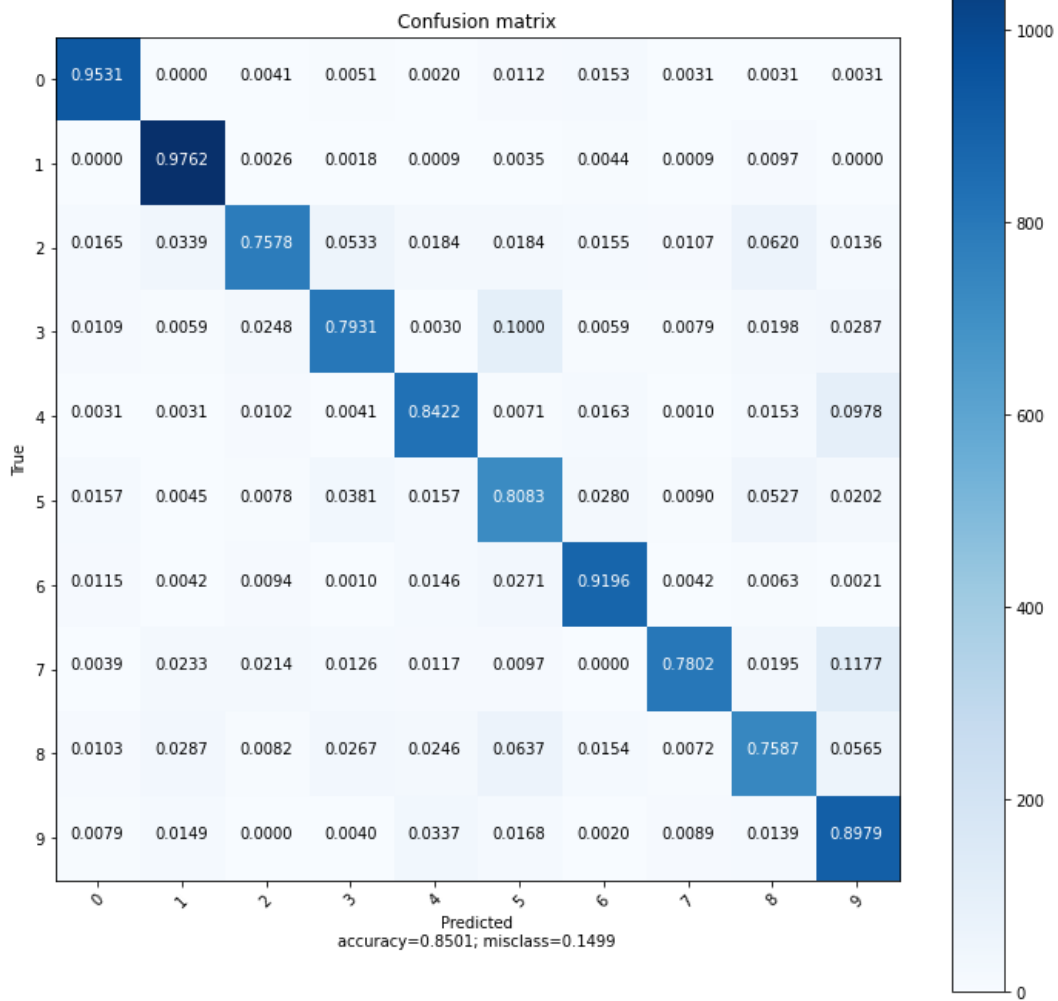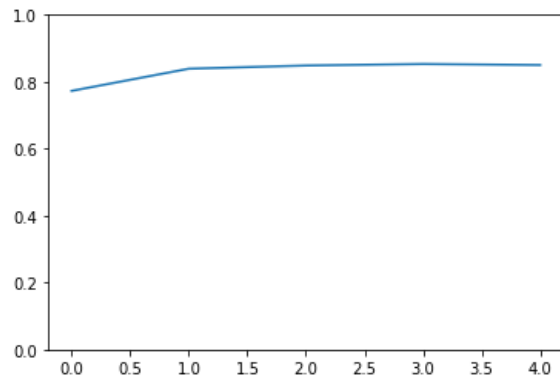# Perceptron 1

