

Neural Network Hw1 Report

1.

Neural Network Hw1

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1. (1) \because 3-2-1 Network can't implement all function.

\Rightarrow 則必定存在一種 function 使得 3-2-1 Network 的 hidden tree 中存在 mixed region 的 leaf node.

\Rightarrow 增加 layer 數後 mixed region 的 leaf node 仍為 mixed region

\therefore 3-2-2-1 can not implement all 2^3 functions too.

(2)

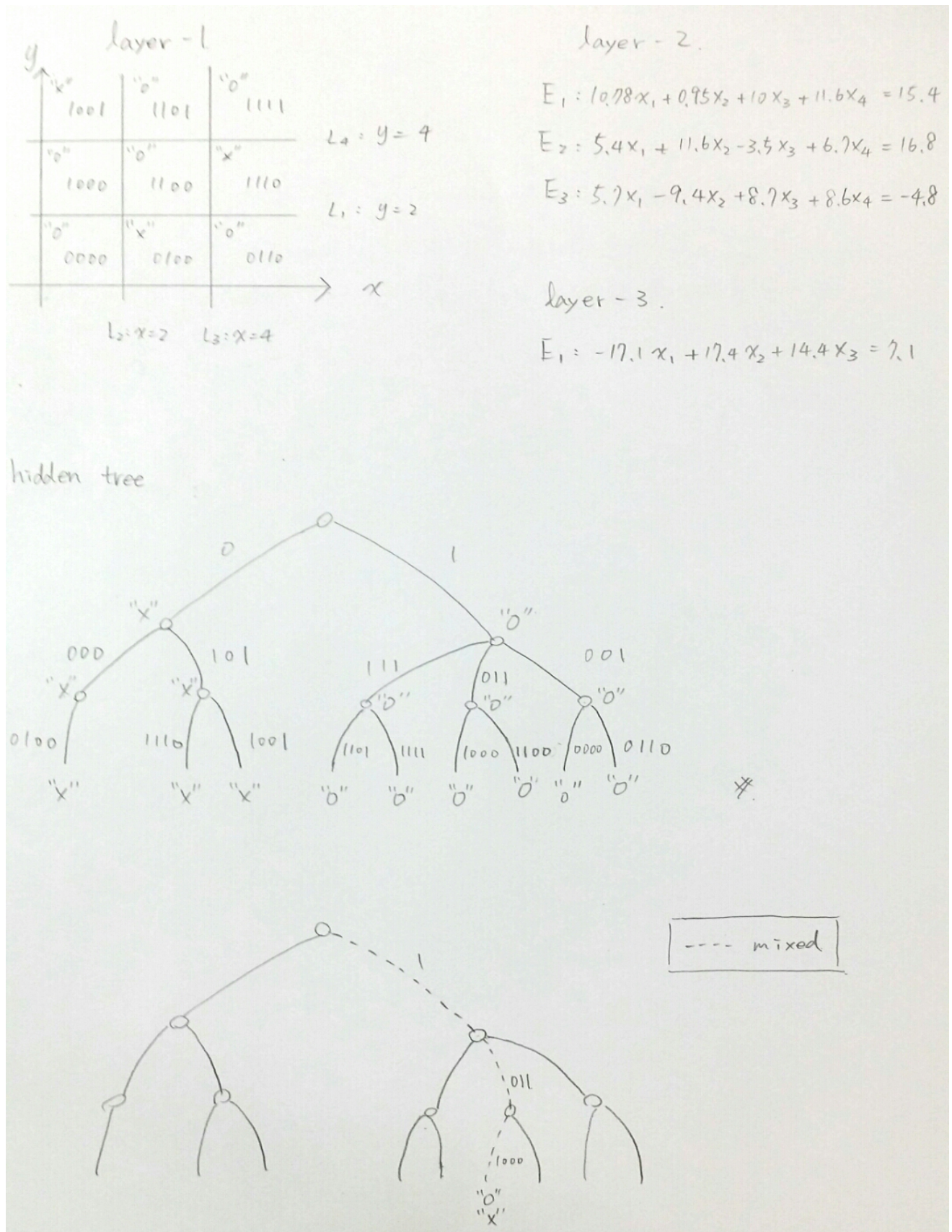
在 N-N-1 network 中，第一層 hidden layer 的 N 個 neural，

必能將 N-dimensional space 用 N 個 n-1 維的 hyperplane 切

成 2^N 塊，將所有可能的 input ($\underbrace{00\dots0}_n \sim 11\dots1$) 區分開來，

所以必能完成 N input xor function。

2.



