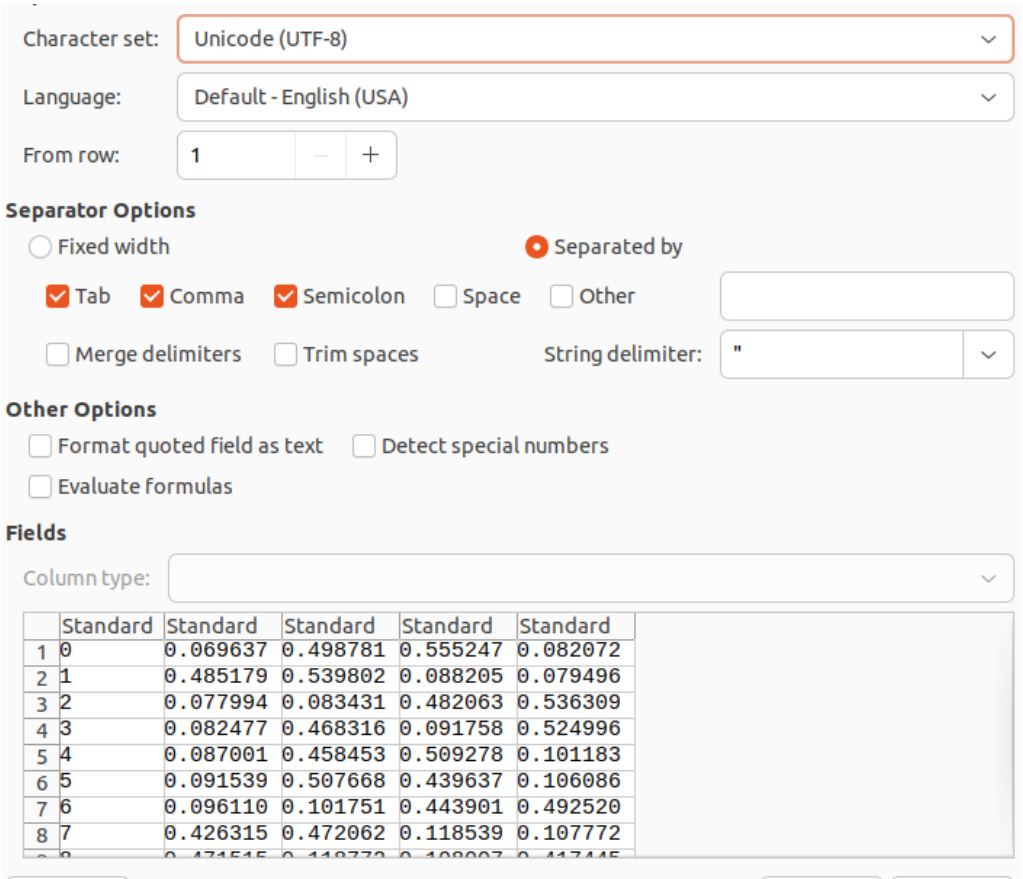
Assignment 1

109503528 李彥岑

編譯&執行結果

```
lyc@lyc-virtual-machine:~$ cd Desktop/DS
lyc@lyc-virtual-machine:~/Desktop/DS$ gcc -o DS.out DS.c -lm
lyc@lyc-virtual-machine:~/Desktop/DS$ ./DS.out
Final Hidden Weights
[ [ 3.672099 3.670897 ] [ 5.874482 5.867946 ] ]
Final Hidden Biases
[ -5.610720 -2.422902 ]
Final Output Weights[ -8.068704 7.450911 ]
Final Output Biases
[ -3.355583 ]
lyc@lyc-virtual-machine:~/Desktop/DS$
```

CSV 輸出每次 train 的 error (MSE)



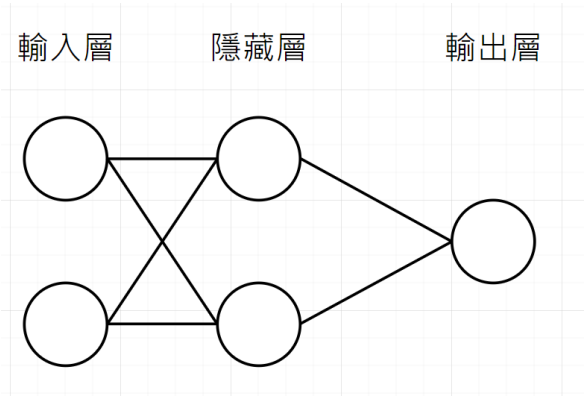
	Standard	Standard	Standard	Standard	Standard
1	0	0.069637	0.498781	0.555247	0.082072
2	1	0.485179	0.539802	0.088205	0.079496
3	2	0.077994	0.083431	0.482063	0.536309
4	3	0.082477	0.468316	0.091758	0.524996
5	4	0.087001	0.458453	0.509278	0.101183
6	5	0.091539	0.507668	0.439637	0.106086
7	6	0.096110	0.101751	0.443901	0.492520
8	7	0.426315	0.472062	0.118539	0.107772

