
COMP 4211 - Machine Learning Programming Assignment 2

Report

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1 CNN Classifier

1.1 Screen Shots of the CNN Classifier

The following are the screen shot of the CNN Network and loading the pretrained encoder.

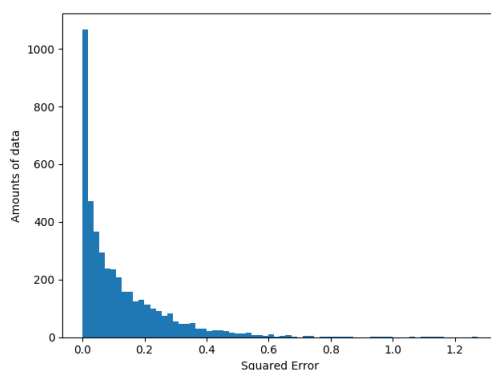


Figure 1: Screen shot of the CNN Network

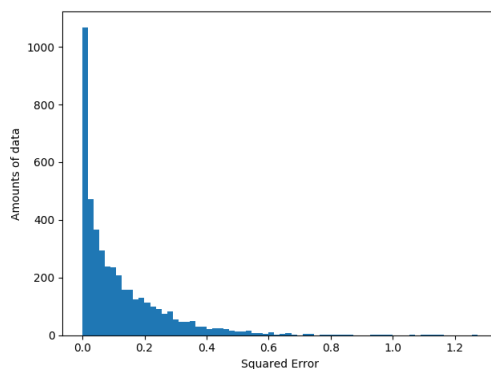


Figure 2: Screen Loading the Pretrained Encoder

1.2 Hold out validation result of CNN classifier from scratch

The following are the hold out validation results of CNN classifier from scratch. The network architecture of using in the hold out validation was the same as the snapshot above. In the validation, we partitioned the training set into the training and validation sets with ratio 4:1. For each candidate set of hyperparameters, we trained the network for 20 epochs batch size 32 and validate it against the validation set. The cross entropy loss on validation set shown in the results table was the optimal one .

Table 1: Hold out Validation Results of scratch CNN classifier

Parameters set	Optimizer	Learning Rate	Num of Hidden	Cross Entropy Loss
1	Adam	0.001	32	440.98172
2	SGD	0.1	32	2533.93441
3	SGD	0.01	32	2533.97749
4	Adam	0.001	64	410.54719
5	SGD	0.1	64	2533.96268
6	SGD	0.01	64	2534.04213

The cross entropy loss of parameters set 4 had the lowest optimal cross entropy loss 410.54719 after conducting the hold out validation, so we would choose the parameters set $[Adam, 0.001, 64]$ as the hyperparameters for the training in the testing phase.

1.3 Hold out validation result of the CNN classifier with Pretrained Encoder Weights

The following are the hold out validation results of the CNN classifier with pretrained encoder weights. The network architecture of using in the hold out validation was the same as the snapshot above. In the validation, we partitioned the training set into the training and validation sets with ratio 4:1. For each candidate set of hyperparameters, we trained the network for 20 epochs batch size 32 and validate it against the validation set. The cross entropy loss on validation set shown in the results table was the optimal one .

Table 2: Hold out Validation Results of scratch CNN classifier

Parameters set	Optimizer	Learning Rate	Num of Hidden	Cross Entropy Loss
1	Adam	0.001	32	735.95330
2	SGD	0.1	32	668.04426
3	SGD	0.01	32	964.40623
4	Adam	0.001	64	673.44847
5	SGD	0.1	64	636.57846
6	SGD	0.01	64	902.99894

The cross entropy loss of parameters set 5 had the lowest optimal cross entropy loss 636.57846 after conducting the hold out validation, so we would choose the parameters set $[SGD, 0.1, 64]$ as the hyperparameters for the training in the testing phase.

1.4 Testing Results of CNN Classifier

In the testing phase, for both CNN classifier from scratch and with Pretrained Encoder Weights, we trained using the entire training set with the best set of hyperparameters obtained from the hold out validation and the same network architecture as the hold out validation, and tested with the testing test. We used 32 as our batch size and trained with 20 epoch. And we had repeated the same process for 5 rounds. The below was the results.

Table 3: Testing Metric of CNN classifier from scratch

	Cross Entropy Loss	Top-1 Accuracy	Top-3 Accuracy
Mean	515.75526	79.27811	78.79027
Std	12.76076	0.34077	0.62663

Table 4: Testing Metric of CNN classifier with Pretrained Encoder Weights

	Cross Entropy Loss	Top-1 Accuracy	Top-3 Accuracy
Mean	768.54128	71.47568	70.88601
Std	14.14077	0.48995	0.37438

The following was the learning curve of the testing metric that we randomly selected only one run out of the total of five runs. The blue color curve was results on testing set and the orange color curve was the results on training set. (The diagram on the left hand side was the results drawn from CNN classifier from scratch and the right hand side was the results drawn from the CNN classifier with Pretrained Encoder Weights)