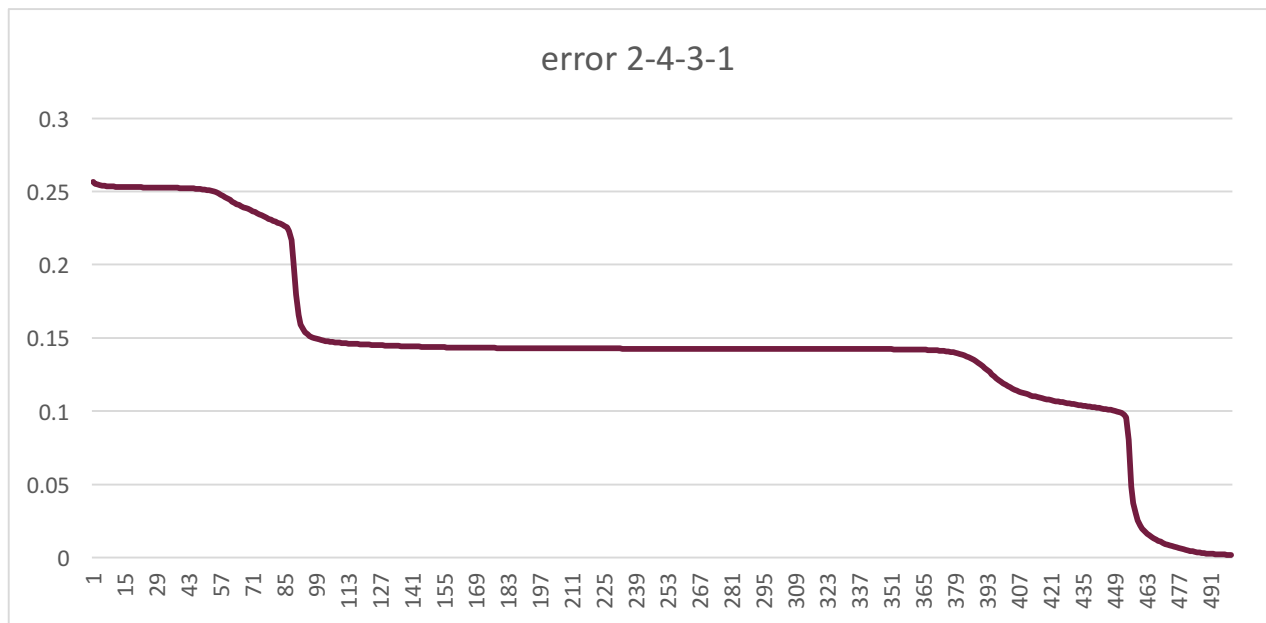
3.

BPN source code in folder "BackPropagationNN"

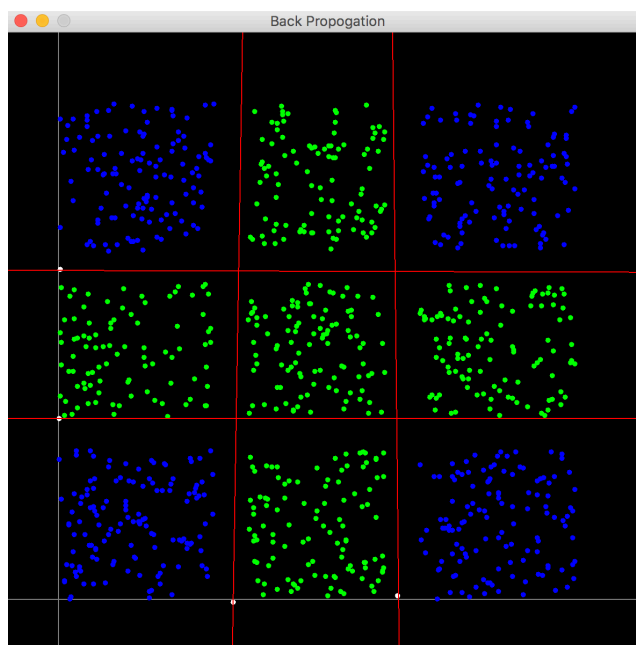
BPN executable file in folder "ExecutableJAR"

