ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Distributed Computing

Prof. R. Wattenhofer

What can Neural Networks learn? - Set Functions

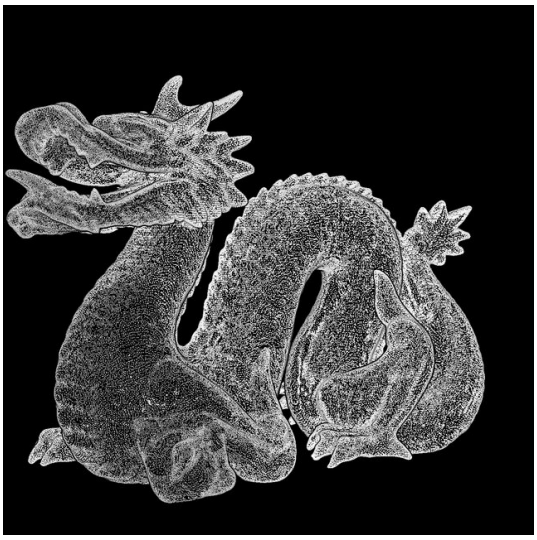

Figure 1: Point cloud of a dragon

Neural networks have become the go-to approach for learning from many different types of data, be it text, images, medical scans or audio. Recently, they have also been designed and applied with increasing success for learning set functions and more generally graph functions. A range of machine learning problems can naturally be formulated in terms of sets; e.g. parsing a scene composed of a set of objects, making predictions from 3D point clouds, or training a set of agents in reinforcement learning. Moreover set functions are the crucial building blocks of graph neural networks, which have achieved great successes with knowledge graphs, combinatorial optimization, chemistry, and physics simulations. There is a selection of different models used for learning set functions, each with different in-built biases, strengths and weaknesses. However currently there is a lack of a set of rigorous, well-understood benchmark tasks of increasing complexity, which would allow for a comprehensive comparison of the models and more importantly would point researchers in the right direction for finding improvements.

In this thesis we aim to introduce a set of controlled, synthetic, set-based tasks of increasing complexity that can help tease apart different set function architectures. In addition we aim to better understand the current roster of benchmark tasks. We will carry out an extensive comparison of current state-of-the-art architectures. Finally, we will test out new ideas for improving the power of these models.

Requirements: Strong motivation, knowledge in deep learning, or a solid background in machine learning. Experience with Python and TensorFlow or PyTorch is an advantage as well as knowledge in discrete maths. We will have weekly meetings to address questions, discuss progress and think about new ideas.

Interested? Please contact us for more details!

Contact

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