Assignment #1

110503520 通訊二 葉易展

1 編譯結果

```
easonyeh@easonyeh-VirtualBox:~/nn$ make
cc -g -Wall -Werror -c src/main.c -o build/backdrop.o
cc -g -Wall -Werror -c src/layer.c -o build/layer.o
cc -g -Wall -Werror -c src/neuron.c -o build/neuron.o
cc -pthread -lpthread -o backprop build/main.o build/layer.o build/neuron.o -lm
-o bin/backdrop
easonyeh@easonyeh-VirtualBox:~/nn$
```

2 執行結果

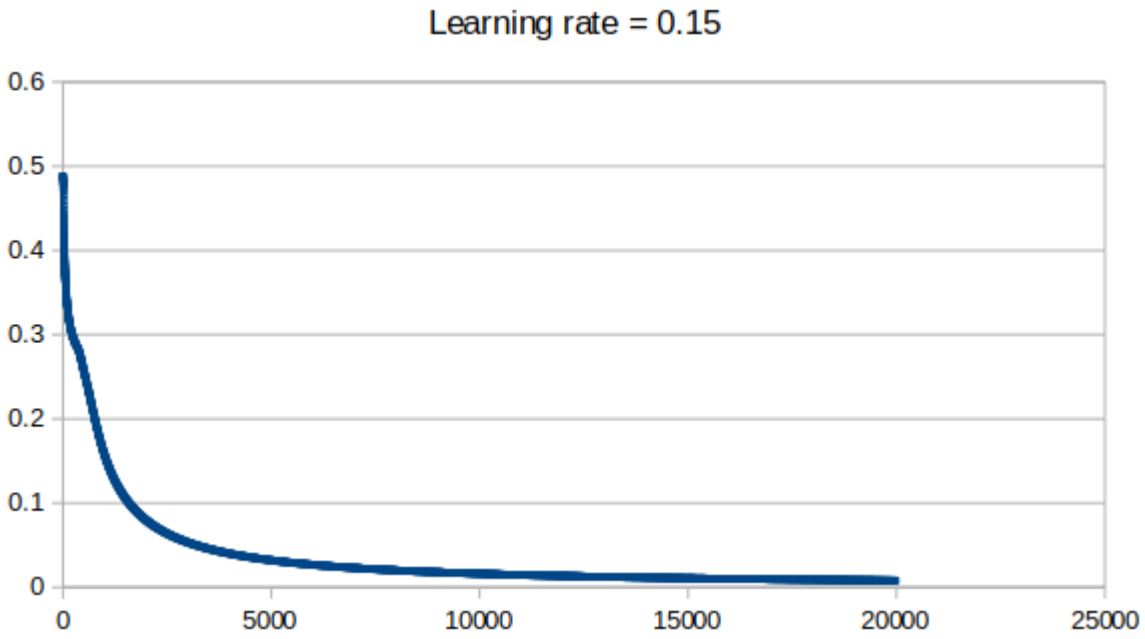
```
easonyeh@easonyeh-VirtualBox:~/nn$ make run
./bin/backprop
Enter the number of Layers in Neural Network:
4
Enter number of neurons in layer[1]:
2
Enter number of neurons in layer[2]:
4
Enter number of neurons in layer[3]:
4
Enter number of neurons in layer[4]:
1

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]: 0.307105
1:w[0][0]: 0.783893
2:w[0][0]: 0.253676
3:w[0][0]: 0.849229
0:w[0][1]: 0.097758
1:w[0][1]: 0.471032
2:w[0][1]: 0.740590
3:w[0][1]: 0.817618
0:w[1][0]: 0.723954
1:w[1][0]: 0.635423
2:w[1][0]: 0.500945
3:w[1][0]: 0.980836
0:w[1][1]: 0.730688
1:w[1][1]: 0.225457
2:w[1][1]: 0.520364
3:w[1][1]: 0.550701
0:w[1][2]: 0.062342
1:w[1][2]: 0.051404
2:w[1][2]: 0.274265
3:w[1][2]: 0.737246
0:w[1][3]: 0.181326
1:w[1][3]: 0.868263
2:w[1][3]: 0.876298
3:w[1][3]: 0.442769
0:w[2][0]: 0.311295
0:w[2][1]: 0.652906
0:w[2][2]: 0.768216
0:w[2][3]: 0.467629
```

```
Neural Network Created Successfully...

Enter the learning rate (Usually 0.15):
0.15

Enter the number of training examples:
4

Enter the Inputs for training example[0]:
0 0

Enter the Inputs for training example[1]:
0 1

Enter the Inputs for training example[2]:
1 0

Enter the Inputs for training example[3]:
1 1

Enter the Desired Outputs (Labels) for training example[0]:
0

Enter the Desired Outputs (Labels) for training example[1]:
1

Enter the Desired Outputs (Labels) for training example[2]:
1

Enter the Desired                    aining example[3]:
0
```

```
Input: 0.000000
Input: 0.000000
Output: 0

Input: 0.000000
Input: 1.000000
Output: 1

Input: 1.000000
Input: 0.000000
Output: 1

Input: 1.000000
Input: 1.000000
Output: 0

Enter input to test:
```