2-4-3-1 network

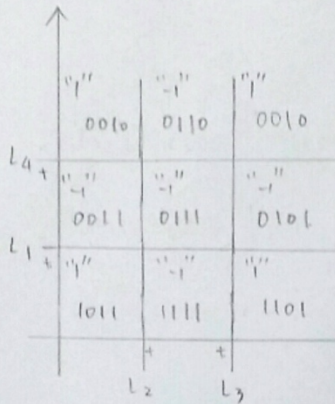
error curve



first layer result



2. (2) 2-4-3-1
error = 8.29×10^{-6}

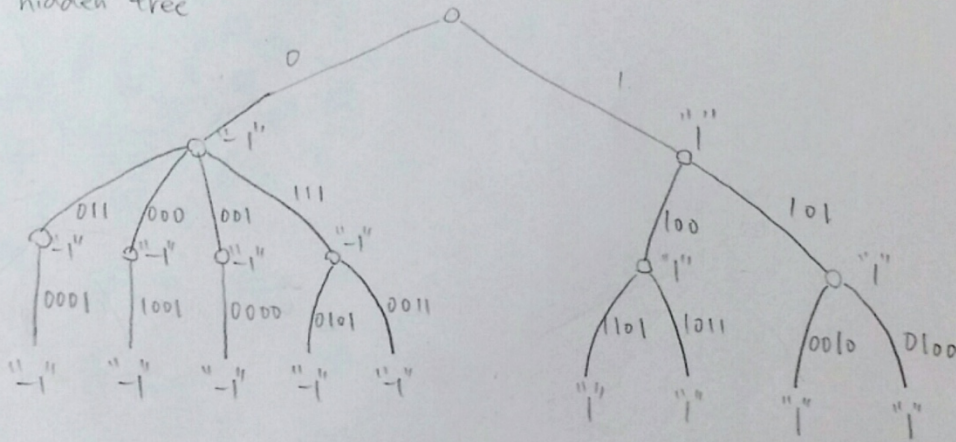


$$\text{layer-1: } \begin{cases} L_1: 0.01x_1 - 18.47x_2 = -6.72 \\ L_2: -16.13x_1 + 0.26x_2 = -5.44 \\ L_3: 17.93x_1 + 0.19x_2 = 11.76 \\ L_4: -0.04x_1 - 13.02x_2 = -8.63 \end{cases}$$

$$\text{layer-2: } \begin{cases} E_1: 4.46x_1 + 12.77x_2 + 11.69x_3 - 5.32x_4 = 5.9 \\ E_2: -2.99x_1 + 3.84x_2 + 3.74x_3 + 11.29x_4 = 9.39 \\ E_3: -8.33x_1 + 1.58x_2 + 1.15x_3 + 2.21x_4 = -1.79 \end{cases}$$