程式架構

初始化神經網路
→ 給予訓練資料&標籤
→ 訓練 10000 次，且每次給予不同的訓練資料
→ 將最後的權重輸出在螢幕上，並輸出每次訓練的 error

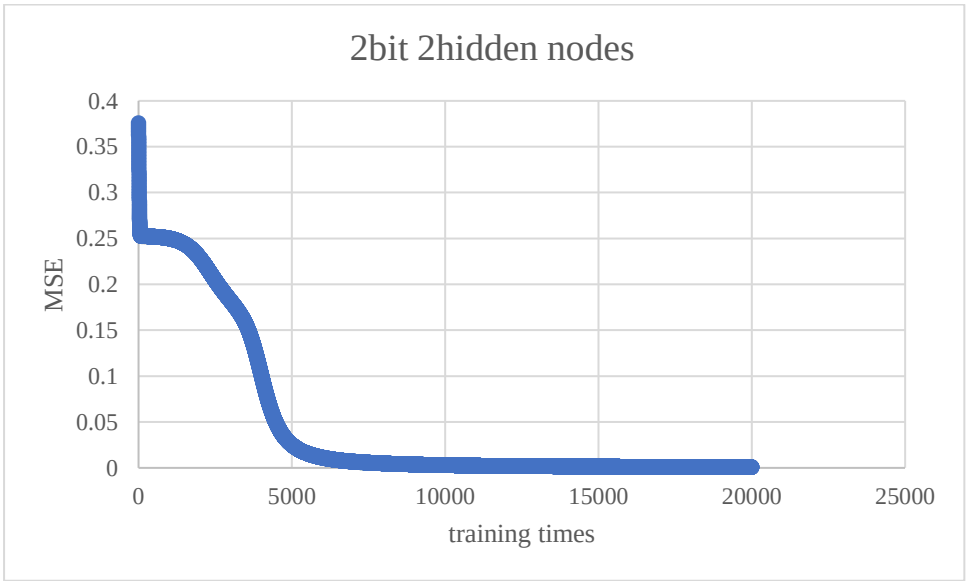
神經網路架構

使用 sigmod 函數來 Forward Pass
使用 dsigmod 函數來 Backward Pass

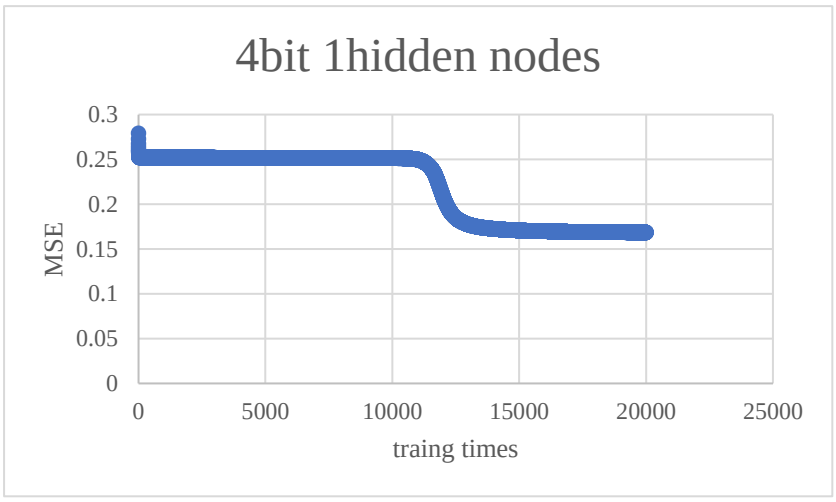


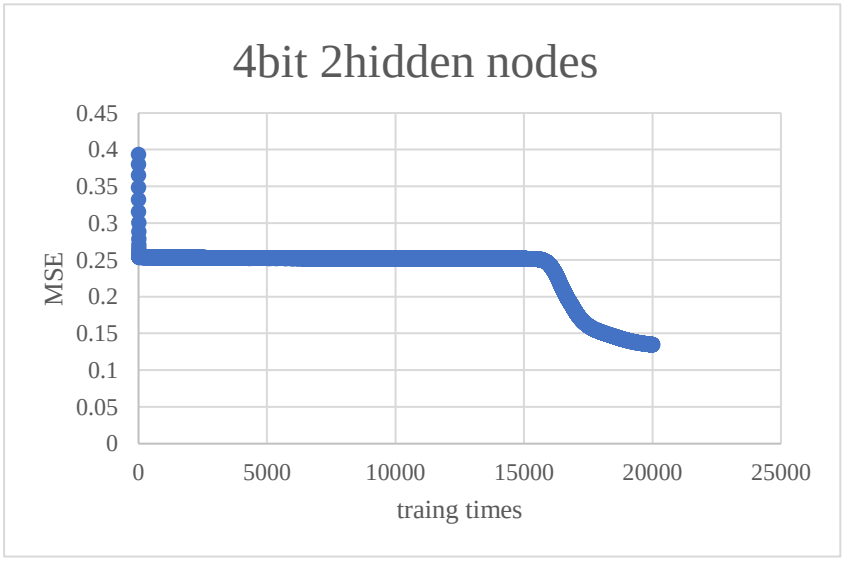