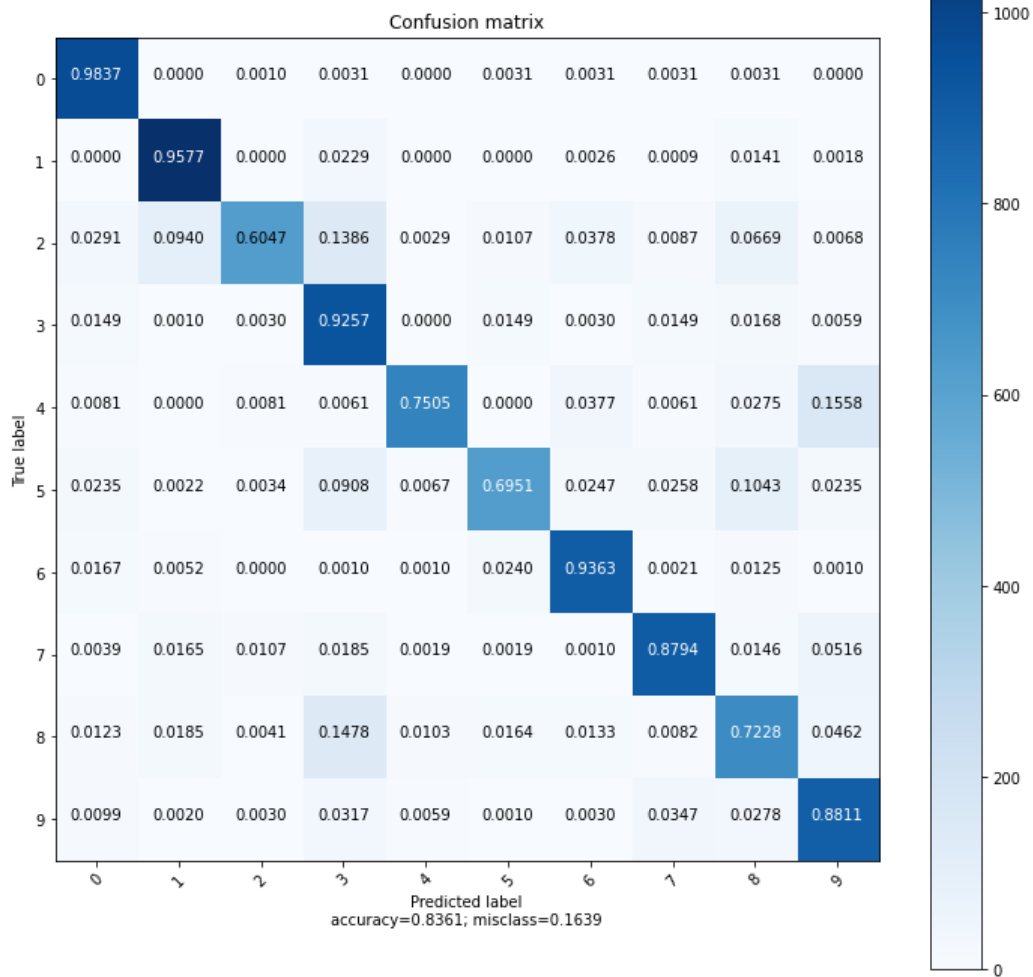Amila Ferron (aferron@pdx.edu)

May 13, 2021

The training and test data was processed with with the learning rate set to 0.001, 0.025, 0.3, and 0.9. Four epochs were used to train the data for each learning rate. Both input data sets were normalized by dividing by 255, then an additional row of 1's was added to each matrix for the bias. For each image, the max of the outputs was selected as the digit. If this didn't match the correct answer the weights were updated before processing the next image. The accuracy for each epoch was recorded and plotted along with the results for the test data. A confusion matrix was produced for the test results for each learning rate.

