Deep Learning for IceCube (DLI)

Abstract

Deep neural networks have revolutionized the classification of images in the last decade. The increase in computing power and tools to train neural networks with several million free parameters is a state of the art tool.

The task proposed here is to investigate the applicability of deep neural networks to the classification and filtering of events in neutrino experiments like IceCube. In a simplified view these experiments can represent a single event as an image where each pixel represents the detection of light by a photo-sensor at a given time. Therefore, it is possible to distinguish event topologies by image classification with neural networks. These computations can efficiently be performed on modern GPUs with low power consumption.

Further an event can be seen as a video where the detected light in a sensor is a function of time. The application of neural networks to video classification has not been studied in as much detail as image classification. However, especially Recurrent Neural Networks have shown promising results.

The goal of the project is to study of applicability of artificial neural networks, especially in the context of deep learning, on event recognition in IceCube. With neural networks the filtering of events can be done with low-computational effort which is a limiting factor in IceCube because of limited power resources at the South Pole. At the same time, it is expected making real time event classification more efficient. For the realization of this project we will invest in the required infrastructure and set up a development server in close cooperation with the IT center of the RWTH and perform initial studies to demonstrate the applicability of deep neural networks for IceCube.