Assighment_1

1. 編譯結果

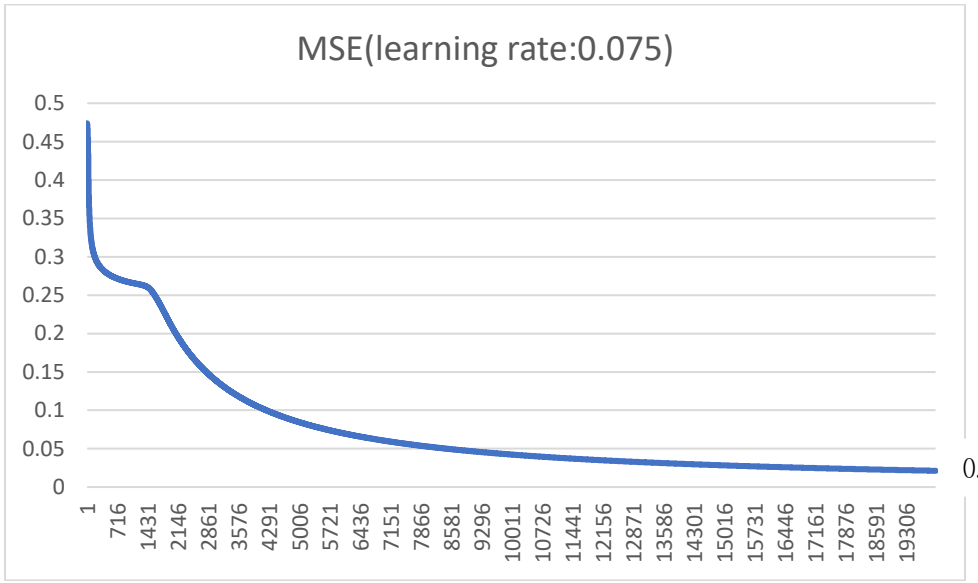
```
casper@LAPTOP-1DKFTNB9:~/work/NN$ gcc main.c -lm layer.c neuron.c
casper@LAPTOP-1DKFTNB9:~/work/NN$
```

2. 執行結果

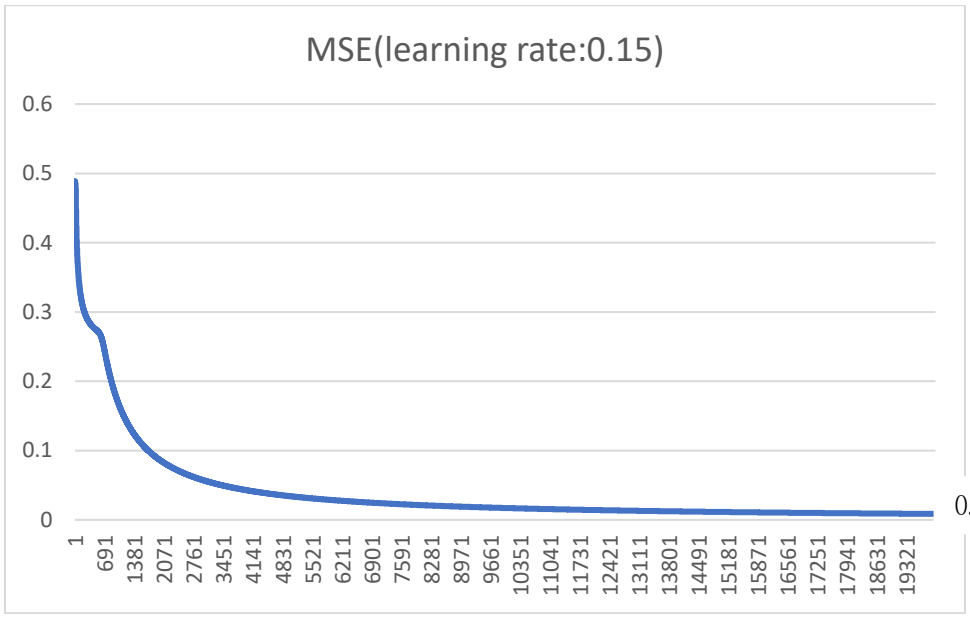
```
Enter the number of Layers in Neural Network:
4
Enter number of neurons in layer[1]:
2
Enter number of neurons in layer[2]:
4
Enter number of neurons in layer[3]:
4
Enter number of neurons in layer[4]:
1

Created Layer: 1
Number of Neurons in Layer 1: 2
Neuron 1 in Layer 1 created
Neuron 2 in Layer 1 created

Created Layer: 2
Number of Neurons in Layer 2: 4
Neuron 1 in Layer 2 created
Neuron 2 in Layer 2 created
Neuron 3 in Layer 2 created
Neuron 4 in Layer 2 created

Created Layer: 3
Number of Neurons in Layer 3: 4
Neuron 1 in Layer 3 created
Neuron 2 in Layer 3 created
Neuron 3 in Layer 3 created
Neuron 4 in Layer 3 created

Created Layer: 4
Number of Neurons in Layer 4: 1
Neuron 1 in Layer 4 created
```

```
Initializing weights...
0:w[0][0]: 0.296730
1:w[0][0]: 0.532401
2:w[0][0]: 0.003100
3:w[0][0]: 0.068759
0:w[0][1]: 0.304956
1:w[0][1]: 0.541783
2:w[0][1]: 0.297007
3:w[0][1]: 0.640177
0:w[1][0]: 0.534337
1:w[1][0]: 0.372291
2:w[1][0]: 0.935845
3:w[1][0]: 0.571215
0:w[1][1]: 0.094694
1:w[1][1]: 0.130542
2:w[1][1]: 0.815099
3:w[1][1]: 0.110021
0:w[1][2]: 0.728264
1:w[1][2]: 0.712449
2:w[1][2]: 0.918843
3:w[1][2]: 0.366524
0:w[1][3]: 0.530922
1:w[1][3]: 0.201486
2:w[1][3]: 0.065975
3:w[1][3]: 0.336909
0:w[2][0]: 0.133504
0:w[2][1]: 0.988753
0:w[2][2]: 0.878117
0:w[2][3]: 0.498992

Neural Network Created Successfully...

  Input: 0.000000
  Input: 0.000000
  Output: 0

  Input: 1.000000
  Input: 1.000000
  Output: 0

  Input: 1.000000
  Input: 0.000000
  Output: 1

  Input: 0.000000
  Input: 1.000000
  Output: 1

  Enter input to test:
```

