Artificial Neural Networks

Teacher or teachers: Branimir T. Todorovic

Course status: elective

ECTS number: 12

Condition: no

The aim of the course

Acquiring knowledge in the field of artificial neural networks and their application in processing in the analysis and processing of images, text, time series, video and audio signals.

Outcome of the case

At the end of the course the student should be able to choose an algorithm for adapting the architecture and parameters of artificial neural networks, implement them using some of the available software environments in Python (NumPy, CuPy, PyTorch) and apply in solving problems in intelligent image processing, text, time series, video and audio signals.

Course content

Mathematical models of neurons, layers with direct signal propagation, matrix form of backward error propagation, normalization and regularization of layers, recurrent neural networks, papacy of error back time, Kalman filter as a neural network learning algorithm, convolutional neural networks, backward propagation of error through convolutional layers, focus layers, autoencoders, variational autoencoders, generative adversary networks, development and coding of software environment in Python for implementation of artificial neural networks using NumPy and CuPy libraries, calculation graphs, algorithmic differentiation, implementation of direct propagation and error propagation backward through linear normalizations, convolutional layer, deconvolutional layer, recurrent layer. Application in word processing, time series prediction, identification and control of dynamic systems, image processing, video and audio signals.

Recomended literature

- 1. Deep Learning, I. Goodfellow, Y. Bengio, A. Courville, MIT Press, 2016
- 2. Neural Networks and Deep Learning, 2018, Charu C. Aggarwal, Springer, ISBN-13: 978-3319944623, ISBN-10: 3319944622
- 3. B. Todorović, S. Todorović-Zarkula, M. Stanković, Rekurentne neuronske mreže: estimacija parametara, stanja i strukture, Univerzitet u Nišu, Prirodno-matematički fakultet, 2012.
- 4. Samuel Burns, Python Deep learning: Develop your first Neural Network in Python Using Tensor Flow, Keras, and PyTorch, Independently Published, 2019, ISBN-13: 978-1092562225, ISBN-10: 1092562222

| Number of hours of active teaching | Theoretical teaching: 5 | Practical teaching: |
|------------------------------------|--------------------------------|---------------------|
| Teaching methods | | |

The lectures use classical teaching methods with the use of video projectors and interaction with students. Students' knowledge is tested through homework and projects. The final oral exam checks the comprehensive understanding of the presented material.

Assessment of knowledge (maximum number of points 100) colloquia - 30, seminars - 20, oral exam - 50