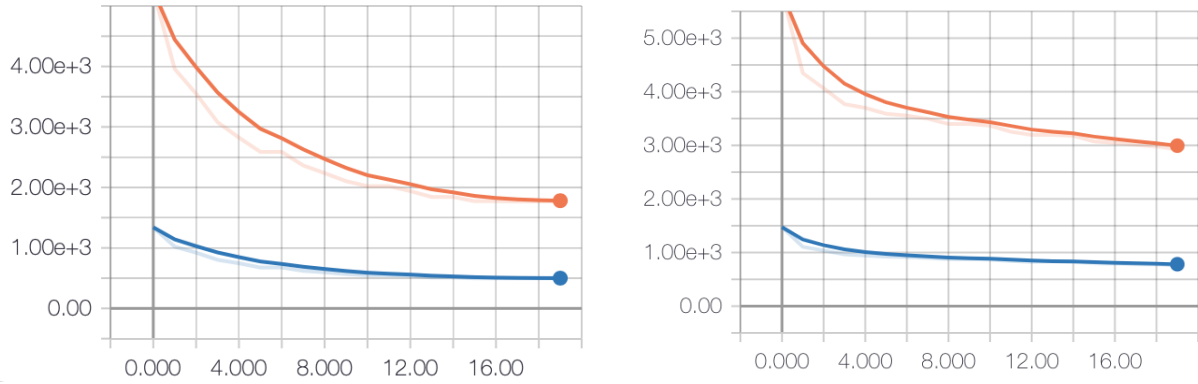


Figure 3: Learning Curve of Cross Entropy Loss

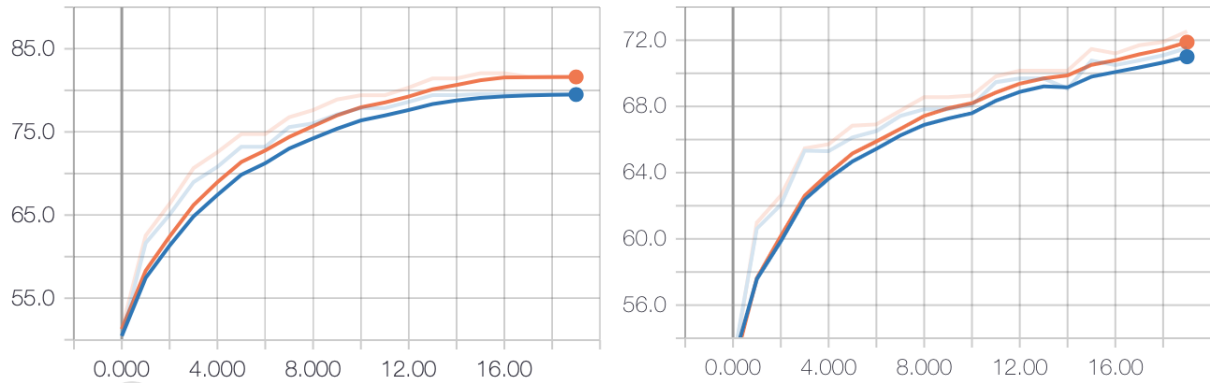


Figure 4: Learning Curve of Top-1 Accuracy

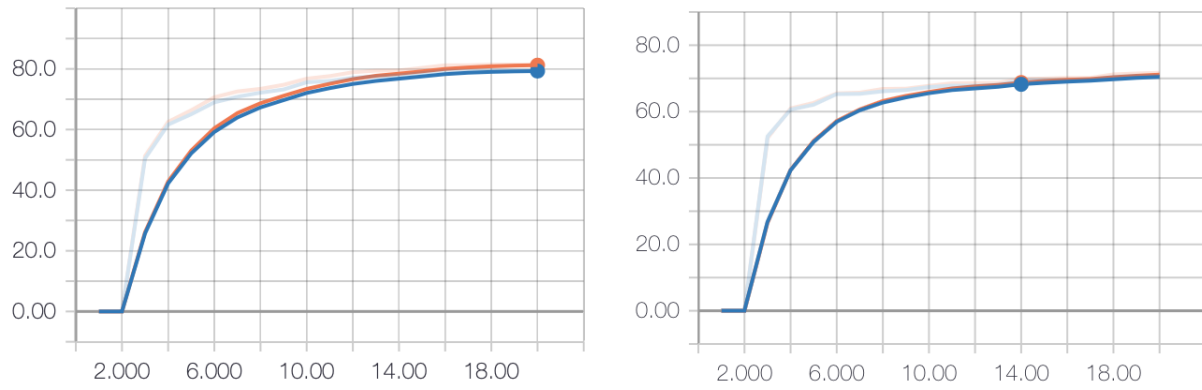


Figure 5: Learning Curve of Top-3 Accuracy

From the square loss histogram of test sets, we found out that the mean squared error of the most of the data points are around zero. It means that this model perform quite well for most of the data points. However, for the finance datasets, there are some data points that have the squared error far away from zero (23.77581) which means that there might be some **outliers** that far away from the curve.