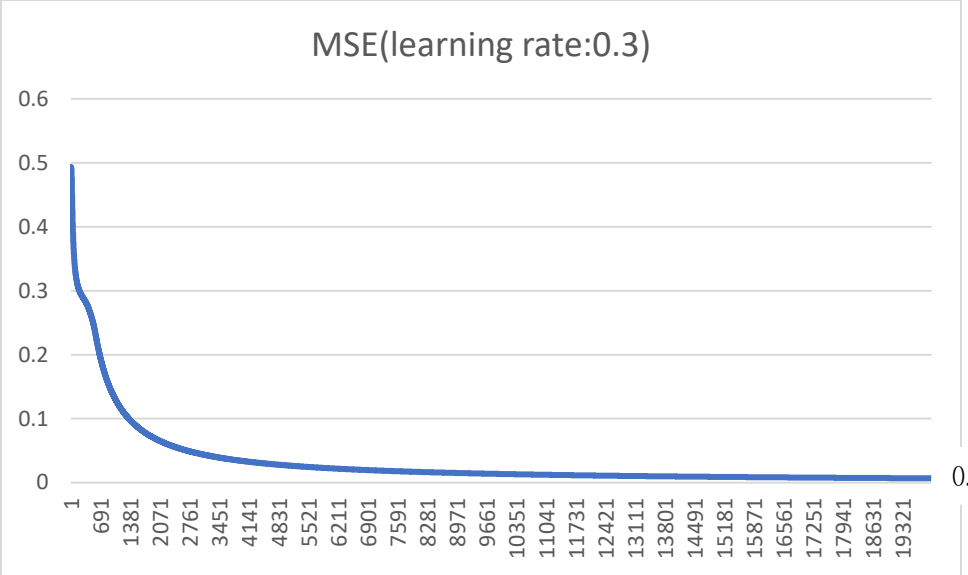
3. 分析



0.021214



0.008541



此類神經網路程式呈現 2 位元 XOR 的結果，根據 Mean Square Error(MSE)修正權重，最終使 MSE 趨近於 0，讓輸出接近想要的結果。

$$MSE = \frac{\sum_{i=1}^{n} (y_i - y_i^p)^2}{n}$$

圖表中每 4 個數據一組算出平均 MSE，重複計算了 20000 組資料，可以看出 MSE 收斂於 0，且當 learning rate 升高時，MSE 最終會越接近於 0，輸出越準確。

4. 參考資料
https://medium.com/analytics-vidhya/building-neural-network-framework-in-c-using-backpropagation-8ad589a0752d