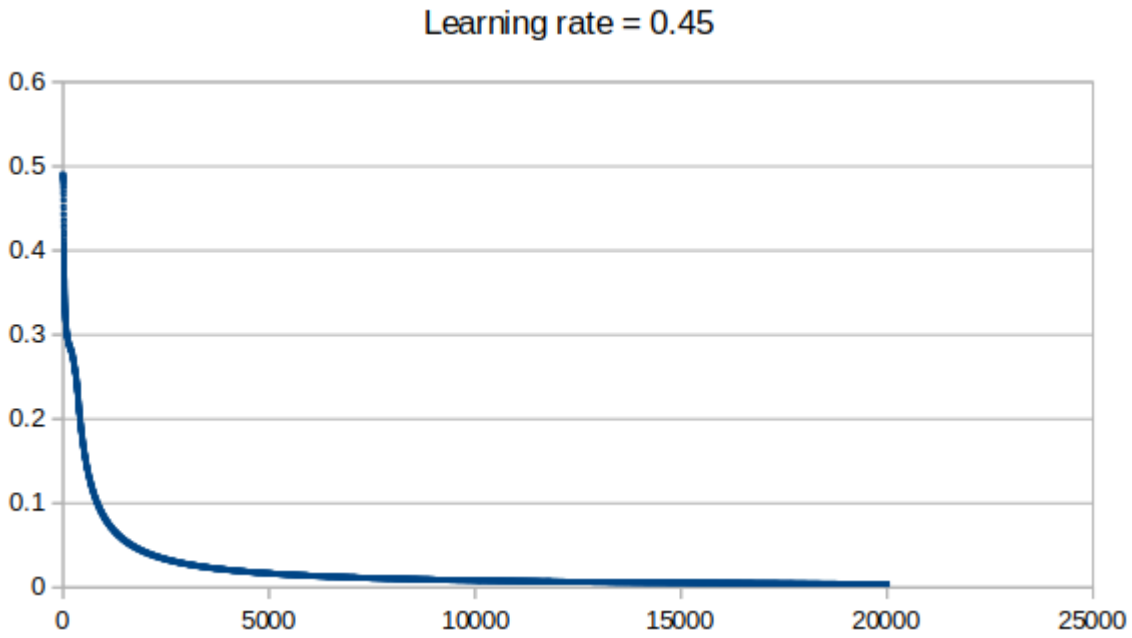
3 分析



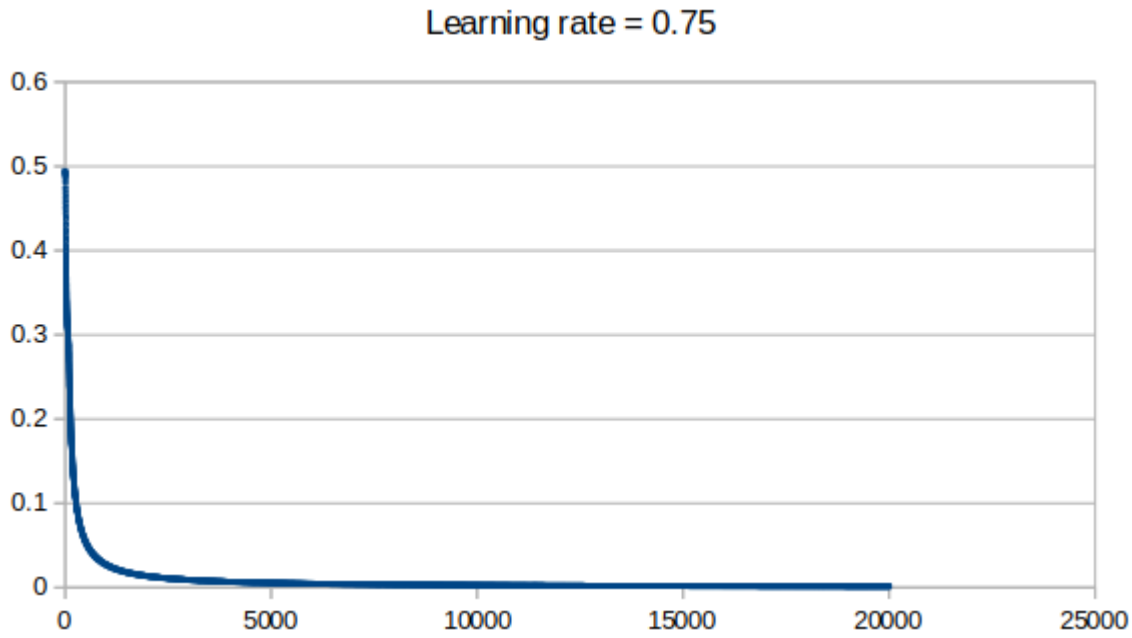
圖一、橫軸為資料數，縱軸為均方誤差 Mean square error

計算均方誤差的公式如下：

$$MSE = \frac{1}{n}\sum_{i=1}^{n}\left(y_i - \hat{y}_i\right)^2$$



圖二、



圖三、

觀察圖一～圖三發現，學習率越高能越快達到最小誤差，並且最終值越靠近 0