Developing deep learning methods to support pathomorphological image analysis

The deep learning is a type of machine learning method which is very popular nowadays. The basics of this methods is the detection of object features on high level of abstraction. The architecture of these neural networks is built with many different types of layers with many parameters (for example Alex Net has 60 million parameters and 500,000 neurons). The biological inspiration was the way human brain works.

This Deep Learning method is widely used by international corporations such as: Google and Facebook. The examples of practical use of DL are: systems for automatic speech recognition, automatic scene recognition, prediction of gene ontology, toxic effects of environmental chemicals, age and gender classification. Moreover, this solution is used in many technical application and research areas. Wide application of DL shows its big potential in these solutions. The biggest advantage of the DL application is fast classification and possibility to use many categories. However, the process of training and developing in this type of neural networks is complicated. We can distinguish two manor types of learning methods: full training of networks or transfer learning. The pre-training models, trained on a large dataset (1.3 million of data cases or more) are used in the transfer-learning process. The fine-tuning method is based on the modification of parameters of pre-trained neural network during a new training process. The crucial aspect of training of a DL network is the amount of data. Thousands of hundreds of data are necessary for the training process. In the case of face detection, object detection, animal recognition or gender recognition, the data collection is not a problem, but in medical research it is complicated and limited. The amount of the medical data is limited and some classes can be represented in a worse manner than other.

Our research subject is to evaluate the usefulness of different methods of DL training to achieve correct classifications of medical (pathomorphological) data and to develop training methods of DL networks in the case of limited data amount. It is a very important problem because the amount of medical data is limited and it raises a question of "how big of a dataset is necessary for DL network learning". We will develop fine-tuning training method for pathomorphological image analysis. Our results will be compared with other methods of training. In order to solve the problem of data amount, we would like to develop methods of artificial increase of the amount of data. Deep analysis of pathomorphological images allows to select methods of modification image in order to multiply their amount. The studies on this area are innovative and necessary. The method of artificial increasing of the amount of pathomorphological data can be a useful tool in the images processing area and deep learning.

The results of this project will have direct impact on scientific disciplines, economy and society. The results of studies allow for the increasing of the level of social knowledge and for developing new medical solutions. Proving that DL methods can be efficient tools in a cease of limited amount of data allows to build systems supporting digital pathomorphology.