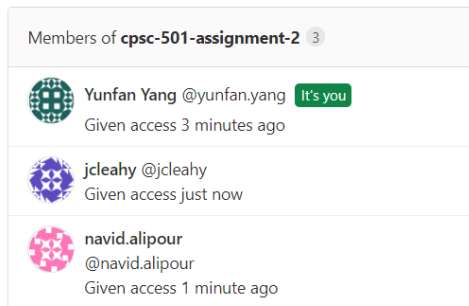


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<https://gitlab.cpsc.ucalgary.ca/yunfan.yang/cpsc-501-assignment-4/>

The access to this repository has been granted to the TA and the professor. Please let me know if it is not working by sending email to [yunfan.yang1@ucalgary.ca](mailto:yunfan.yang1@ucalgary.ca) so I can fix. 😊



For performance for each network, see PART1.md, PART2.md and PART3.md.

Each part consists of two neural networks, baseline and optimized. Hyperparameters are shown in the screenshot.

## Part I

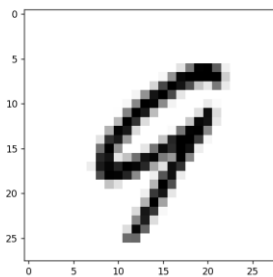
```
- net = network.Network([784, 10, 10])
- net.SGD(trainingData, 10, 10, .1, test_data=testingData)
-
network.saveToFile(net, "part1.pkl")
```

90	90	+ net = network.Network([784, 30, 10])
91	91	+ net.SGD(trainingData, 20, 10, 5, test_data=testingData)
92		
93	92	network.saveToFile(net, "part1.pkl")

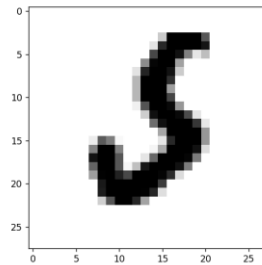
Adjustment:

1. Modifying the number of neurons in the second network layer, by changing the value from 10 to 30. This improves the accuracy because it is more meaningful to have the second layer with more neurons in order to summarize.
2. Change the number of epoch from 10 to 20. It needs more epoch to train to get to ideal accuracy.
3. Changing the value of eta from 0.1 to 5. It needs larger step to reach to the lowest point.

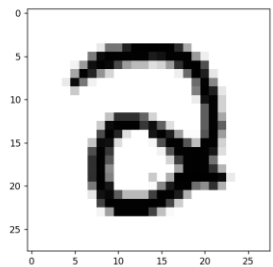
By having all the adjustments above, the accuracy is increased from 88% to 95%.



Index 9890 (Label 9, Test 7)



Index 9982 (Label 5, Test 0)



Index 7637 (Label 2, Test 0)

## Part II

<pre>- net = network.Network([784, 10, 10]) - net.SGD(trainingData, 10, 10, .1, test_data=testingData) - network.saveToFile(net, "part2.pkl")</pre>	<table border="1"><tr><td>63</td><td>63</td></tr><tr><td>64</td><td>64</td></tr><tr><td>65</td><td>65</td></tr></table>	63	63	64	64	65	65	<pre>+ net = network.Network([784, 30, 10]) + net.SGD(trainingData, 20, 10, 3, test_data=testingData) + network.saveToFile(net, "part2.pkl")</pre>
63	63							
64	64							
65	65							

Adjustment:

1. Modifying the number of neurons in the second network layer, by changing the value from 10 to 30. This improves the accuracy because it is more meaningful to have the second layer with more neurons in order to summarize.
2. Change the number of epoch from 10 to 20. It needs more epoch to train to get to ideal accuracy.
3. Changing the value of eta from 0.1 to 3. It needs larger step to reach to the lowest point.

By having all the adjustments above, the accuracy is increased from 89% to 90%.

By comparing this with MNIST dataset, this has lower accuracy because MNIST dataset has more distinguish features for all the digits, similar font and clearer outlines, whereas in this dataset, the letters are in several different fonts, and they are sometimes are to recognize even by human eyes.

## Part III

<pre>net = network.Network([9,10,2]) - net.SGD(trainingData, 10, 10, .1, test_data = testingData) network.saveToFile(net, "part3.pkl")</pre>	<table border="1"><tr><td>128</td><td>128</td></tr><tr><td>129</td><td>129</td></tr><tr><td>130</td><td>130</td></tr></table>	128	128	129	129	130	130	<pre>net = network.Network([9,10,2]) + net.SGD(trainingData, 10, 10, 1, test_data = testingData) network.saveToFile(net, "part3.pkl")</pre>
128	128							
129	129							
130	130							

Adjustment:

1. Changing the value of eta from 0.1 to 1. It needs larger step to reach to the lowest point.

By having all the adjustments above, the accuracy is increased from 70% to 75%.