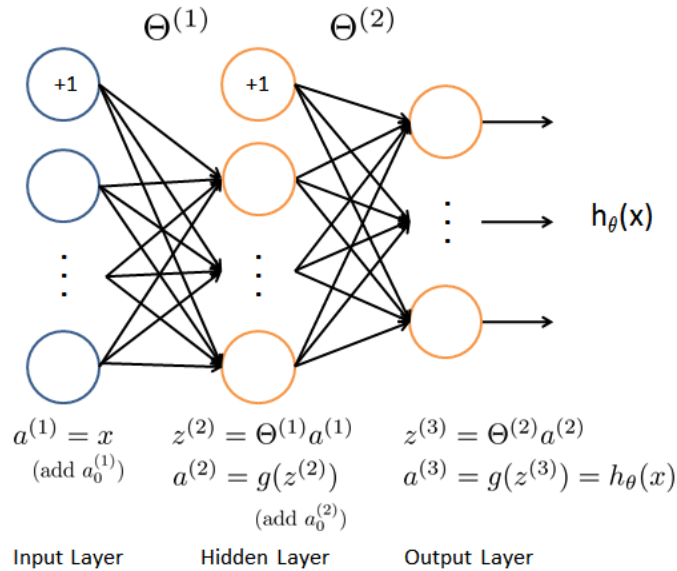


HW5 Report

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Q1 Neural Network

I add a bias unit to the input layer and the hidden layer respectively. So, the network looks like:



Note that sometimes the program won't give you the result because the weights (theta1 and theta2) are initialized randomly, which may cause the cost function J won't converge.

You can change the `learning_rate` and `target_error` in Line 97 and 98.

Results

Learning rate is: 0.5

Target error is: 0.1

```
hw5_1_nn
"C:\Program Files\Python36\python.exe" C:/Users/tzzma/source/ghsite/ECE
Learning rate is: 0.5
Target error is: 0.1
The init weights Theta_1 is [[-0.70448519  0.34962265 -0.00183366]
[-0.42859289  0.77025037 -0.33904636]]
The init weights Theta_2 is [[-0.81346943  0.40370946 -0.00211733]]
The first batch error is 0.7473887431733525
The final weights Theta_1 is [[-2.48518389 -4.75741324  4.44052302]
[-2.7905454  4.75670488 -4.97117611]]
The final weights Theta_2 is [[-2.87972984  5.87076914  6.06534585]]
The final error is 0.09984352710240205
the total number of batches run is 1235
The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:
[[0.11130846]
[0.90600535]
[0.92019333]
[0.09469871]]
Process finished with exit code 0
```

Learning rate is: 1

Target error is: 0.1

```
hw5_1_nn
"C:\Program Files\Python36\python.exe" C:/Users/tzzma/source/ghsite/EC
Learning rate is: 1
Target error is: 0.1
The init weights Theta_1 is [[ 0.3573027 -0.72953712  0.9722783 ]
 [-0.58346584  1.13691247 -0.85103366]]
The init weights Theta_2 is [[ 0.41257762 -0.8423969  1.12269028]]
The first batch error is 0.7089763138034719
The final weights Theta_1 is [[-2.5799918 -4.89598273  4.55655585]
 [-2.61352661  4.51694967 -4.74151045]]
The final weights Theta_2 is [[-2.91457465  5.9856883  6.0645454 ]]
The final error is 0.09923552372526871
the total number of batches run is 279
The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:
[[0.11116314]
 [0.91266492]
 [0.9142492 ]
 [0.09340726]]

Process finished with exit code 0
```

