Siamese-Networks-for-One-Shot-Learning Report

April 2021

1 Exploratory Data Analysis (EDA)

In this section let us introduce the main dataset characteristics. The dataset is composed of images of people.

- Each image is available as `lfw/name/name_xxxx.jpg`, where "`xxxx`" is the image number padded to four characters with leading zeroes.
- There are a total of 13233 images and 5749 people in the database.
- The train dataset is composed of 2200 pairs of images - 1100 matched pairs and an additional 1100 unmatched pairs.
- The test dataset is composed of a 1000 pairs of images - 500 matched pairs and an additional 500 unmatched pairs.
- We took a validation set of 20% of the original train set and saved the remaining 80% for the actual training.
- Let us observe the frequency of matched cases in the train dataset:

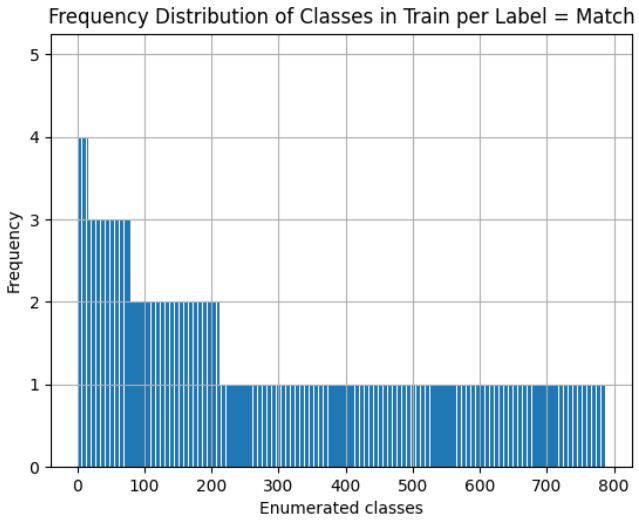

Figure 1: Frequency of Matched Classes in the Train Dataset

2 Design Overview

Let us present the general architecture of the Siamese network as we implemented:

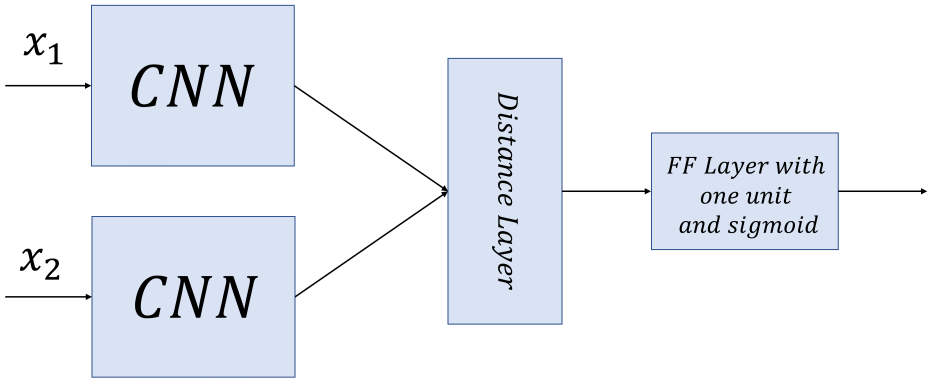

Figure 2: Frequency of Matched Classes in the Train Dataset

This architecture is as described in the article.

3 Experiments

Our experiments to improve the final results revolved around changing the CNN architecture. Let us present the experiments we did, with different parameters for the neural network each time:

3.1 Experiment 1

- CNN architecture:

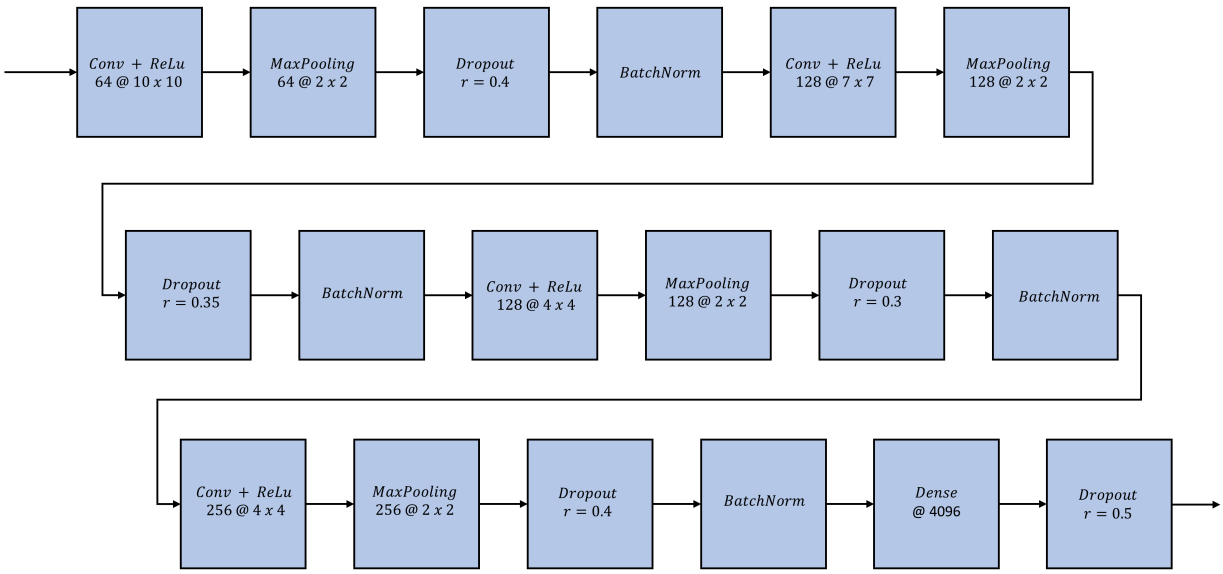

Figure 3: CNN Architecture of Experiment 1

- Total parameters: 152,213,057
- Learning rate: $\alpha = 0.01$ with exponential decay every epoch by a factor of 0.99
- Maximal accuracy on the validation set: 60%
- Maximal accuracy on the train set: 87.37%
- Accuracy on the test set: 52.9%
- Loss on the test set: 2.657

In the following graphs, the red marker indicates the described attribute on the train set and the green one - on the validation set.
Let us consider the accuracy of experiment 1 as a function of the epoch number:

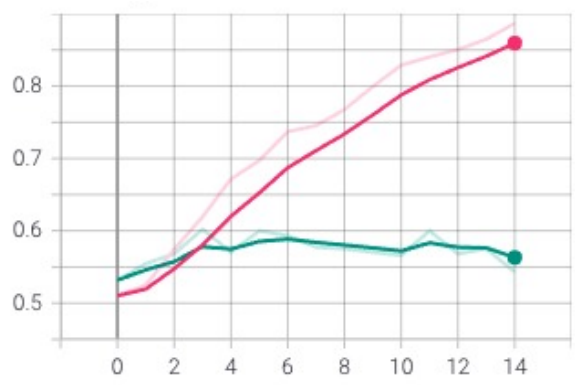

Figure 4: Experiment 1 Accuracy as a Function of Epoch Number

Let us consider the loss of experiment 1 as a function of the epoch number:

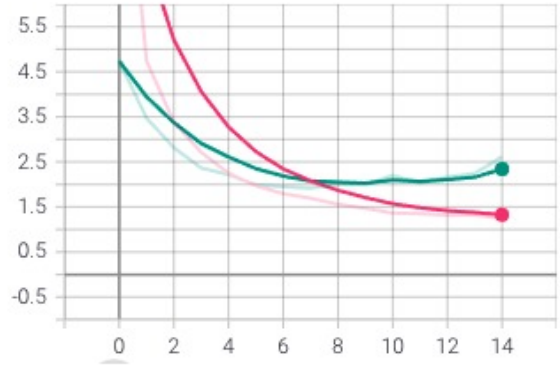

Figure 5: Experiment 1 Loss as a Function of Epoch Number

Let us consider the learning rate of experiment 1 as a function of the epoch number:

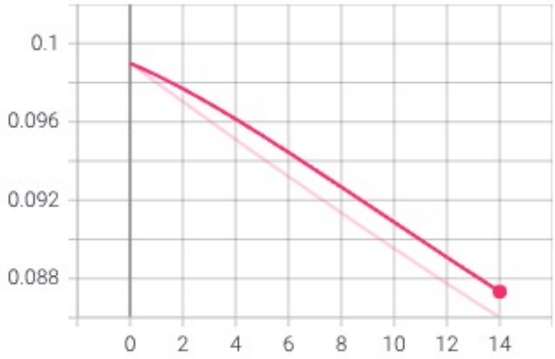

Figure 6: Experiment 1 Learning Rate as a Function of Epoch Number

3.2 Experiment 2

- CNN architecture:

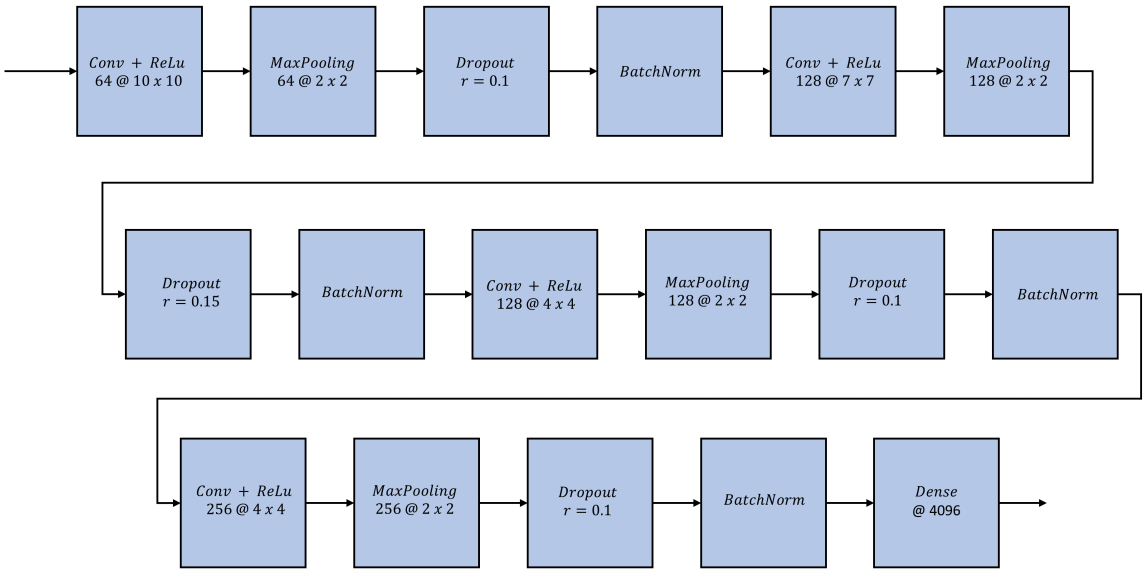

Figure 7: CNN architecture 2

- Total parameters: 152,213,057
- Learning rate: $\alpha = 0.01$ with exponential decay every epoch by a factor of 0.99
- Maximal accuracy on the validation set: 65.91%
- Maximal accuracy on the train set: 100%
- Accuracy on the test set: 63.2%
- Loss on the test set: 3.57

Let us consider the accuracy of experiment 2 as a function of the epoch number:

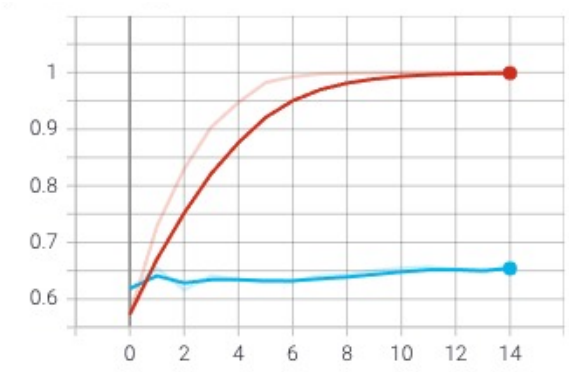

Figure 8: Experiment 2 Accuracy as a Function of Epoch Number

Let us consider the loss of experiment 2 as a function of the epoch number:

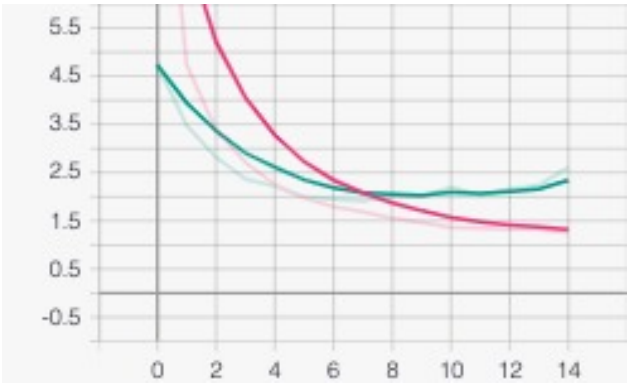

Figure 9: Experiment 2 Loss as a Function of Epoch Number

Let us consider the learning rate of experiment 2 as a function of the epoch number:

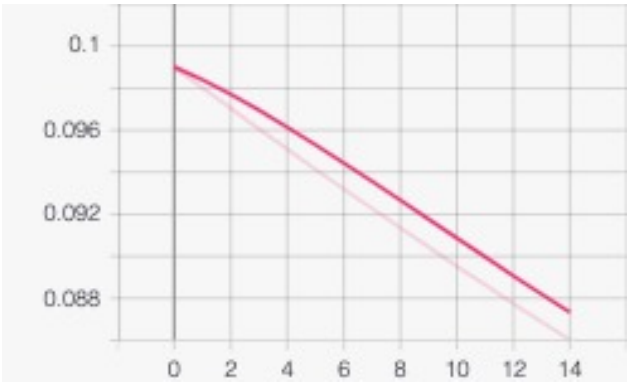

Figure 10: Experiment 2 Learning Rate as a Function of Epoch Number

3.3 Experiment 3

- CNN architecture:

