Prestin Bell
Patrick Hurley
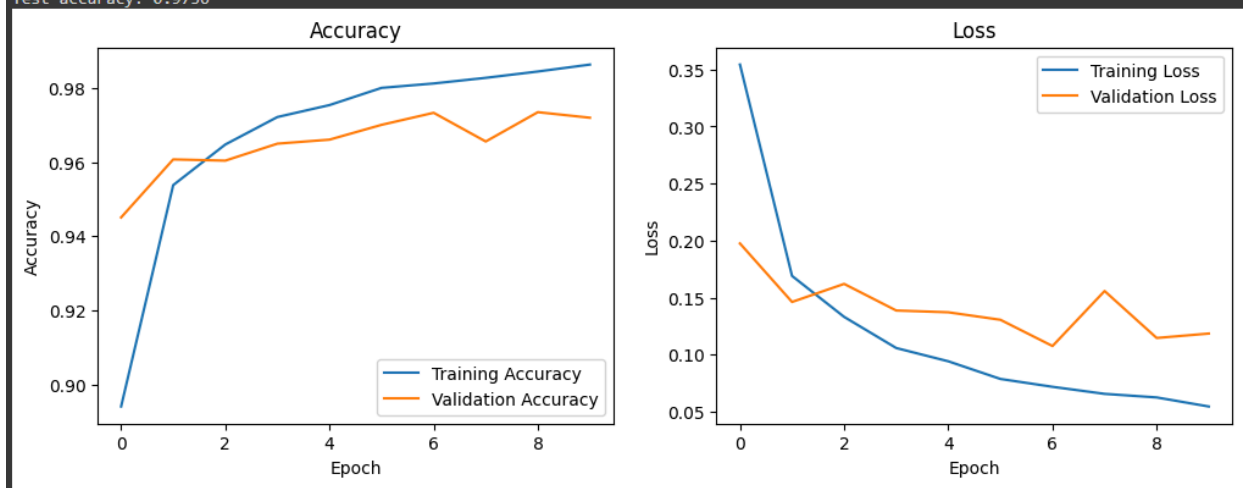
Homework 5

1. Create a new collab file to train a neural network with 10 dense layers and upload a screenshot of its testing accuracy and training history (plotted history of loss and accuracy).
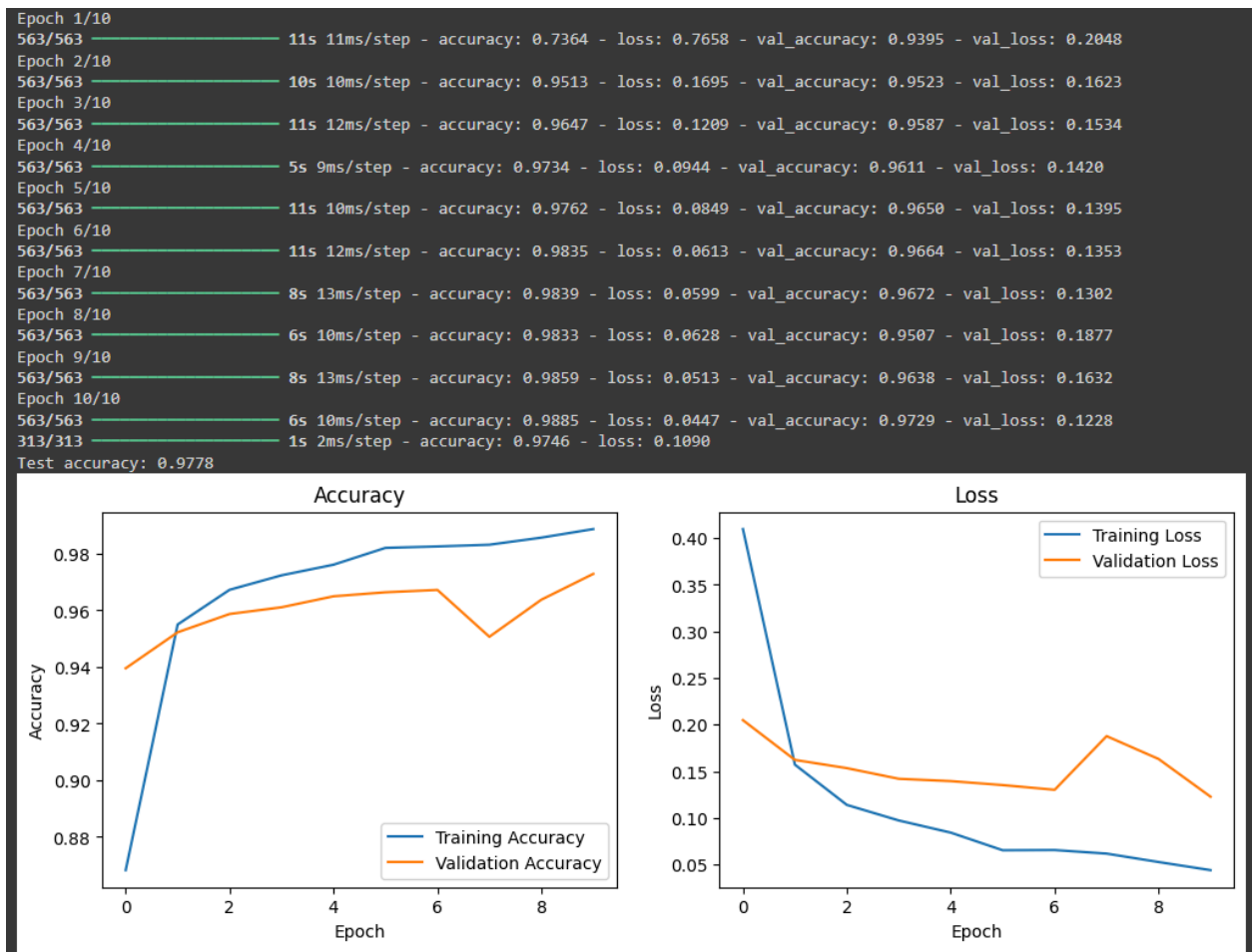
Below is a picture of the results we had from some of our first couple of rounds of training.

