Resultados das Amostras

A estratégia utilizada para alcançar um desempenho melhor na acurácia da rede foi testar algumas possibilidades **(tentativa-erro)**. Em primeiro lugar, variou-se o números de treinamentos**(5->10->15)** para cada quantidade de neurônios e posteriormente foi-se variando a quantidade de neurônios em uma taxa de 2^1 **(512->2014->2048)**. Dessa forma, uma variável foi alocada para captura a melhor acurácia e propriedades da rede. A melhor taxa encontrada foi de 0.9837 utilizando-se 1024 neurônios, 15 épocas de treinamento e 0.5 de dropout.

```
Neurons: 512 neurons - Epochs: 5 epochs
Epoch 1/5
60000/60000 [==============================] - 8s 126us/sample
- loss: 0.2645 - acc: 0.9206
Epoch 2/5
60000/60000 [==============================] - 8s 133us/sample
- loss: 0.1382 - acc: 0.9585
Epoch 3/5
60000/60000 [==============================] - 8s 133us/sample
- loss: 0.1092 - acc: 0.9656
Epoch 4/5
60000/60000 [==============================] - 8s 127us/sample
- loss: 0.0906 - acc: 0.9715
Epoch 5/5
60000/60000 [==============================] - 8s 130us/sample
- loss: 0.0832 - acc: 0.9738
10000/10000 [==============================] - 1s 58us/sample
- loss: 0.0709 - acc: 0.9802
Model saved to disk

Neurons: 512 neurons - Epochs: 10 epochs
Epoch 1/10
60000/60000 [==============================] - 8s 127us/sample
- loss: 0.2721 - acc: 0.9189
Epoch 2/10
60000/60000 [==============================] - 8s 136us/sample
- loss: 0.1368 - acc: 0.9593
Epoch 3/10
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60000/60000 [==============================] - 8s 131us/sample
- loss: 0.1094 - acc: 0.9666
Epoch 4/10
60000/60000 [==============================] - 8s 126us/sample
- loss: 0.0894 - acc: 0.9707
Epoch 5/10
60000/60000 [==============================] - 8s 129us/sample
- loss: 0.0838 - acc: 0.9739
Epoch 6/10
60000/60000 [==============================] - 7s 124us/sample
- loss: 0.0721 - acc: 0.9768
Epoch 7/10
60000/60000 [==============================] - 8s 126us/sample
- loss: 0.0672 - acc: 0.9776
Epoch 8/10
60000/60000 [==============================] - 8s 128us/sample
- loss: 0.0632 - acc: 0.9795
Epoch 9/10
60000/60000 [==============================] - 8s 132us/sample
- loss: 0.0586 - acc: 0.9814
Epoch 10/10
60000/60000 [==============================] - 8s 131us/sample
- loss: 0.0539 - acc: 0.9828
10000/10000 [==============================] - 1s 61us/sample
- loss: 0.0663 - acc: 0.9815
Model saved to disk

Neurons: 512 neurons - Epochs: 15 epochs
Epoch 1/15
60000/60000 [==============================] - 8s 136us/sample
- loss: 0.2714 - acc: 0.9183
Epoch 2/15
60000/60000 [==============================] - 8s 137us/sample
- loss: 0.1384 - acc: 0.9578
Epoch 3/15
60000/60000 [==============================] - 8s 133us/sample
- loss: 0.1071 - acc: 0.9670
Epoch 4/15
60000/60000 [==============================] - 8s 131us/sample
- loss: 0.0941 - acc: 0.9707
Epoch 5/15
```

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60000/60000 [==============================] - 8s 131us/sample
- loss: 0.0823 - acc: 0.9739
Epoch 6/15
60000/60000 [==============================] - 8s 130us/sample
- loss: 0.0723 - acc: 0.9771
Epoch 7/15
60000/60000 [==============================] - 8s 132us/sample
- loss: 0.0674 - acc: 0.9776
Epoch 8/15
60000/60000 [==============================] - 8s 127us/sample
- loss: 0.0642 - acc: 0.9800
Epoch 9/15
60000/60000 [==============================] - 7s 123us/sample
- loss: 0.0581 - acc: 0.9812
Epoch 10/15
60000/60000 [==============================] - 8s 134us/sample
- loss: 0.0533 - acc: 0.9823
Epoch 11/15
60000/60000 [==============================] - 8s 132us/sample
- loss: 0.0511 - acc: 0.9829
Epoch 12/15
60000/60000 [==============================] - 8s 132us/sample
- loss: 0.0492 - acc: 0.9843
Epoch 13/15
60000/60000 [==============================] - 8s 126us/sample
- loss: 0.0474 - acc: 0.9847
Epoch 14/15
60000/60000 [==============================] - 8s 126us/sample
- loss: 0.0456 - acc: 0.9855
Epoch 15/15
60000/60000 [==============================] - 8s 131us/sample
- loss: 0.0452 - acc: 0.9852
10000/10000 [==============================] - 1s 62us/sample
- loss: 0.0703 - acc: 0.9830
Model saved to disk