分析

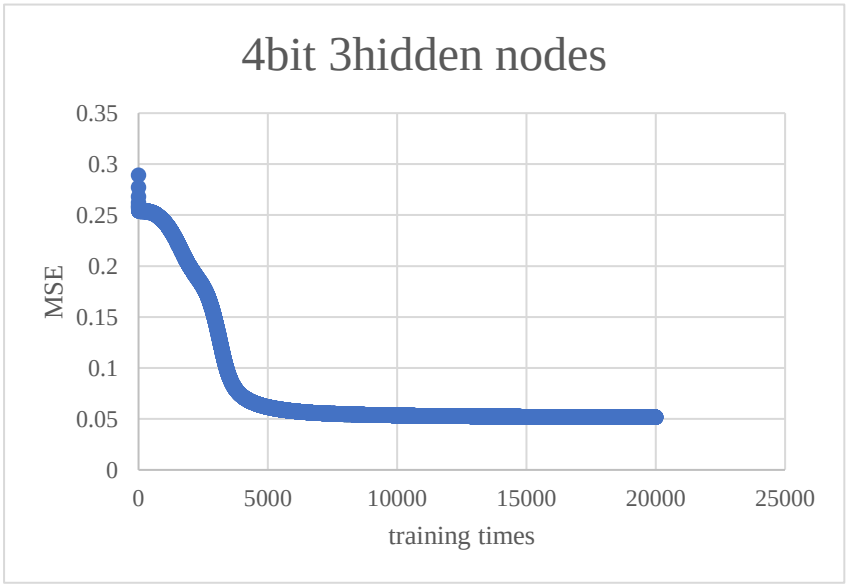
在經過多次訓練後，模型有明顯的 loss convergence

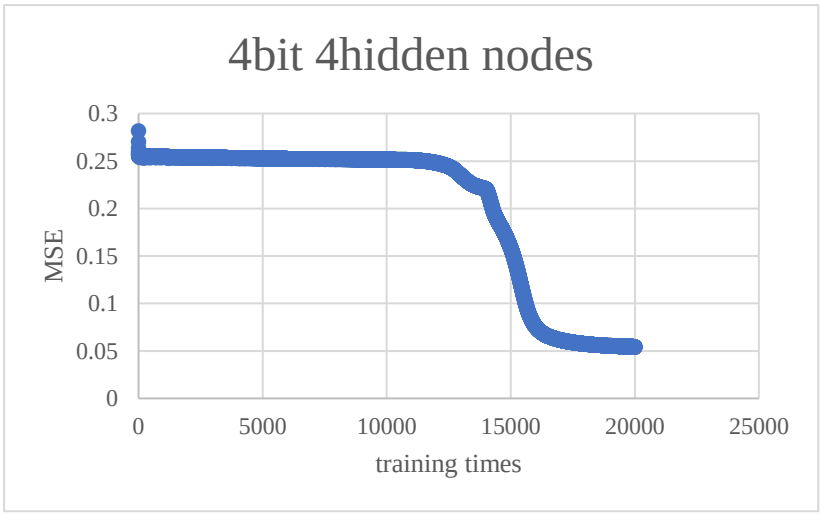


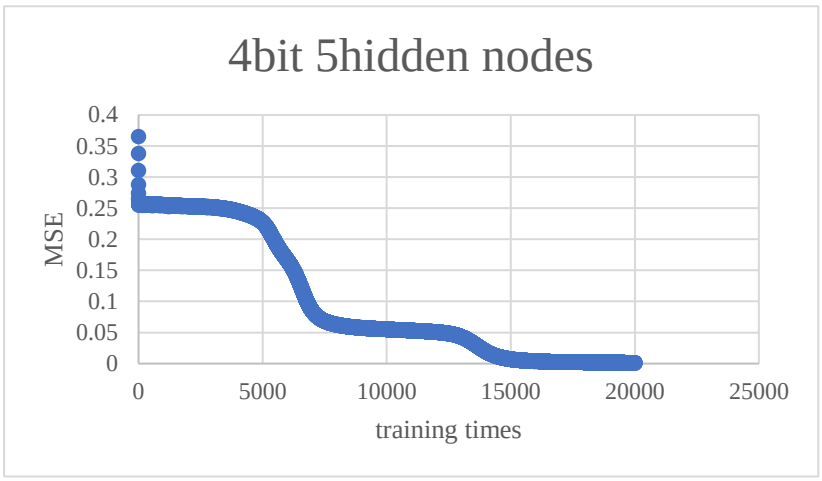
增加 hidden nodes 的數目可以有效減少 error
且 bit 數越多，hidden nodes 的數目不夠多可能導致無法收斂



