ECE568 Software Engineering HW5: neural network report

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1. Target error = 0.1
   a) Learning rate=0.5, target error = 0.1

```
In [241]: runfile('/Users/ciuji/2019Spring/course_workspace/ECE568_WebApplication/
assignment5/NeuralNetwork.py', wdir='/Users/ciuji/2019Spring/course_workspace/
ECE568_WebApplication/assignment5')
initial weight1:
 [[ 0.32953734 -0.5963937   0.67209426]
 [-0.86244793 -0.69984745  0.37885   ]]
initial weight2:
 [[-0.1214627  -0.32346355  0.50457067]]
the first batch error:
 0.5016720752913575
final weight1:
 [[-1.96355966  3.61239801 -4.05945718]
 [-2.60159189 -4.277321    4.03823843]]
final weight2:
 [[-1.86337509  3.59358629  4.42791976]]
final error: 0.09744147978454158
total number of batch: 152
```

   b) Learning rate=1.0, target error = 0.1

```
In [244]: runfile('/Users/ciuji/2019Spring/course_workspace/ECE568_WebApplicatic
assignment5/NeuralNetwork.py', wdir='/Users/ciuji/2019Spring/course_workspace/
ECE568_WebApplication/assignment5')
initial weight1:
 [[ 0.86049871  0.55282488  0.24842435]
 [ 0.73270446 -0.10678338 -0.68100188]]
initial weight2:
 [[-0.53453724 -0.06138145  0.34921673]]
the first batch error:
 0.5176337435568733
final weight1:
 [[-1.48415347  4.3544911   4.36011008]
 [ 4.87941872 -3.26587865 -3.2688098 ]]
final weight2:
 [[-6.68937842  5.16059162  4.26305891]]
final error: 0.08482114444928297
total number of batch: 187
```

   c) Best learning rate

```
learning rate: 0.0 total number of batch: 10000
learning rate: 0.05 total number of batch: 3140
learning rate: 0.11 total number of batch: 1571
learning rate: 0.16 total number of batch: 1048
learning rate: 0.21 total number of batch: 786
learning rate: 0.26 total number of batch: 629
learning rate: 0.32 total number of batch: 524
learning rate: 0.37 total number of batch: 450
learning rate: 0.42 total number of batch: 393
learning rate: 0.47 total number of batch: 350
learning rate: 0.53 total number of batch: 315
learning rate: 0.58 total number of batch: 286
learning rate: 0.63 total number of batch: 262
learning rate: 0.68 total number of batch: 242
learning rate: 0.74 total number of batch: 224
learning rate: 0.79 total number of batch: 209
learning rate: 0.84 total number of batch: 196
learning rate: 0.89 total number of batch: 184
learning rate: 0.95 total number of batch: 173
learning rate: 1.0 total number of batch: 163
```

When the learning rate is 1.0, the program would converge fastest.

2. Target error = 0.02
   a) Learning rate = 0.5

```
initial weight1:
 [[-0.08936714 -0.13902266 -0.14713828]
 [-0.80765195  0.47410116  0.79215458]]
initial weight2:
 [[ 0.02046121 -0.68607191  0.69635045]]
the first batch error:
 0.50183973826573
final weight1:
 [[ 6.39310145 -4.27731861 -4.28088578]
 [-2.50879451  5.88872305  5.90605095]]
final weight2:
 [[-8.39355021  5.77027616  5.82239677]]
final error: 0.019829689553382126
total number of batch: 354
```

   b) Learning rate = 1.0

```
initial weight1:
 [[0.01794304 0.9845457  0.49402942]
 [0.60150322 0.16158761 0.56599795]]
initial weight2:
 [[0.15162962 0.54673268 0.23937786]]
the first batch error:
 0.5527926000977021
final weight1:
 [[ 2.57608052  5.46352474 -5.11652586]
 [ 2.74127903 -5.34118094  5.55579821]]
final weight2:
 [[ 8.00399569 -5.52761066 -5.5272253 ]]
final error: 0.01979839642400613
total number of batch: 507
```

c) Best learning rate

```
learning rate: 0.0 total number of batch: 10000
learning rate: 0.05 total number of batch: 3399
learning rate: 0.11 total number of batch: 1703
learning rate: 0.16 total number of batch: 1137
learning rate: 0.21 total number of batch: 855
learning rate: 0.26 total number of batch: 685
learning rate: 0.32 total number of batch: 573
learning rate: 0.37 total number of batch: 492
learning rate: 0.42 total number of batch: 432
learning rate: 0.47 total number of batch: 385
learning rate: 0.53 total number of batch: 348
learning rate: 0.58 total number of batch: 317
learning rate: 0.63 total number of batch: 292
learning rate: 0.68 total number of batch: 272
learning rate: 0.74 total number of batch: 255
learning rate: 0.79 total number of batch: 241
learning rate: 0.84 total number of batch: 240
learning rate: 0.89 total number of batch: 10000
learning rate: 0.95 total number of batch: 10000
learning rate: 1.0 total number of batch: 10000
```

In this case, the best learning rate is 0.84.