Neurons: 1024 neurons - Epochs: 5 epochs
Epoch 1/5
60000/60000 [==============================] - 14s
231us/sample - loss: 0.2414 - acc: 0.9258
Epoch 2/5
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```
60000/60000 [==============================] - 14s
236us/sample - loss: 0.1259 - acc: 0.9614
Epoch 3/5
60000/60000 [==============================] - 14s
237us/sample - loss: 0.1008 - acc: 0.9686
Epoch 4/5
60000/60000 [==============================] - 14s
234us/sample - loss: 0.0828 - acc: 0.9740
Epoch 5/5
60000/60000 [==============================] - 13s
222us/sample - loss: 0.0765 - acc: 0.9762
10000/10000 [==============================] - 1s 83us/sample
- loss: 0.0628 - acc: 0.9814
Model saved to disk

Neurons: 1024 neurons - Epochs: 10 epochs
Epoch 1/10
60000/60000 [==============================] - 15s
249us/sample - loss: 0.2444 - acc: 0.9257
Epoch 2/10
60000/60000 [==============================] - 16s
259us/sample - loss: 0.1230 - acc: 0.9622
Epoch 3/10
60000/60000 [==============================] - 15s
250us/sample - loss: 0.0992 - acc: 0.9689
Epoch 4/10
60000/60000 [==============================] - 15s
256us/sample - loss: 0.0845 - acc: 0.9730
Epoch 5/10
60000/60000 [==============================] - 15s
249us/sample - loss: 0.0743 - acc: 0.9761
Epoch 6/10
60000/60000 [==============================] - 14s
240us/sample - loss: 0.0658 - acc: 0.9794
Epoch 7/10
60000/60000 [==============================] - 14s
232us/sample - loss: 0.0618 - acc: 0.9802
Epoch 8/10
60000/60000 [==============================] - 15s
246us/sample - loss: 0.0570 - acc: 0.9819
Epoch 9/10
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```
60000/60000 [==============================] - 14s
241us/sample - loss: 0.0525 - acc: 0.9834
Epoch 10/10
60000/60000 [==============================] - 14s
230us/sample - loss: 0.0509 - acc: 0.9841
10000/10000 [==============================] - 1s 88us/sample
- loss: 0.0692 - acc: 0.9830
Model saved to disk

Neurons: 1024 neurons - Epochs: 15 epochs
Epoch 1/15
60000/60000 [==============================] - 14s
229us/sample - loss: 0.2442 - acc: 0.9269
Epoch 2/15
60000/60000 [==============================] - 14s
228us/sample - loss: 0.1258 - acc: 0.9610
Epoch 3/15
60000/60000 [==============================] - 14s
230us/sample - loss: 0.0992 - acc: 0.9695
Epoch 4/15
60000/60000 [==============================] - 15s
242us/sample - loss: 0.0866 - acc: 0.9725
Epoch 5/15
60000/60000 [==============================] - 14s
239us/sample - loss: 0.0742 - acc: 0.9760
Epoch 6/15
60000/60000 [==============================] - 15s
250us/sample - loss: 0.0660 - acc: 0.9792
Epoch 7/15
60000/60000 [==============================] - 15s
252us/sample - loss: 0.0617 - acc: 0.9808
Epoch 8/15
60000/60000 [==============================] - 16s
262us/sample - loss: 0.0573 - acc: 0.9817
Epoch 9/15
60000/60000 [==============================] - 15s
258us/sample - loss: 0.0542 - acc: 0.9827
Epoch 10/15
60000/60000 [==============================] - 16s
264us/sample - loss: 0.0496 - acc: 0.9840
Epoch 11/15
```

```
60000/60000 [==============================] - 15s
246us/sample - loss: 0.0491 - acc: 0.9847
Epoch 12/15
60000/60000 [==============================] - 15s
244us/sample - loss: 0.0460 - acc: 0.9857
Epoch 13/15
60000/60000 [==============================] - 15s
252us/sample - loss: 0.0429 - acc: 0.9868
Epoch 14/15
60000/60000 [==============================] - 15s
253us/sample - loss: 0.0402 - acc: 0.9875
Epoch 15/15
60000/60000 [==============================] - 15s
251us/sample - loss: 0.0408 - acc: 0.9879
10000/10000 [==============================] - 1s 92us/sample
- loss: 0.0689 - acc: 0.9837
Model saved to disk