learning rate: 0.001

Confusion matrix

	0	1	2	3	4	5	6	7	8	9
0	0.9531	0.0000	0.0041	0.0051	0.0020	0.0112	0.0153	0.0031	0.0031	0.0031
1	0.0000	0.9762	0.0026	0.0018	0.0009	0.0035	0.0044	0.0009	0.0097	0.0000
2	0.0165	0.0339	0.7578	0.0533	0.0184	0.0184	0.0155	0.0107	0.0620	0.0136
3	0.0109	0.0059	0.0248	0.7931	0.0030	0.1000	0.0059	0.0079	0.0198	0.0287
4	0.0031	0.0031	0.0102	0.0041	0.8422	0.0071	0.0163	0.0010	0.0153	0.0978
5	0.0157	0.0045	0.0078	0.0381	0.0157	0.8083	0.0280	0.0090	0.0527	0.0202
6	0.0115	0.0042	0.0094	0.0010	0.0146	0.0271	0.9196	0.0042	0.0063	0.0021
7	0.0039	0.0233	0.0214	0.0126	0.0117	0.0097	0.0000	0.7802	0.0195	0.1177
8	0.0103	0.0287	0.0082	0.0267	0.0246	0.0637	0.0154	0.0072	0.7587	0.0565
9	0.0079	0.0149	0.0000	0.0040	0.0337	0.0168	0.0020	0.0089	0.0139	0.8979

Predicted
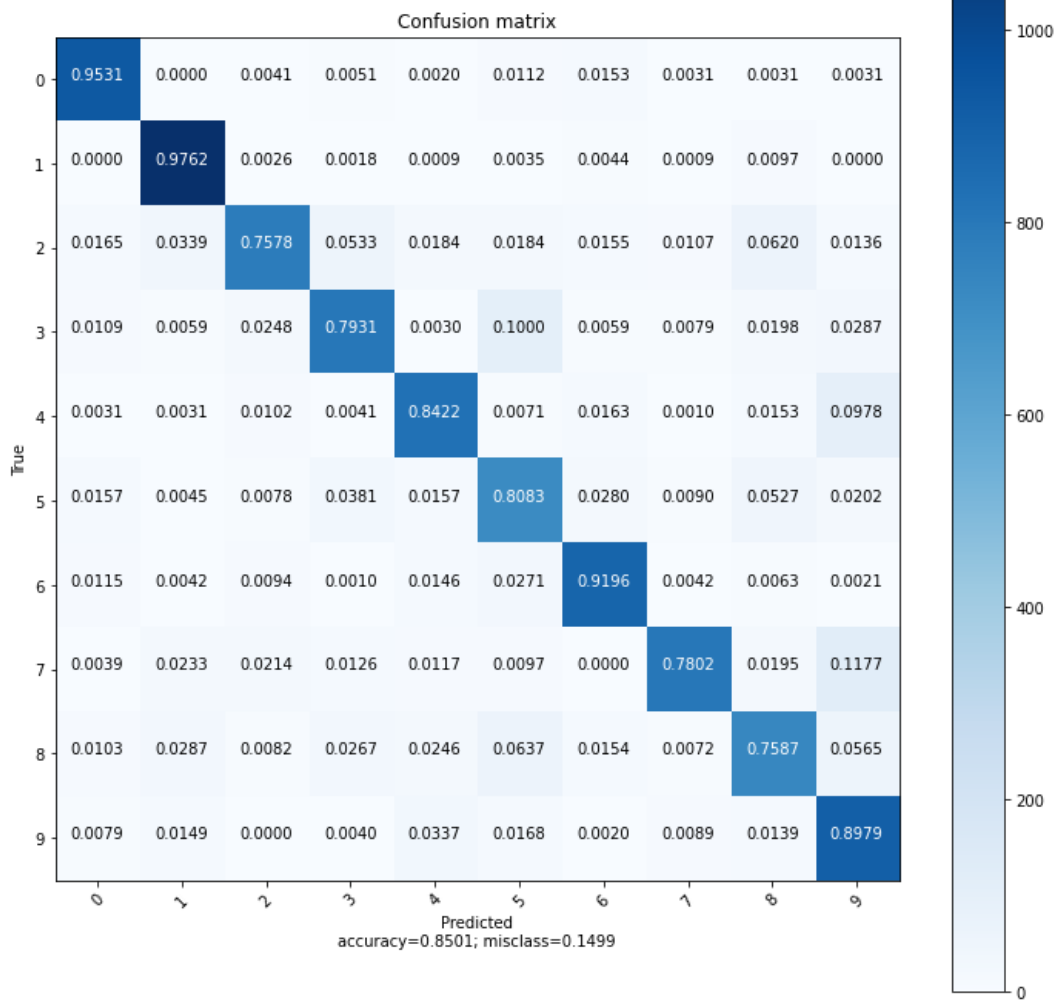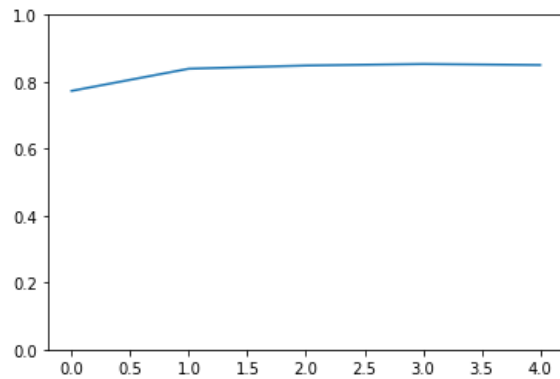accuracy=0.8501; misclass=0.1499

