❖ **PART 1:**

➢ **Training set error over number of epochs:**
for epoch # 0

Train Error:
0.002668761095225525

for epoch # 1

Train Error:
0.0

for epoch # 2

Train Error:
0.0

for epoch # 3

Train Error:
0.0

for epoch # 4

Train Error:
0.0

for epoch # 5

Train Error:
0.0

for epoch # 6

Train Error:
0.0

for epoch # 7

Train Error:
0.0

for epoch # 8

Train Error:
0.0

for epoch # 9

Train Error:
0.0

for epoch # 10

Train Error:
0.0

for epoch # 11

Train Error:
0.0

for epoch # 12

Train Error:
0.0

for epoch # 13

Train Error:
0.0

for epoch # 14

Train Error:
0.0
Train Accuracy :: 100.0 %

```
for epoch # 12

Train Error:
0.0


for epoch # 13

Train Error:
0.0


for epoch # 14

Train Error:
0.0



Train Accuracy 100.0  %
```

- **Test set error over number of epochs:**
  epoch: 0 test error:: 0.13004502899507095
  epoch: 1 test error:: 0.13004502899507095
  epoch: 2 test error:: 0.13004502899507095
  epoch: 3 test error:: 0.13004502899507095
  epoch: 4 test error:: 0.13004502899507095
  epoch: 5 test error:: 0.13004502899507095
  epoch: 6 test error:: 0.13004502899507095
  epoch: 7 test error:: 0.13004502899507095
  epoch: 8 test error:: 0.13004502899507095
  epoch: 9 test error:: 0.13004502899507095
  epoch: 10 test error:: 0.13004502899507095
  epoch: 11 test error:: 0.13004502899507095
  epoch: 12 test error:: 0.13004502899507095

epoch: 13 test error:: 0.13004502899507095
epoch: 14 test error:: 0.13004502899507095

- **Final Test set accuracy:**
Test accuracy :: 86.9954971004929 %

```
epoch:  0   test error::   0.13004502899507095
epoch:  1   test error::   0.13004502899507095
epoch:  2   test error::   0.13004502899507095
epoch:  3   test error::   0.13004502899507095
epoch:  4   test error::   0.13004502899507095
epoch:  5   test error::   0.13004502899507095
epoch:  6   test error::   0.13004502899507095
epoch:  7   test error::   0.13004502899507095
epoch:  8   test error::   0.13004502899507095
epoch:  9   test error::   0.13004502899507095
epoch:  10   test error::   0.13004502899507095
epoch:  11   test error::   0.13004502899507095
epoch:  12   test error::   0.13004502899507095
epoch:  13   test error::   0.13004502899507095
epoch:  14   test error::   0.13004502899507095
Test accuracy ::   86.9954971004929 %

Process finished with exit code 0
```

❖ PART 2 :

➢ **Training set error over number of epochs:**
after epoch: 1 train error--- 0.5766912346551406
after epoch: 2 train error--- 0.5720259337264455
after epoch: 3 train error--- 0.4064771132006119
after epoch: 4 train error--- 0.22960791617303897
after epoch: 5 train error--- 0.2361212820105808
after epoch: 6 train error--- 0.23599518508126877
after epoch: 7 train error--- 0.25394070386770884
after epoch: 8 train error--- 0.24296316337530055
after epoch: 9 train error--- 0.23882115724646868
after epoch: 10 train error--- 0.23522980189595277
after epoch: 11 train error--- 0.2312125301884199
after epoch: 12 train error--- 0.2307893215655949
after epoch: 13 train error--- 0.23351665211474026
after epoch: 14 train error--- 0.22795571328354236
after epoch: 15 train error--- 0.23098456508562445
Train accuracy:: 76.90154349143755 %

```
layers 30 15
after epoch: 1 train error--- 0.5766912346551406
after epoch: 2 train error--- 0.5720259337264455
after epoch: 3 train error--- 0.4064771132006119
after epoch: 4 train error--- 0.22960791617303897
after epoch: 5 train error--- 0.2361212820105808
after epoch: 6 train error--- 0.23599518508126877
after epoch: 7 train error--- 0.25394070386770884
after epoch: 8 train error--- 0.24296316337530055
after epoch: 9 train error--- 0.23882115724646868
after epoch: 10 train error--- 0.23522980189595277
after epoch: 11 train error--- 0.2312125301884199
C:/Users/Sourav Biswas/Desktop/18CS92R08_ML_A4/NeuralNetw
   return 1/(1 + np.exp(-x))
after epoch: 12 train error--- 0.2307893215655949
after epoch: 13 train error--- 0.23351665211474026
after epoch: 14 train error--- 0.22795571328354236
after epoch: 15 train error--- 0.23098456508562445
Train accuracy:: 76.90154349143755  %
```

➤ Test error over number of epochs:

After epoch: 1 test error: 0.5618897925278062
After epoch: 2 test error: 0.5428628228098078
After epoch: 3 test error: 0.22205826578629742
After epoch: 4 test error: 0.2140650032798368
After epoch: 5 test error: 0.2299526127339579
After epoch: 6 test error: 0.23822457879965908
After epoch: 7 test error: 0.24559919083149365
After epoch: 8 test error: 0.23950566554218045
After epoch: 9 test error: 0.2528042514925054
After epoch: 10 test error: 0.2462061901498092
After epoch: 11 test error: 0.233175483222757
After epoch: 12 test error: 0.2364616498522636
After epoch: 13 test error: 0.23084315445559497

After epoch: 14 test error: 0.22941014132576254
After epoch: 15 test error: 0.23920922690915503

➢ **Final Test set accuracy:**
Test accuracy :: 76.0790773090845 %

```
After epoch:  1 test error:  0.5618897925278062
After epoch:  2 test error:  0.5428628228098078
After epoch:  3 test error:  0.22205826578629742
After epoch:  4 test error:  0.2140650032798368
After epoch:  5 test error:  0.2299526127339579
After epoch:  6 test error:  0.23822457879965908
After epoch:  7 test error:  0.24559919083149365
After epoch:  8 test error:  0.23950566554218045
After epoch:  9 test error:  0.2528042514925054
After epoch:  10 test error:  0.2462061901498092
After epoch:  11 test error:  0.233175483222757
After epoch:  12 test error:  0.2364616498522636
After epoch:  13 test error:  0.23084315445559497
After epoch:  14 test error:  0.22941014132576254
After epoch:  15 test error:  0.23920922690915503
Test accuracy ::  76.0790773090845  %

Process finished with exit code 0
```