Aalto University

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How to train large scale deep neural networks with fewer labeled examples?

Title of the dissertation	Algorithms for Data-efficient Training of Deep Neural Networks
Contents of the dissertation	State-of-the-art deep neural networks have had a transformative impact across many tasks, yet this improvement typically can only be achieved by using hundreds of thousands (ideally millions) of labeled data samples. This is due to the fact that modern-day large scale deep neural networks contain millions of trainable parameters. In many tasks, collecting this labeled data is either difficult or impossible. For example, segmented medical images can be produced by a skilled human annotator, yet doing this for a significant number of images is very expensive and time consuming. In this thesis I have explored a class of methods which improve the data efficiency of DNNs by constructing synthetic samples. These synthetic samples are constructed by combining two or more real samples. Depending on the problem setting, e.g., fully-supervised learning, semi-supervised learning, adversarial learning, and unsupervised learning, this thesis proposes various novel methods for leveraging such synthetic samples. In addition, this thesis also explores methods for training graph neural networks, which are an important class of neural networks for domains where samples naturally exist as graphs, e.g. in drug discovery. The methods proposed in this thesis are easily reproducible and achieve state-of-the-performances across many problem settings. Furthermore, these methods have already been deployed by other research labs in many data-critical applications, such as for medical image segmentation.
Field of the dissertation	Deep Neural Networks, Machine Learning, Artificial Intelligence
Doctoral candidate	Vikas Verma M.Sc.(Tech)
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Custos	Professor Juho Kannala, Aalto University School of Science, Department of Computer Science
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Doctoral candidate's contact information	Vikas Verma, Department of Computer Science, vikas.verma@aalto.fi and +3580504685953