The rate of success shows good consistency between training and test sets, implying there's no overfitting. The accuracy is as good as any other output so there is likely no oscillation.

learning rate: 0.025

Confusion matrix

	0	1	2	3	4	5	6	7	8	9
0	0.9837	0.0000	0.0010	0.0031	0.0000	0.0031	0.0031	0.0031	0.0031	0.0000
1	0.0000	0.9577	0.0000	0.0229	0.0000	0.0000	0.0026	0.0009	0.0141	0.0018
2	0.0291	0.0940	0.6047	0.1386	0.0029	0.0107	0.0378	0.0087	0.0669	0.0068
3	0.0149	0.0010	0.0030	0.9257	0.0000	0.0149	0.0030	0.0149	0.0168	0.0059
4	0.0081	0.0000	0.0081	0.0061	0.7505	0.0000	0.0377	0.0061	0.0275	0.1558
5	0.0235	0.0022	0.0034	0.0908	0.0067	0.6951	0.0247	0.0258	0.1043	0.0235
6	0.0167	0.0052	0.0000	0.0010	0.0010	0.0240	0.9363	0.0021	0.0125	0.0010
7	0.0039	0.0165	0.0107	0.0185	0.0019	0.0019	0.0010	0.8794	0.0146	0.0516
8	0.0123	0.0185	0.0041	0.1478	0.0103	0.0164	0.0133	0.0082	0.7228	0.0462
9	0.0099	0.0020	0.0030	0.0317	0.0059	0.0010	0.0030	0.0347	0.0278	0.8811

Predicted label
accuracy=0.8361; misclass=0.1639

The rate of success dips when run on the test set, indicating potential overfitting.