2. Try and compare the model's performance (accuracy) by adopting different training parameters such as number of epochs, learning rate, optimizer, etc.\

Below is a picture of the model training with the batch size set to 64 and the Validation split set to 0.4

```
Epoch 1/10
563/563 ──────────────── 11s 11ms/step - accuracy: 0.7364 - loss: 0.7658 - val_accuracy: 0.9395 - val_loss: 0.2048
Epoch 2/10
563/563 ──────────────── 10s 10ms/step - accuracy: 0.9513 - loss: 0.1695 - val_accuracy: 0.9523 - val_loss: 0.1623
Epoch 3/10
563/563 ──────────────── 11s 12ms/step - accuracy: 0.9647 - loss: 0.1209 - val_accuracy: 0.9587 - val_loss: 0.1534
Epoch 4/10
563/563 ──────────────── 5s 9ms/step - accuracy: 0.9734 - loss: 0.0944 - val_accuracy: 0.9611 - val_loss: 0.1420
Epoch 5/10
563/563 ──────────────── 11s 10ms/step - accuracy: 0.9762 - loss: 0.0849 - val_accuracy: 0.9650 - val_loss: 0.1395
Epoch 6/10
563/563 ──────────────── 11s 12ms/step - accuracy: 0.9835 - loss: 0.0613 - val_accuracy: 0.9664 - val_loss: 0.1353
Epoch 7/10
563/563 ──────────────── 8s 13ms/step - accuracy: 0.9839 - loss: 0.0599 - val_accuracy: 0.9672 - val_loss: 0.1302
Epoch 8/10
563/563 ──────────────── 6s 10ms/step - accuracy: 0.9833 - loss: 0.0628 - val_accuracy: 0.9507 - val_loss: 0.1877
Epoch 9/10
563/563 ──────────────── 8s 13ms/step - accuracy: 0.9859 - loss: 0.0513 - val_accuracy: 0.9638 - val_loss: 0.1632
Epoch 10/10
563/563 ──────────────── 6s 10ms/step - accuracy: 0.9885 - loss: 0.0447 - val_accuracy: 0.9729 - val_loss: 0.1228
313/313 ──────────────── 1s 2ms/step - accuracy: 0.9746 - loss: 0.1090
Test accuracy: 0.9778
```


