DL Assignment 3

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- 50 iterations / epochs for training.
- For our neural network, number of input nodes were 784 (since each image was 28*28 pixels.). Number of hidden nodes was chosen to be 256. Number of output nodes will be number of classes, that is 10.
- A seed of 123 was chosen randomly, to ensure result reproducibility.
- The learning rate was set to 0.005, for a smoother convergence.
- Batch size chosen as 50, to accommodate individuality of samples, and optimise number of batches.
- Possible to restrict iterations via --iter flag.
- Weights downloaded from GitHub repo.

Final training accuracy : 96.88% (Maximum Training accuracy: 100.00%)
Final testing accuracy: 89.46%

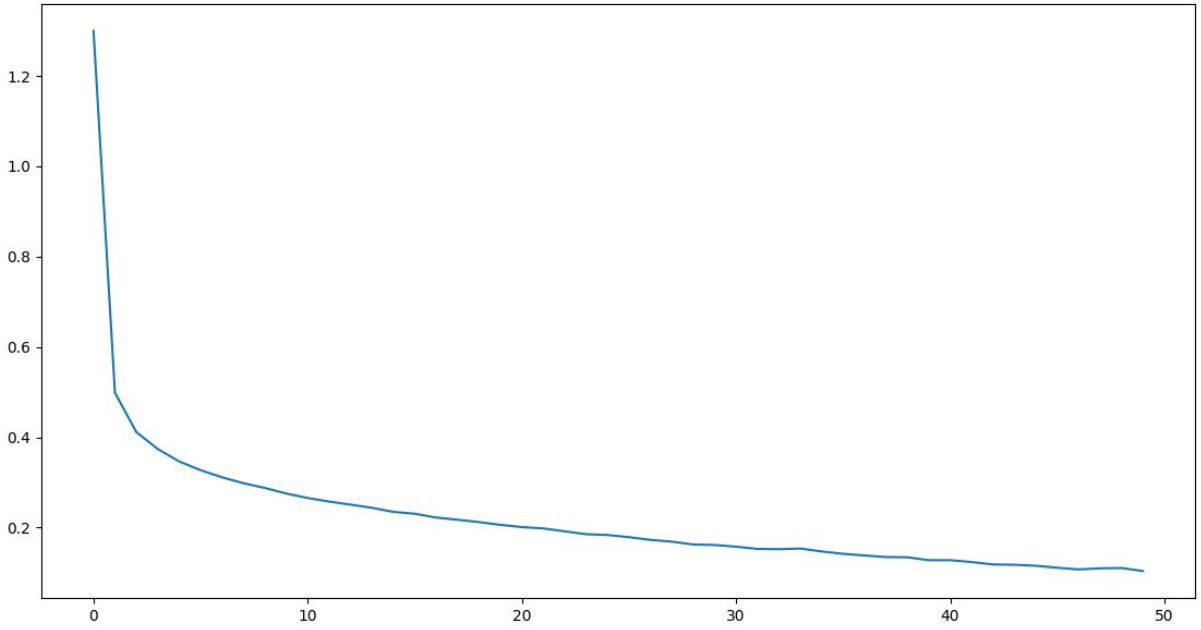
Logistic regression results

Layer 1: 88.87%
Layer 2: 89.33%
Layer 3: 89.46%

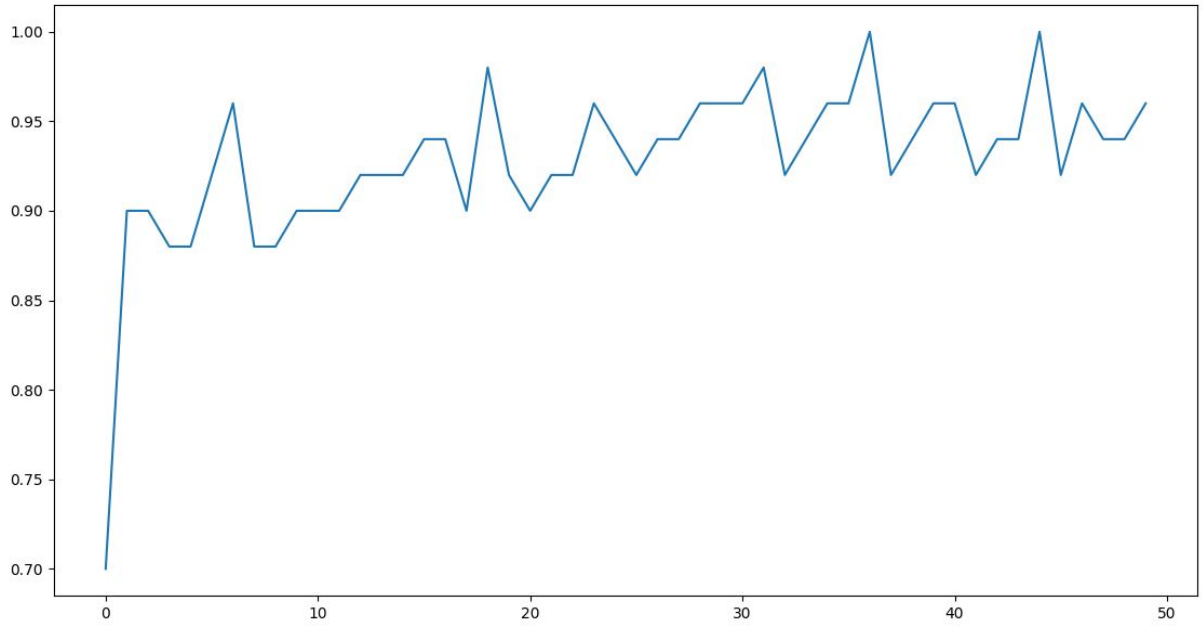
We see that, the first layer is sufficient for our multiclass classification problem is sufficient, and the improvement in accuracy is not significant in consequent layers.

