Assignment1

1.編譯 compile result

```
cornertw@DESKTOP-HD1IFP1:/mnt/c/Users/Max Liu/OneDrive/文件/中央大學/大二/資料結構/110503531_assignment_1/Neural-Network-framework-using-Backpropoga
tion-in-C$ make
cc -g -Wall -Werror -c main.c
cc -pthread -lpthread -o backprop main.o layer.o neuron.o -lm
cornertw@DESKTOP-HD1IFP1:/mnt/c/Users/Max Liu/OneDrive/文件/中央大學/大二/資料結構/110503531_assignment_1/Neural-Network-framework-using-Backpropoga
tion-in-C$ gcc main.c -lm layer.c neuron.c
cornertw@DESKTOP-HD1IFP1:/mnt/c/Users/Max Liu/OneDrive/文件/中央大學/大二/資料結構/110503531_assignment_1/Neural-Network-framework-using-Backpropoga
tion-in-C$
```

The picture shows the result after make and gcc compiling

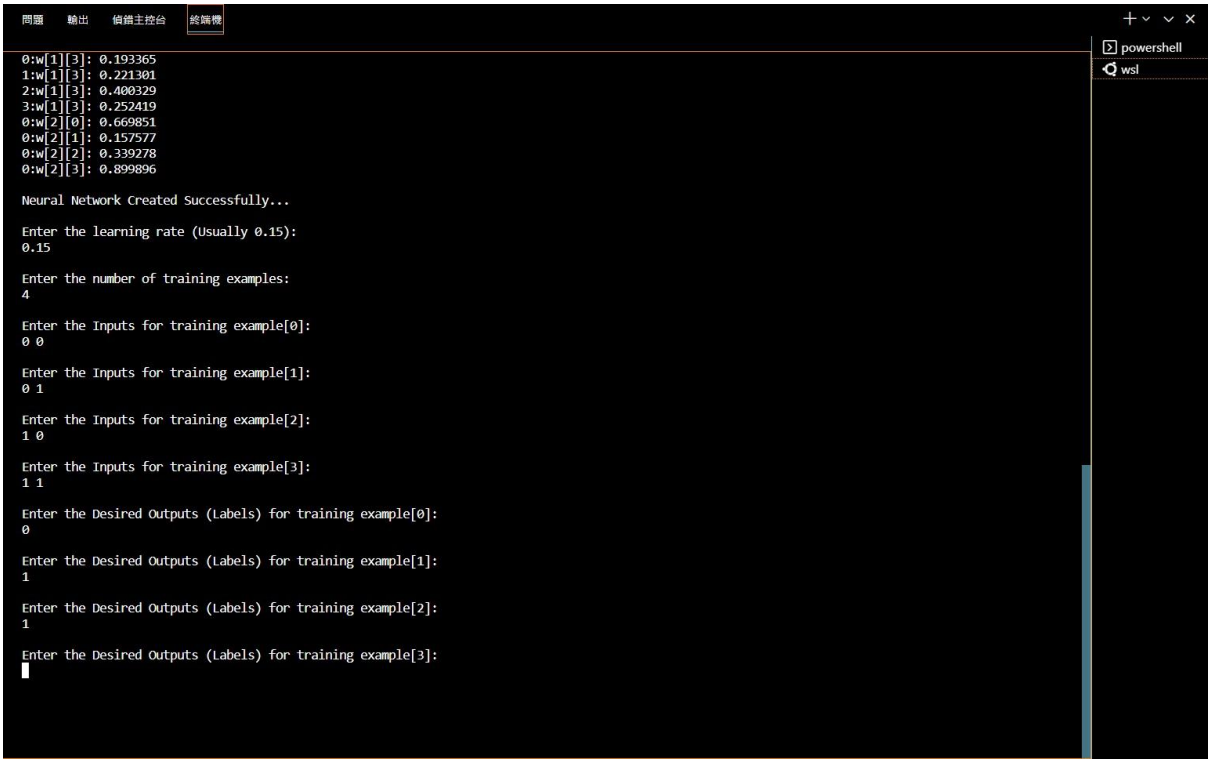
2.執行 execute result

```
cornertw@DESKTOP-HD1IFP1:/mnt/c/Users/Max Liu/OneDrive/文件/中央大學/大二/資料結構/110503531_assignment_1/Neural-Network-framework-using-Backpropoga
tion-in-C$ gcc main.c -lm layer.c neuron.c
cornertw@DESKTOP-HD1IFP1:/mnt/c/Users/Max Liu/OneDrive/文件/中央大學/大二/資料結構/110503531_assignment_1/Neural-Network-framework-using-Backpropoga
tion-in-C$ ./a.out
Enter the number of Layers in Neural Network:
```

問題　輸出　偵錯主控台　終端機

powershell
wsl

```
cornertw@DESKTOP-HD1IFP1:/mnt/c/Users/Max Liu/OneDrive/文件/中央大學/大二/資料結構/110503531_assignment_1/Neural-Network-framework-using-Backpropoga
tion-in-C$ ./a.out
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]: 0.240725
1:w[0][0]: 0.823587
2:w[0][0]: 0.972657
3:w[0][0]: 0.989320
0:w[0][1]: 0.433656
1:w[0][1]: 0.347187
2:w[0][1]: 0.044248
```