Below is another picture with the same batch size but a different Validation split, which is 0.6.

```
Epoch 1/10
375/375 ──────────────── 10s 17ms/step - accuracy: 0.6900 - loss: 0.9106 - val_accuracy: 0.9266 - val_loss: 0.2542
Epoch 2/10
375/375 ──────────────── 4s 11ms/step - accuracy: 0.9436 - loss: 0.1964 - val_accuracy: 0.9419 - val_loss: 0.2016
Epoch 3/10
375/375 ──────────────── 6s 15ms/step - accuracy: 0.9578 - loss: 0.1430 - val_accuracy: 0.9515 - val_loss: 0.1839
Epoch 4/10
375/375 ──────────────── 5s 12ms/step - accuracy: 0.9711 - loss: 0.1006 - val_accuracy: 0.9499 - val_loss: 0.1881
Epoch 5/10
375/375 ──────────────── 6s 15ms/step - accuracy: 0.9758 - loss: 0.0829 - val_accuracy: 0.9552 - val_loss: 0.1719
Epoch 6/10
375/375 ──────────────── 7s 18ms/step - accuracy: 0.9797 - loss: 0.0692 - val_accuracy: 0.9609 - val_loss: 0.1586
Epoch 7/10
375/375 ──────────────── 5s 13ms/step - accuracy: 0.9813 - loss: 0.0648 - val_accuracy: 0.9543 - val_loss: 0.1892
Epoch 8/10
375/375 ──────────────── 9s 24ms/step - accuracy: 0.9815 - loss: 0.0609 - val_accuracy: 0.9611 - val_loss: 0.1615
Epoch 9/10
375/375 ──────────────── 6s 14ms/step - accuracy: 0.9881 - loss: 0.0460 - val_accuracy: 0.9622 - val_loss: 0.1758
Epoch 10/10
375/375 ──────────────── 6s 16ms/step - accuracy: 0.9892 - loss: 0.0423 - val_accuracy: 0.9569 - val_loss: 0.1875
313/313 ──────────────── 1s 2ms/step - accuracy: 0.9576 - loss: 0.1919
Test accuracy: 0.9609
```
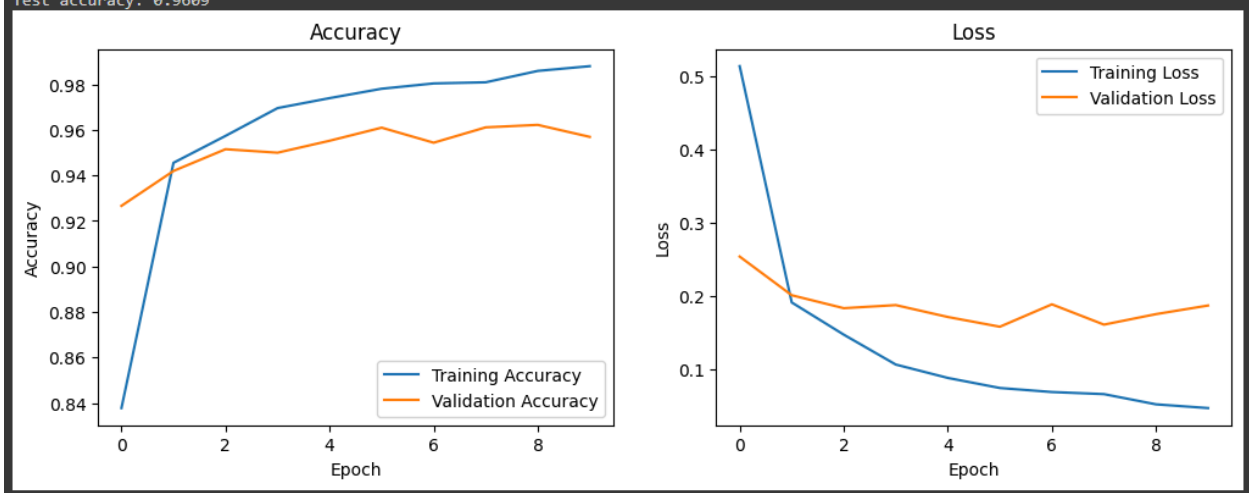

We also tried the extreme examples of setting the validation split to 0.1 and 0.9, and they gave bad results, so there is a good middle ground. We also tried higher and lower batch sizes ranging from 8 to 2048, and around 32 to 100 gave the best results.

3. Based on the findings of steps 1 and 2, train a model with the highest possible accuracy. This step's grade will be proportional to the testing precision.

After tinkering with the numbers, we came up with our highest-accuracy Test, which had a batch size of 64 and a Validation split of 0.4.

```
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Test accuracy: 0.9778
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