2 CAE with Pretrained Encoder

2.1 Screen Shots of the CAE with Pretrained Encoder

The following are the screen shot of the Network of CAE Decoder and loading the pretrained encoder.

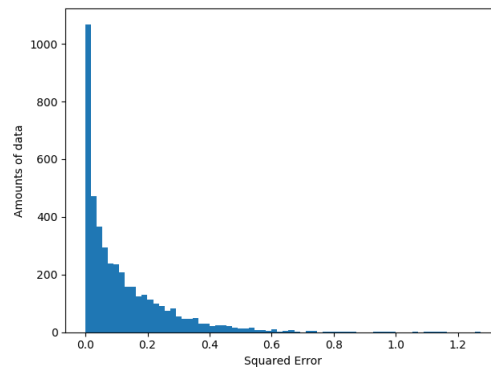


Figure 6: Screen shot of the Network of CAE Decoder

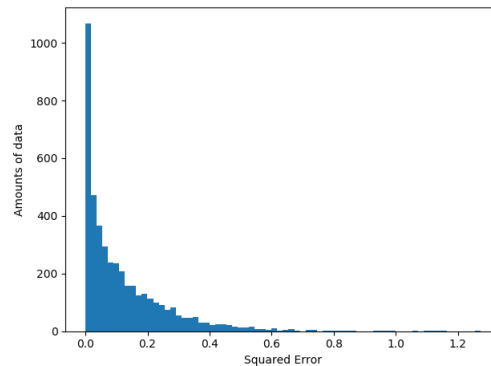


Figure 7: Screen Loading the Pretrained Encoder

2.2 Hold out validation result of CAE with Pretrained Encoder

The following are the hold out validation results of the CAE with Pretrained Encoder. The network architecture of using in the hold out validation was the same as the snapshot above. In the validation, we partitioned the training set into the training and validation sets with ratio 4:1. For each candidate set of hyperparameters, we trained the network for 20 epochs batch size 32 and validate it against the validation set. The MSE loss of the validation set shown in the results table was the optimal one .

Table 5: Hold out Validation Results of the CAE with Pretrained Encoder

Parameters set	Optimizer	Learning Rate	MSE Loss
1	Adam	0.01	0.02729
2	SGD	0.1	0.03881
3	SGD	0.01	0.11098

Some examples of the image reconstructed by the decoder network by using different set of parameters during the hold out validation were shown below. (The left is the input image and the right is the reconstructed image.)



Figure 8: Parameters set 1



Figure 9: Parameters set 2

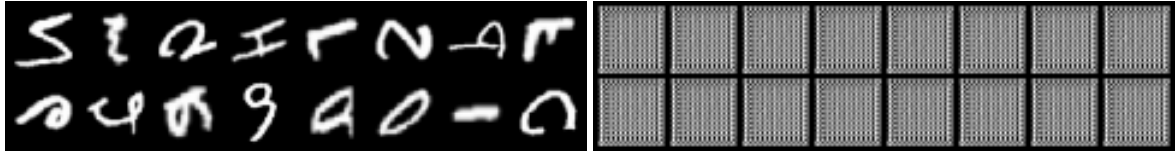


Figure 10: Parameters set 3

From the results of hold out validation, we could see for parameters set 1, it had the lowest MSE loss 0.02729 and the quality of the reconstructed image was the best. Therefore, we would choose the parameters set $[Adam, 0.01]$ as the hyperparameters for the training in the testing phase.

2.3 Testing Results of CAE with Pretrained Encoder

In the testing phase, we trained using the entire training set with the best set of hyperparameters obtained from the hold out validation and the same network architecture as the hold out validation, and tested with the testing test. We used 32 as the batch size and trained for 20 epoch. The following was the results obtained from the testing phase. The MSE Loss shown in the table was the optimal MSE loss.

Table 6: Testing Result CNN classifier from scratch

Best MSE Loss
0.02817

Some examples of the image reconstructed by the decoder network during the test phase were shown below.

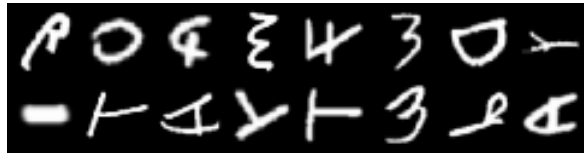


Figure 11: Raw Image

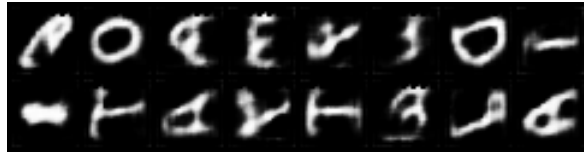


Figure 12: Reconstructed Image

The following was the learning curve of the MSE loss. The blue color curve was results on testing set and the orange color curve was the results on training set.