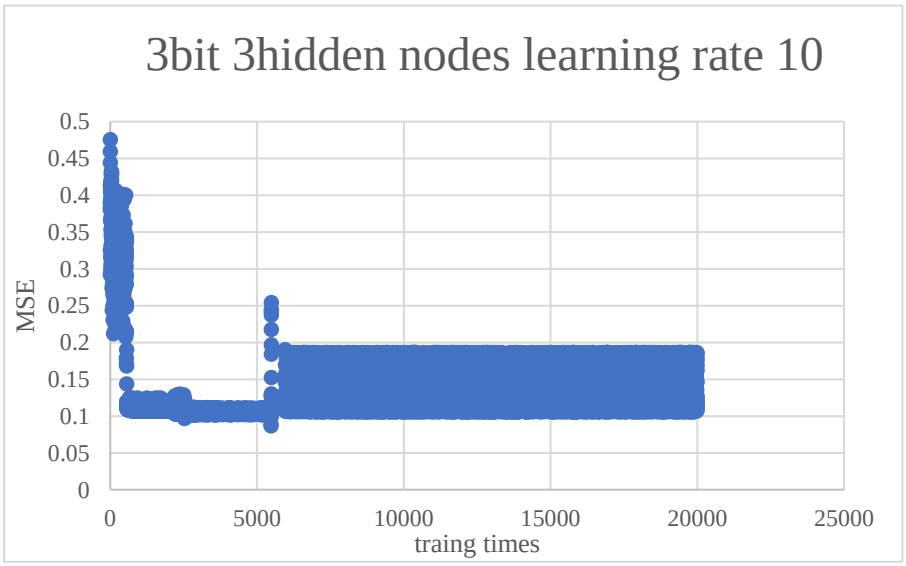


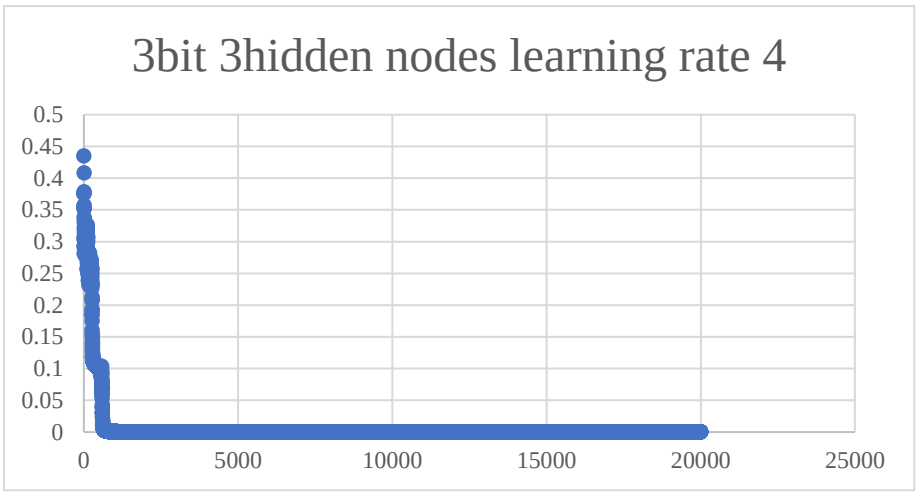


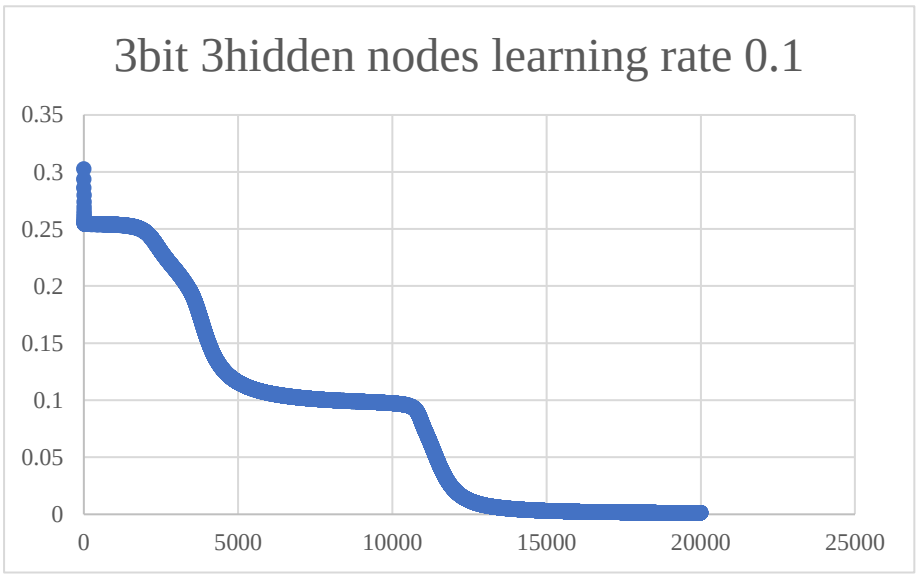


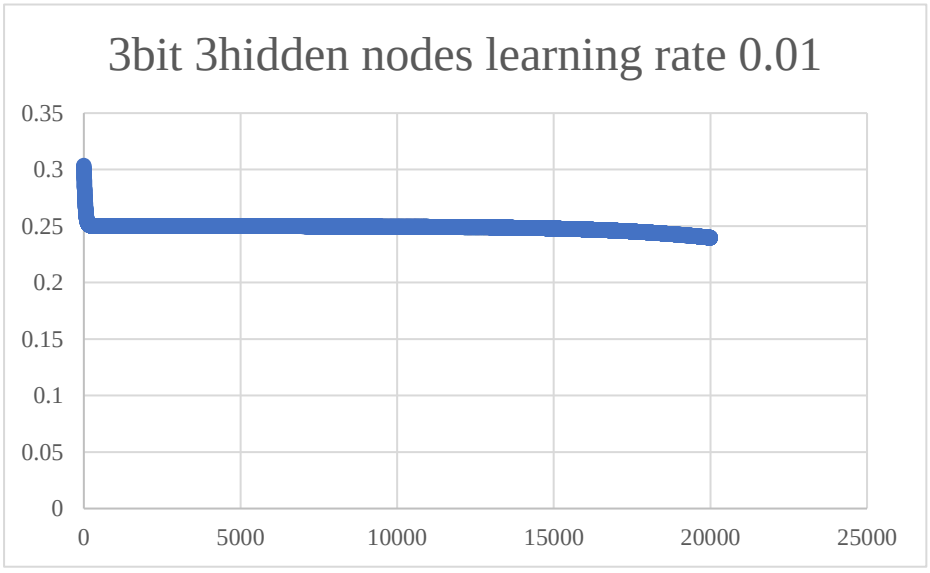


Learing rate 加大可加快訓練速度，但可能導致無法收斂




3bit 3hidden nodes learning rate 4
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5000
10000
15000
20000
25000


3bit 3hidden nodes learning rate 0.1
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5000
10000
15000
20000
25000


3bit 3hidden nodes learning rate 0.01
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5000
10000
15000
20000
25000

遇到的問題&解決方法

編譯器 C 語言標準不同→指定 C 語言標準
不同編譯器支援的語法不一樣→根據錯誤訊息修改語法

資料來源

Simple neural network implementation in C | by Santiago Becerra | Towards Data Science
Build Neural Network Framework in C Backpropagation | Analytics Vidhya (medium.com)
[Linux] [C++] 如何在 Ubuntu 撰寫以及編譯執行 C++ 程式 | Laird Studio
C compile error: "Variable-sized object may not be initialized" - Stack Overflow
undefined reference to ‘exp‘_Markwu115 的博客-CSDN 博客