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IMAGE CLASSIFICATION WITH DEEP NEURAL NETWORK LEARNING USING GPUS

Abstract

With invention of machine learning computers gained ability approach problems required knowledge about real world and make decisions seemingly incomprehensible. Although system with Artificial Intelligence must independently gather knowledge, looking for patterns in initial data. This can be achieved using Deep Learning techniques which prove their efficiency in many application of Computer Science such as Computer Vision, Speech Recognition, Natural Language Processing, Robotics, Bioinformatics, Digital Entertainments, Search Engines, Digital Marketing, Financial Technologies, etc. [**?**]

This paper describes the workflow of Image Classification process. During this process Learning stage was necessary in which Deep Neural Network trained in order to classify Images [**?**]. Network trained using GPU acceleration which greately reduced the time spent on Learning. As a result there is 99.24% accuracy of Image Classification achieved.

The workflow included 5 independent stages: Data preparation, Network architecture, Parameters optimization, Image classification, GPU code generation.

There is a database of images which is needed for learning and testing. At the Data preparation stage database images scattered accross classification Labels. Images within each Label divided to training and test sets according to specialized ratio.

Second stage describes network architecure in which a number of Layers of Deep Neural Network described. Each of the Layers has its unique function. The Layers implemented within Deep Neural Network are Images input layer, Image convolution layer, Rectification layer, Layer in which different types of filters can be implemented, Class connection Layer, Class probability transition Layer, Image Classification layer. At this stage default parameters of each layer are predefined and they require further tuning in accordance with problem specifications.

The next stage perform optimization of predefined parameters and tuning of hyperparameters of the Deep Neural Network. Above all it was necessary to set training options especially type of the solver required for training algorithm. At this stage several powerful Stochastic Gradient based methods tested for solving given training algorithm.

At the fourth stage the results of Image Classification are demonstrated as well as accuracy comparisions with other Machine Learning and Computer Vision applications.

Fifth stage devoted to automatic generation of industry ready GPU code which is written in CUDA language by nVidia Corporation [**?**]. Described complete process of CUDA code generation and its execution on a single GPU computer as well as multi GPU cluster.

Bibliography

[1] Goodfellow J. et.al., *Deep Learning*, MIT Press, Cambridge, Massachusetts (2016).

[2] Sutskever J., et.al., *On the importance of initialization and momentum in deep learning*, International conference on machine learning, 1139-1147 (2013).

[3] Sharan C., et al., *cudnn: Efficient primitives for deep learning*, arXiv preprint arXiv:1410.0759 (2014).