Master Thesis

Evaluation of synergistic effects of tensor decomposition methods within (deep) neural network applications

Project Plan (1st version)

Tobias Engelhardt Rasmussen, s153057

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Project Description

This M.Sc. project aims at assessing possible synergistic effects between tensor decompositions, such as TUCKER and/or PARAFAC and CNN applications. In this context, the tensor decomposition shall be understood as a data compression method. It shall be applied either prior to training the neural network to reduce the input dimensionality, or within the neural network to "compress the fitted parameters" and to potentially replace convolutional layers. The synergistic effects of the tensorized neural networks (TNNs) are meant to lead to increased computational efficiency and simpler network architectures, while at the same time performing at maximal prediction accuracy.

The project will implement tensor decompositions, such as TUCKER and/or PARAFAC, prior/within a chosen CNN architecture. Initially, a simple (image) data set will be simulated to test the methodology under well controlled conditions. In a second step, a suitable data set (from state-of-the-art papers) will be selected to assess and benchmark the developed TNNs against state-of-the-art performance(s).

This master thesis is to be based on research and trial and error, which is why there are no clear objectives. Also a part of the data set that is going to be used is not determined prior to the start of the project. Having this in mind, an approximation of the objectives of the project is given below:

1. Investigate different tensor decomposition methods and neural network architectures.

2. Investigate how others have attempted to solve the problem
3. Create a simple algorithm that works for a simple architecture for MNIST
4. Find a new data set to develop the algorithm even further
5. Develop the algorithm for the new data set
6. Evaluate the synergy by assessing different results using different performance measures

Initial Project Plan

Week	Activity	Risk
1	Write project plan, initial models on MNIST, literature study	1
2 - 4	Literature study, initial models on MNIST, and studying different methods	1
5 - 6	Create and test improved model for MNIST	3
7	Writing about MNIST methods and results	3
8	Explore new data set and establish baseline / state-of-the-art	3
9 - 15	Develop and test model for the new data set	5
16 - 20	Writing about methods and results for new data set and discussion	2
21 - 22	Correcting, writing conclusion and abstract and making everything come together	1

In the plan the risk is classified using a scale from 1 (no risk) to 5 (high risk).The risk is described as the chance of the activity being delayed.

Risk Analysis

Before week 5 In the first weeks it is all about getting to know different tensor decomposition methods, and how different architectures for convolutional neural networks work. It is also to study the problem itself and what have previously been done to solve it. This has a very low risk as literature is easily accessible and reading does not usually pose problems.

Weeks 5 - 8 In this period I plan to create a simple algorithm for MNIST using some decomposition method to help a simple neural network architecture perform better. In the end of this period the new data set should also be chosen and ready to work with. This has a slightly higher risk since developing an algorithm can cause problems, but not a high risk since the MNIST data set is relatively simple and well-studied.

Weeks 9 - 15 Since this period will be used to develop an algorithm for a more complex data set, the risk is high. This can be approached in many different ways, hence problems are likely to occur. Structure and a clear working order is needed during this time.

Weeks 16 - end The last weeks will be all about writing the missing sections, correcting and making everything come together. It should be noted that some of the writing will already have taken place, since some sections are better to write having the methods and thoughts clear in mind. This means that this period should have a relatively low risk of being delayed. Also allowing a couple of weeks of corrections means a potential buffer if something goes wrong.