Neurons: 2048 neurons - Epochs: 5 epochs
Epoch 1/5
60000/60000 [==============================] - 25s
416us/sample - loss: 0.2334 - acc: 0.9289
Epoch 2/5
60000/60000 [==============================] - 24s
407us/sample - loss: 0.1224 - acc: 0.9617
Epoch 3/5
60000/60000 [==============================] - 23s
381us/sample - loss: 0.0997 - acc: 0.9692
Epoch 4/5
60000/60000 [==============================] - 24s
394us/sample - loss: 0.0851 - acc: 0.9740
Epoch 5/5
60000/60000 [==============================] - 23s
385us/sample - loss: 0.0770 - acc: 0.9768
10000/10000 [==============================] - 1s 111us/sample
- loss: 0.0651 - acc: 0.9802
Model saved to disk


Neurons: 2048 neurons - Epochs: 10 epochs
Epoch 1/10
60000/60000 [==============================] - 24s
395us/sample - loss: 0.2330 - acc: 0.9294
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Epoch 2/10
60000/60000 [==============================] - 23s
386us/sample - loss: 0.1255 - acc: 0.9623
Epoch 3/10
60000/60000 [==============================] - 24s
394us/sample - loss: 0.1004 - acc: 0.9690
Epoch 4/10
60000/60000 [==============================] - 24s
401us/sample - loss: 0.0839 - acc: 0.9738
Epoch 5/10
60000/60000 [==============================] - 24s
408us/sample - loss: 0.0782 - acc: 0.9764
Epoch 6/10
60000/60000 [==============================] - 23s
391us/sample - loss: 0.0670 - acc: 0.9798
Epoch 7/10
60000/60000 [==============================] - 24s
400us/sample - loss: 0.0630 - acc: 0.9810
Epoch 8/10
60000/60000 [==============================] - 24s
399us/sample - loss: 0.0604 - acc: 0.9822
Epoch 9/10
60000/60000 [==============================] - 23s
382us/sample - loss: 0.0529 - acc: 0.9845
Epoch 10/10
60000/60000 [==============================] - 25s
415us/sample - loss: 0.0567 - acc: 0.9839
10000/10000 [==============================] - 1s 124us/sample
- loss: 0.0836 - acc: 0.9819
Model saved to disk

Neurons: 2048 neurons - Epochs: 15 epochs
Epoch 1/15
60000/60000 [==============================] - 25s
414us/sample - loss: 0.2318 - acc: 0.9287
Epoch 2/15
60000/60000 [==============================] - 24s
398us/sample - loss: 0.1232 - acc: 0.9621
Epoch 3/15
60000/60000 [==============================] - 24s
404us/sample - loss: 0.1028 - acc: 0.9681
Epoch 4/15
```

```
60000/60000 [==============================] - 24s
400us/sample - loss: 0.0879 - acc: 0.9733
Epoch 5/15
60000/60000 [==============================] - 23s
388us/sample - loss: 0.0771 - acc: 0.9760
Epoch 6/15
60000/60000 [==============================] - 23s
383us/sample - loss: 0.0696 - acc: 0.9790
Epoch 7/15
60000/60000 [==============================] - 22s
373us/sample - loss: 0.0634 - acc: 0.9811
Epoch 8/15
60000/60000 [==============================] - 22s
370us/sample - loss: 0.0571 - acc: 0.9829
Epoch 9/15
60000/60000 [==============================] - 23s
378us/sample - loss: 0.0556 - acc: 0.9831
Epoch 10/15
60000/60000 [==============================] - 23s
386us/sample - loss: 0.0534 - acc: 0.9848
Epoch 11/15
60000/60000 [==============================] - 23s
382us/sample - loss: 0.0524 - acc: 0.9849
Epoch 12/15
60000/60000 [==============================] - 24s
408us/sample - loss: 0.0499 - acc: 0.9858
Epoch 13/15
60000/60000 [==============================] - 25s
411us/sample - loss: 0.0442 - acc: 0.9868
Epoch 14/15
60000/60000 [==============================] - 23s
389us/sample - loss: 0.0449 - acc: 0.9877
Epoch 15/15
60000/60000 [==============================] - 24s
394us/sample - loss: 0.0438 - acc: 0.9879
10000/10000 [==============================] - 1s 117us/sample
- loss: 0.1009 - acc: 0.9814
Model saved to disk
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0.9837
1024
15
```

0.5