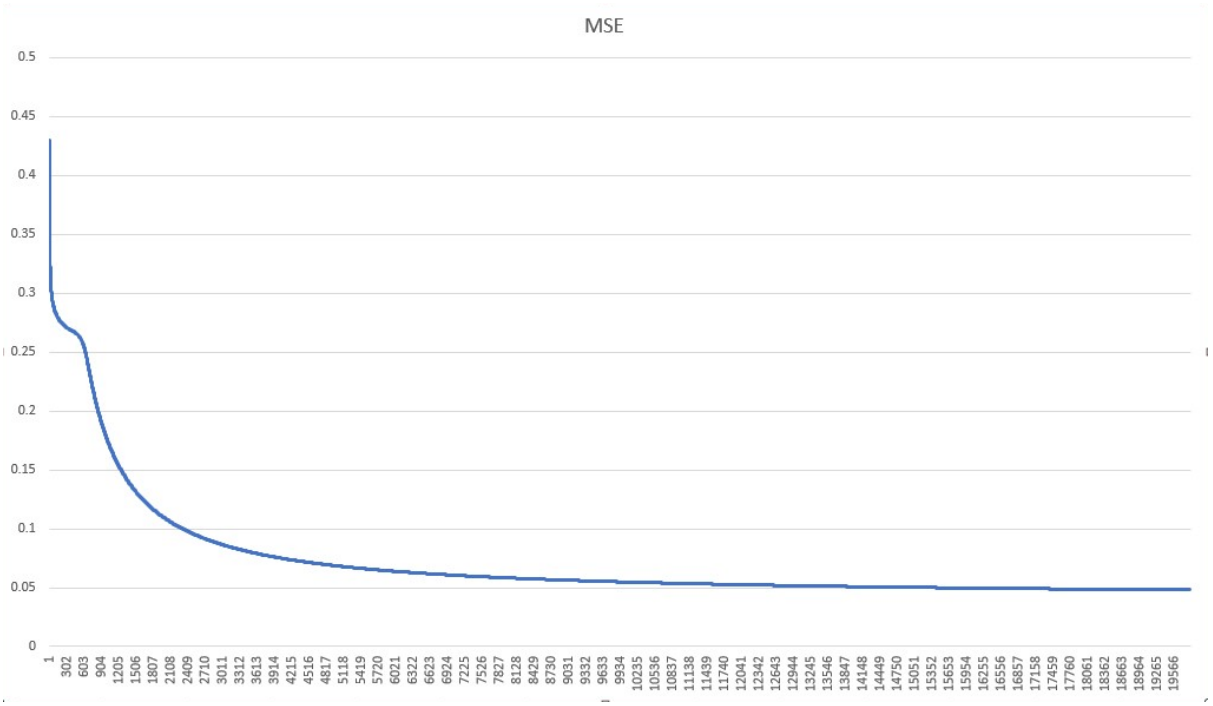
The input of the last training example 3 of this image is 0

```
Output: 1
Full Cost: 0.000002

Input: 0.000000
Input: 0.000000
Output: 0
Full Cost: 0.000000

Input: 0.000000
Input: 1.000000
Output: 1
Full Cost: 0.000000

Input: 1.000000
Input: 0.000000
Output: 1
Full Cost: 0.000000

Input: 1.000000
Input: 1.000000
Output: 1
Full Cost: 0.000002

Input: 0.000000
Input: 0.000000
Output: 0
Full Cost: 0.000000

Input: 0.000000
Input: 1.000000
Output: 1
Full Cost: 0.000000

Input: 1.000000
Input: 0.000000
Output: 1
Full Cost: 0.000000

Input: 1.000000
Input: 1.000000
Output: 1
Full Cost: 0.000002

Enter input to test:
```

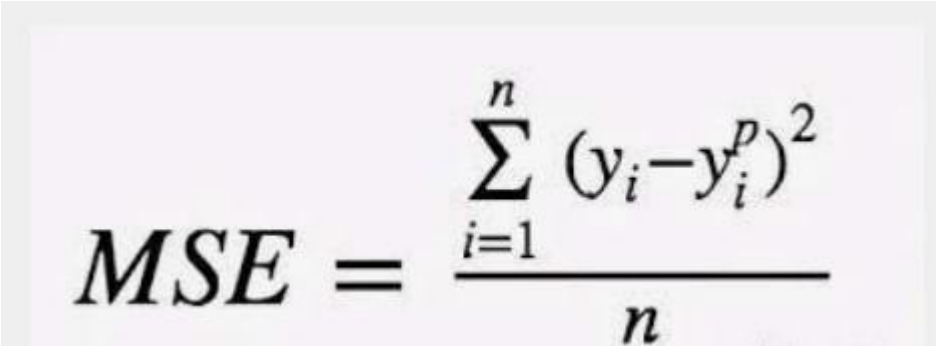
```
Enter input to test:
0 0
Output: 0
Enter input to test:
0 1
Output: 1
Enter input to test:
1 0
Output: 1
Enter input to test:
1 1
Output: 1
Enter input to test:
```

The above five pictures are the results of the execution after the compilation is completed.It can be seen that the program requires the user to input the amount of data and the data to learning, and learn according to the input data, and after 20,000 times of training, the program will let the user test the data to detect whether the learning is complete.

3.誤差分析error analysis



This figure is an analysis of the error value generated during learning. And then, the Mean Square Error was used for the analysis. The formula is as follows.



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

Through the calculate_MSE function in the program, each error is brought into the formula to become the Mean Square Error, and recorded in the MSE_Data.csv file. And here is drawn by excel, it can be found that after many times of training, the error will become smaller and smaller and finally converge to complete the correct learning.

4.問題problem

Linux VM setup with GUI in WSL2, then vmmem causes high CPU usage.
I solved the problem by restarting WSL from CMD.
There are indeed many other problems or lack of knowledge in this work, and I also recognize my own shortcomings. What I need to do now is to see more and learn more.

5.Develop

- This time it is only 2-bit operation, I hope to try n-bit operation
- Try more efficient operations