Learning rate is: 0.5

Target error is: 0.02

```
hw5_1_nn
"C:\Program Files\Python36\python.exe" C:/Users/tzzma/source/ghsite/EC
Learning rate is: 0.5
Target error is: 0.02
The init weights Theta_1 is [[-0.59928954  0.13425667 -0.27135531]
 [-0.88114372  1.12000965 -0.73457506]]
The init weights Theta_2 is [[-0.69199996  0.15502625 -0.31333413]]
The first batch error is 0.7638760278363563
The final weights Theta_1 is [[-3.1616405 -6.04327358  5.7397642 ]
 [-3.29555825  5.91701938 -6.13000175]]
The final weights Theta_2 is [[-4.42671289  9.05579296  9.0589677 ]]
The final error is 0.019994021264273812
the total number of batches run is 1665
The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:
[[0.02331405]
 [0.98185122]
 [0.98235048]
 [0.02005942]]

Process finished with exit code 0
```

Learning rate is: 1
Target error is: 0.02

```
v5_1_nn
"C:\Program Files\Python36\python.exe" C:/Users/tzzma/source/ghsite/EC
Learning rate is: 1
Target error is: 0.02
The init weights Theta_1 is [[ 1.0694485 -1.09761838  0.77473512]
 [-1.18344097 -0.37105313 -1.15591441]]
The init weights Theta_2 is [[ 1.23489276 -1.26742053  0.89458706]]
The first batch error is 0.7193901853146311
The final weights Theta_1 is [[-3.1922012 -6.07946469  5.7804769 ]
 [-3.18382444  5.72210939 -5.95227636]]
The final weights Theta_2 is [[-4.45401687  9.09426867  9.12495069]]
The final error is 0.019985777758202344
the total number of batches run is 880
The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:
[[0.02338099]
 [0.98211198]
 [0.98207873]
 [0.01994904]]

Process finished with exit code 0
```

Learning rate in [0.05, 0.1, 0.3, 0.5, 0.75, 1]

Target error = 0.1

The init weights Theta_1 is [[-0.38404047 -0.06897211 1.12252285]
[0.99525219 -0.78971388 0.35975224]]
The init weights Theta_2 is [[-0.44345173 -0.07964214 1.29617774]]

Learning rate is: 0.05

Target error is: 0.1

The first batch error is 0.7174708075735095
The final weights Theta_1 is [[-2.27973707 5.47942452 5.48520361]
[6.06182938 -4.05718349 -4.05844979]]
The final weights Theta_2 is [[-8.85899284 6.16701676 6.06162017]]
The final error is 0.09998439355685633
the total number of batches run is 12035

Learning rate is: 0.1

Target error is: 0.1

The first batch error is 0.7174708075735095
The final weights Theta_1 is [[-2.27984016 5.47958173 5.4853568]
[6.06207454 -4.05734265 -4.05860811]]
The final weights Theta_2 is [[-8.85945217 6.16729371 6.06195859]]
The final error is 0.09996820523917618
the total number of batches run is 6019

Learning rate is: 0.3

Target error is: 0.1

The first batch error is 0.7174708075735095

The final weights Theta_1 is [[-2.27994594 5.4797204 5.4854824]
[6.06225125 -4.05745214 -4.05871494]]

The final weights Theta_2 is [[-8.85998035 6.16759386 6.06237466]]

The final error is 0.09995153130685704

the total number of batches run is 2008

Learning rate is: 0.5

Target error is: 0.1

The first batch error is 0.7174708075735095

The final weights Theta_1 is [[-2.28032037 5.48028715 5.48603387]
[6.06313856 -4.05802736 -4.05928699]]

The final weights Theta_2 is [[-8.86165711 6.16860239 6.0636132]]

The final error is 0.09989264894379402

the total number of batches run is 1206

Learning rate is: 0.75

Target error is: 0.1

The first batch error is 0.7174708075735095

The final weights Theta_1 is [[-2.28074798 5.4809295 5.48665797]
[6.06414795 -4.05868079 -4.05993664]]

The final weights Theta_2 is [[-8.86358181 6.16975724 6.06503851]]

The final error is 0.09982531382072798

the total number of batches run is 805

Learning rate is: 1

Target error is: 0.1

The first batch error is 0.7174708075735095

The final weights Theta_1 is [[-2.27965468 5.47914069 5.4848656]
[6.06116554 -4.05671692 -4.05797233]]