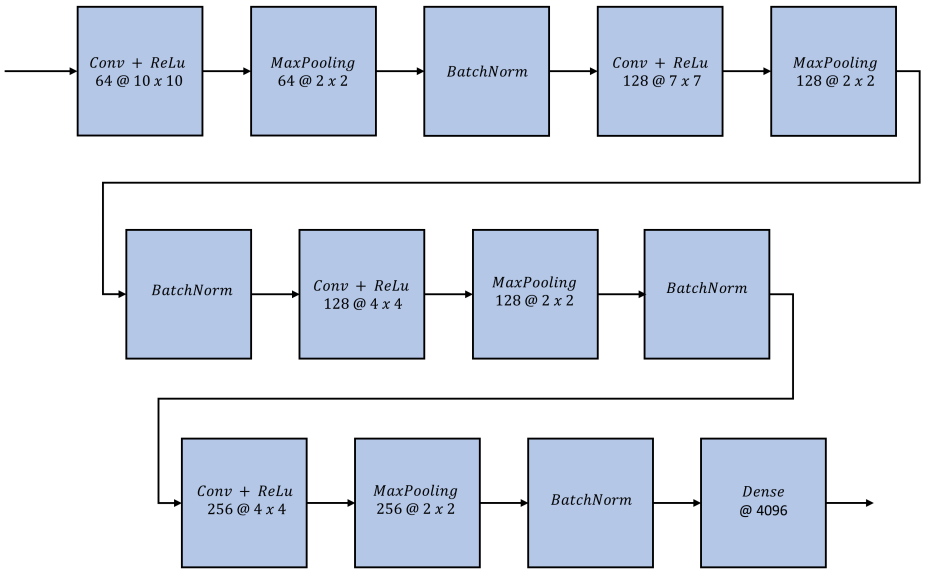

Figure 11: CNN architecture 3

- Total parameters: 152,213,057
- Learning rate: $\alpha = 0.01$ with exponential decay every epoch by a factor of 0.99
- Maximal accuracy on the validation set: 70%
- Maximal accuracy on the train set: 96.65%
- Accuracy on the test set: 70.1%
- Loss on the test set: 2.14

Let us consider the accuracy of experiment 3 as a function of the epoch number:

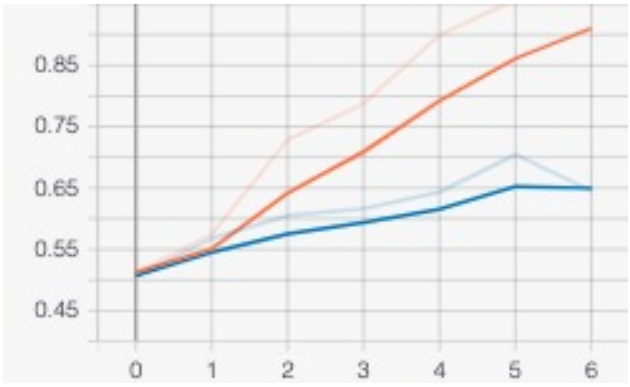

Figure 12: Experiment 3 Accuracy as a Function of Epoch Number

Let us consider the loss of experiment 3 as a function of the epoch number:

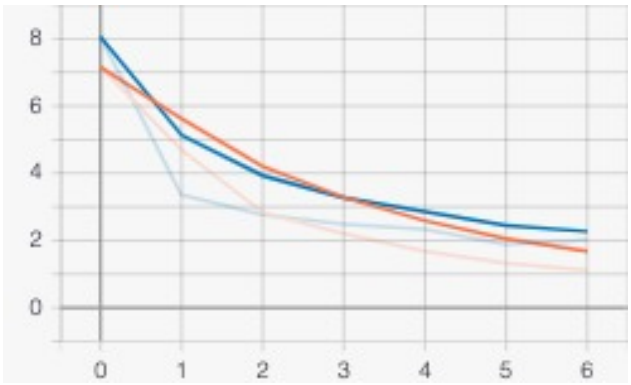

Figure 13: Experiment 3 Loss as a Function of Epoch Number

Let us consider the learning rate of experiment 3 as a function of the epoch number:

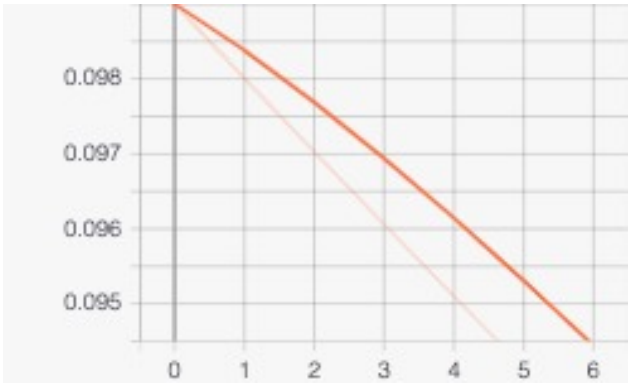

Figure 14: Experiment 3 Learning Rate as a Function of Epoch Number