Machine Learning **First Semester 2020**
Masters in Systems Engineering **Project Proposal**

Names: Sneyder Gantiva, Diego Useche
Emails: [esgantivar,diusecher]@unal.edu.co

Supervised Learning using Tensor Networks for MNIST and Sentiment Analysis

Problem Statement

Tensor networks are mathematical models which have been used historically in physics to find the ground states of multi-particle systems, recently, there has been a growing interest to apply such methods in machine learning. Tensor networks allow to approximate a multidimensional tensor to a simpler mathematical structure. Matrix Product State (MPS) is a well-known model of tensor networks. MPS is a tensor decomposition that has been used in many fields, MPS is a model where the tensors are connected in a one-dimensional geometry. The main idea behind this model is reduce the total number of tensors to enable a efficient simulation of the systems.

Frequently machine learning models need to deal with big quantities of data, classical algorithms of classification like kernel methods map the input data to a feature space where the inputs are close to be linearly separable, however the complexity of the algorithm increases greatly with the size of the input data. Tensor network models offer an alternative to handle this problem.

We propose to use the MPS tensor network to classify the MNIST data set of images, and a sentiment analysis data set of movie, restaurant and product reviews. Given the novelty of the method, we propose to develop the models over two toy datasets.

Objectives

- To train a MPS Tensor Network to classify the digits data set MNIST.
- To train a MPS Tensor Network to predict positive or negative review of a movie, restaurant or product (Sentiment Analysis).
- To compare the the MPS Tensor Network and a classical machine learning algorithm like Support Vector Machines for the task of classifying the MNIST and a Sentiment Analysis data set.

Methodolody

In order to solve the visual and textual problems with a MPS Tensor Network, we will perform the following tasks:

1. Train the MPS tensor network for MNIST using the library *torchmps*.
2. Change the bond dimension of the MPS Tensor Network to achieve better results on the images data set.

3. Try various embeddings like bag of words, or ngrams on characters for the sentiment reviews.

4. Train a MPS Tensor Network over the embeddings using the library *torchmps*.

5. Train the visual and textual data sets with a classical algorithm like support vector machines and compare with the MPS tensor network.