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learning rate: 0.3

Confusion matrix

accuracy=0.8501; misclass=0.1499

The rate of success shows good consistency between training and test sets, implying there's no overfitting. The accuracy is as good as any other output so there is likely no oscillation.
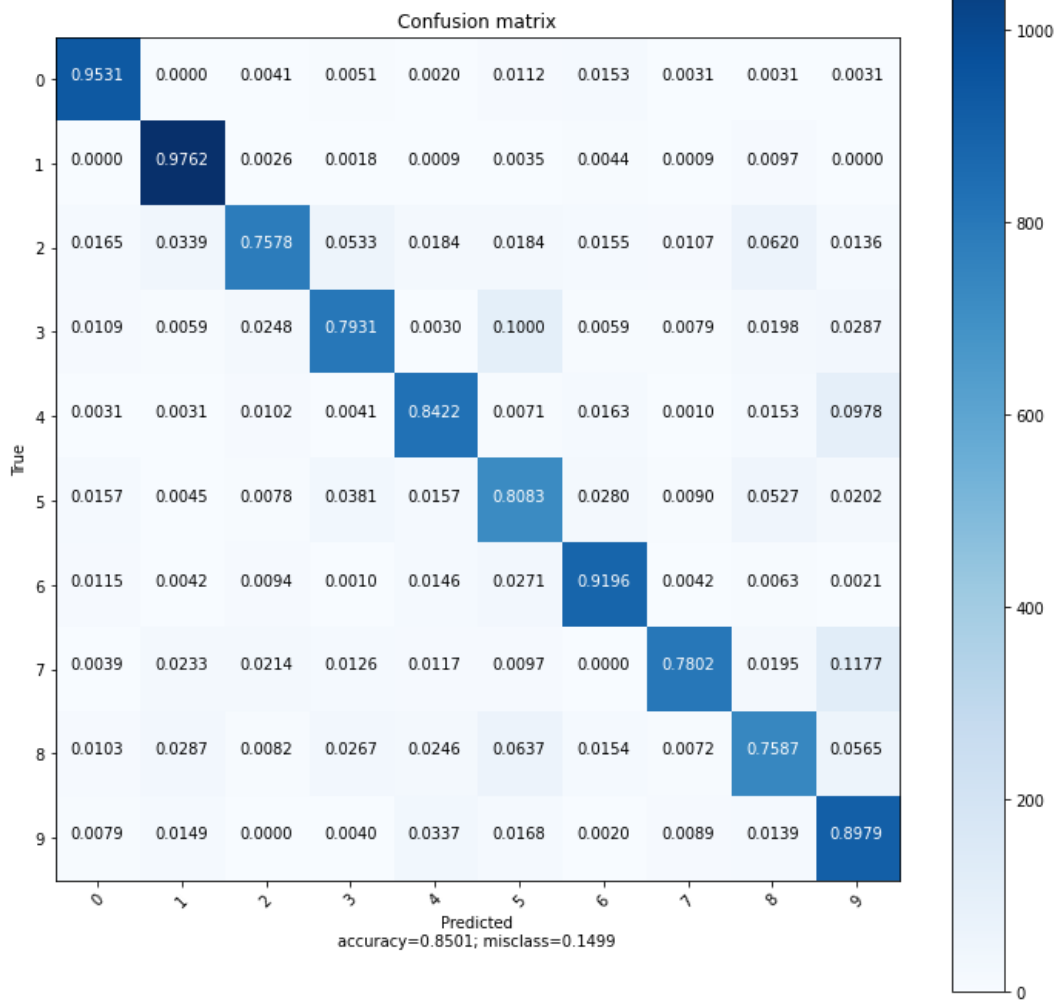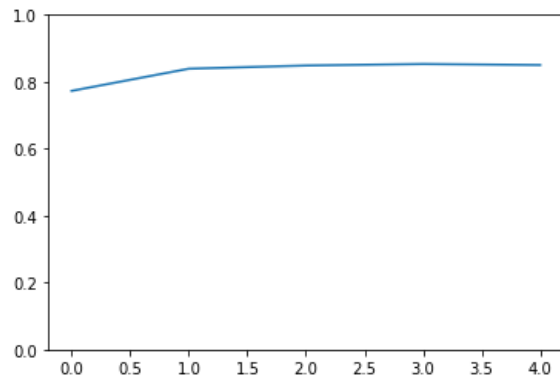
learning rate: 0.9

Confusion matrix

The rate of success shows good consistency between training and test sets, implying there's no overfitting. The accuracy is as good as any other output so there is likely no oscillation.

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