The final weights Theta_2 is [[-8.85901294 6.16690594 6.06181359]]

The final error is 0.09999633955642356

the total number of batches run is 604

Target error = 0.02

Learning rate in [0.05, 0.1, 0.3, 0.5, 0.75, 1]

The init weights Theta_1 is [[0.76198743 -0.86487841 -0.12342132]
[0.21423064 1.09255548 -0.09787427]]

The init weights Theta_2 is [[0.87986729 -0.99867556 -0.14251467]]

Learning rate is: 0.05

Target error is: 0.02

The first batch error is 0.7006059421176762

The final weights Theta_1 is [[3.32277218 -6.6011102 6.86931383]
[3.35944904 6.94771762 -6.67466712]]
The final weights Theta_2 is [[12.72540872 -8.67063999 -8.66164773]]
The final error is 0.019999581783178462
the total number of batches run is 25519
The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:
[[0.01773647]
[0.9770558]
[0.97700279]
[0.01550396]]

Learning rate is: 0.1

Target error is: 0.02

The first batch error is 0.7006059421176762
The final weights Theta_1 is [[3.32280619 -6.60119189 6.86941465]
[3.35950467 6.94781707 -6.67477509]]
The final weights Theta_2 is [[12.72544304 -8.6706606 -8.66166802]]
The final error is 0.019999016339520934
the total number of batches run is 12760
The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:
[[0.01773593]
[0.97705644]
[0.97700341]
[0.01550353]]

Learning rate is: 0.3

Target error is: 0.02

The first batch error is 0.7006059421176762
The final weights Theta_1 is [[3.32294204 -6.60151839 6.86981776]
[3.35972755 6.9482154 -6.67520759]]
The final weights Theta_2 is [[12.7255791 -8.67074224 -8.66174832]]
The final error is 0.019996761445964212
the total number of batches run is 4254
The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:
[[0.0177338]
[0.97705896]
[0.97700589]
[0.01550184]]

Learning rate is: 0.5

Target error is: 0.02

The first batch error is 0.7006059421176762
The final weights Theta_1 is [[3.3231197 -6.60193097 6.870308]
[3.35999171 6.94869873 -6.67572486]]

The final weights Theta_2 is [[12.7260305 -8.67103321 -8.66203819]]

The final error is 0.019992295063982615

the total number of batches run is 2553

The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:

[[0.01772969]

[0.97706399]

[0.97701088]

[0.01549845]]

Learning rate is: 0.75

Target error is: 0.02

The first batch error is 0.7006059421176762

The final weights Theta_1 is [[3.32318306 -6.60212089 6.87059229]

[3.36017017 6.94898903 -6.67605914]]

The final weights Theta_2 is [[12.72540025 -8.67060431 -8.66160618]]

The final error is 0.019995074671481136

the total number of batches run is 1702

The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:

[[0.017732]

[0.97706084]

[0.97700764]

[0.01550064]]

Learning rate is: 1

Target error is: 0.02

The first batch error is 0.7006059421176762

The final weights Theta_1 is [[3.32345632 -6.60274244 6.87131279]

[3.36055335 6.94970157 -6.67681418]]

The final weights Theta_2 is [[12.72635268 -8.67122584 -8.66222624]]

The final error is 0.01998676355932863

the total number of batches run is 1277

The prediction of [0, 0], [0, 1], [1, 0], [1, 1] is:

[[0.01772445]

[0.9770702]

[0.97701696]

[0.01549431]]

We can safely conclude that 1 is the best choice in [0.05, 0.1, 0.3, 0.5, 0.75, 1] for learning rate because the total number of running times of it is the least.

Q2 A Web Page

Just designed as the homework required, but more details. For example, the table will reset itself when the shape, radius or height changes, and the height input textbox will be disabled when the user chooses sphere.