Cost per Iterations

The cost initially starts off high: 1.3, however the first difference in costs is higher than any other. The final cost was 0.103



Accuracy vs Iterations



We observe that accuracy does not continuously increase. In an attempt to optimise cost, accuracy may decrease and the final accuracy we obtain might not be the maximum yet. Maximum training accuracy achieved: 100.00%.

Sample output

```
 ~/A/D/A/A3  python train.py --train --iter 50
Sunday 11 February 2018 01:15:04 AM IST
> Now Training
```

```
2018-02-11 01:22:31.907985: I
tensorflow/core/platform/cpu_feature_guard.cc:137] Your CPU supports
instructions that this TensorFlow binary was not compiled to use: SSE4.1
SSE4.2 AVX AVX2 FMA
Iteration 0, Cost: 1.29979835621, Accuracy: 0.699999988079
Iteration 1, Cost: 0.498526951602, Accuracy: 0.899999976158
Iteration 2, Cost: 0.411545879784, Accuracy: 0.899999976158
Iteration 3, Cost: 0.374051497516, Accuracy: 0.879999995232
Iteration 4, Cost: 0.34644221558, Accuracy: 0.879999995232
Iteration 5, Cost: 0.327229248875, Accuracy: 0.920000016689
Iteration 6, Cost: 0.311393541966, Accuracy: 0.959999978542
Iteration 7, Cost: 0.298341178287, Accuracy: 0.879999995232
Iteration 8, Cost: 0.287860013694, Accuracy: 0.879999995232
Iteration 9, Cost: 0.275486108057, Accuracy: 0.899999976158
Iteration 10, Cost: 0.265572229681, Accuracy: 0.899999976158
Iteration 11, Cost: 0.257660625885, Accuracy: 0.899999976158
Iteration 12, Cost: 0.250814636445, Accuracy: 0.920000016689
Iteration 13, Cost: 0.243896705888, Accuracy: 0.920000016689
Iteration 14, Cost: 0.234815693618, Accuracy: 0.920000016689
Iteration 15, Cost: 0.230709635531, Accuracy: 0.939999997616
Iteration 16, Cost: 0.222220790993, Accuracy: 0.939999997616
Iteration 17, Cost: 0.217428604159, Accuracy: 0.899999976158
Iteration 18, Cost: 0.212171116751, Accuracy: 0.980000019073
Iteration 19, Cost: 0.206121650371, Accuracy: 0.920000016689
Iteration 20, Cost: 0.201129863992, Accuracy: 0.899999976158
Iteration 21, Cost: 0.198192357901, Accuracy: 0.920000016689
Iteration 22, Cost: 0.19175690456, Accuracy: 0.920000016689
Iteration 23, Cost: 0.185409506272, Accuracy: 0.959999978542
Iteration 24, Cost: 0.183650226909, Accuracy: 0.939999997616
Iteration 25, Cost: 0.178834511335, Accuracy: 0.920000016689
Iteration 26, Cost: 0.172861208192, Accuracy: 0.939999997616
Iteration 27, Cost: 0.168905319029, Accuracy: 0.939999997616
Iteration 28, Cost: 0.162662261601, Accuracy: 0.959999978542
Iteration 29, Cost: 0.161534249625, Accuracy: 0.959999978542
Iteration 30, Cost: 0.157819050951, Accuracy: 0.959999978542
Iteration 31, Cost: 0.152851665982, Accuracy: 0.980000019073
Iteration 32, Cost: 0.152222470208, Accuracy: 0.920000016689
Iteration 33, Cost: 0.15365693096, Accuracy: 0.939999997616
Iteration 34, Cost: 0.147197643146, Accuracy: 0.959999978542
Iteration 35, Cost: 0.141958735539, Accuracy: 0.959999978542
Iteration 36, Cost: 0.138357927942, Accuracy: 1.0
Iteration 37, Cost: 0.134810501366, Accuracy: 0.920000016689
Iteration 38, Cost: 0.134340606692, Accuracy: 0.939999997616
Iteration 39, Cost: 0.127849028951, Accuracy: 0.959999978542
Iteration 40, Cost: 0.127920822739, Accuracy: 0.959999978542
```

```
Iteration 41, Cost: 0.123717169781, Accuracy: 0.920000016689
Iteration 42, Cost: 0.118458007173, Accuracy: 0.939999997616
Iteration 43, Cost: 0.117677982228, Accuracy: 0.939999997616
Iteration 44, Cost: 0.115562057127, Accuracy: 1.0
Iteration 45, Cost: 0.111096384374, Accuracy: 0.920000016689
Iteration 46, Cost: 0.107374930103, Accuracy: 0.959999978542
Iteration 47, Cost: 0.109891661938, Accuracy: 0.939999997616
Iteration 48, Cost: 0.110537695116, Accuracy: 0.939999997616
Iteration 49, Cost: 0.103779618308, Accuracy: 0.959999978542
Parameters have been trained and saved!
Train Accuracy: 0.9688333

 ~/A/D/A/A3  python train.py --test
                           10m  Sunday 11 February 2018 01:32:32 AM IST
> Now Testing
2018-02-11 01:32:46.159946: I
tensorflow/core/platform/cpu_feature_guard.cc:137] Your CPU supports
instructions that this TensorFlow binary was not compiled to use: SSE4.1
SSE4.2 AVX AVX2 FMA
Test Accuracy: 0.8946
 ~/A/D/A/A3            4066ms  Sunday 11 February 2018 01:32:48 AM IST
```