$$\text{layer-3: } \{ Z_1: 17.08x_1 - 13.75x_2 - 4.02x_3 = 6.11$$

hidden tree

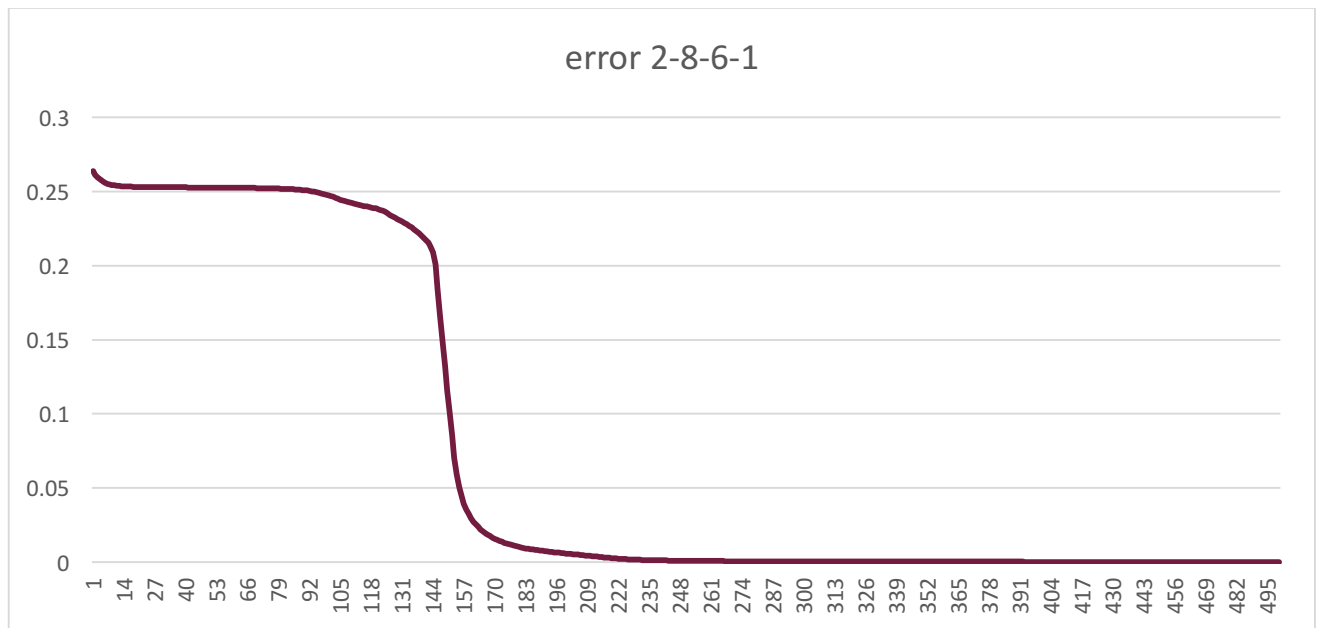


no mixed region *

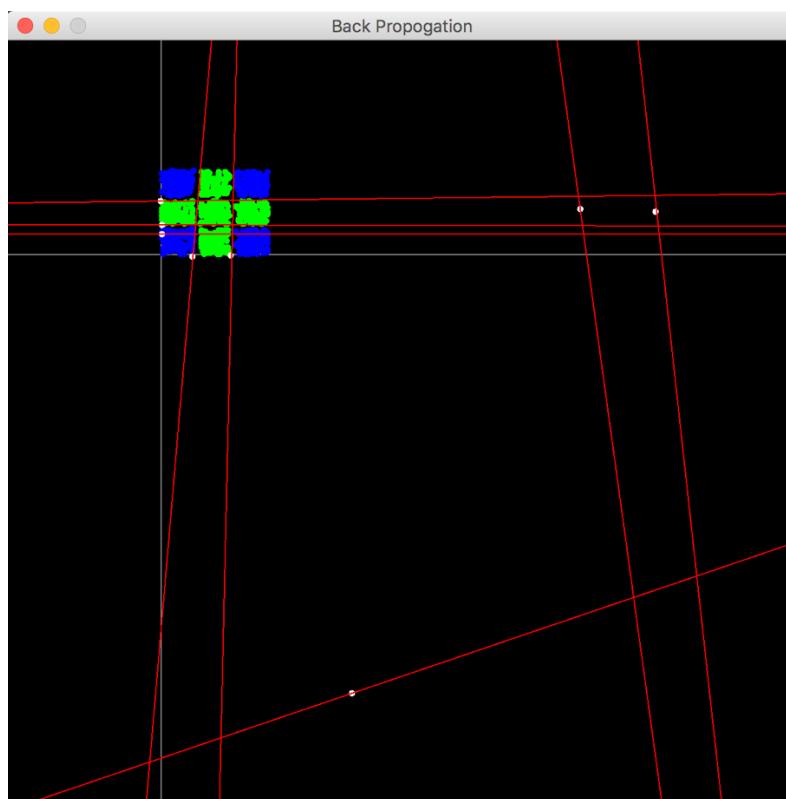
no redundant neural *

2-8-6-1 network

error curve



first layer result



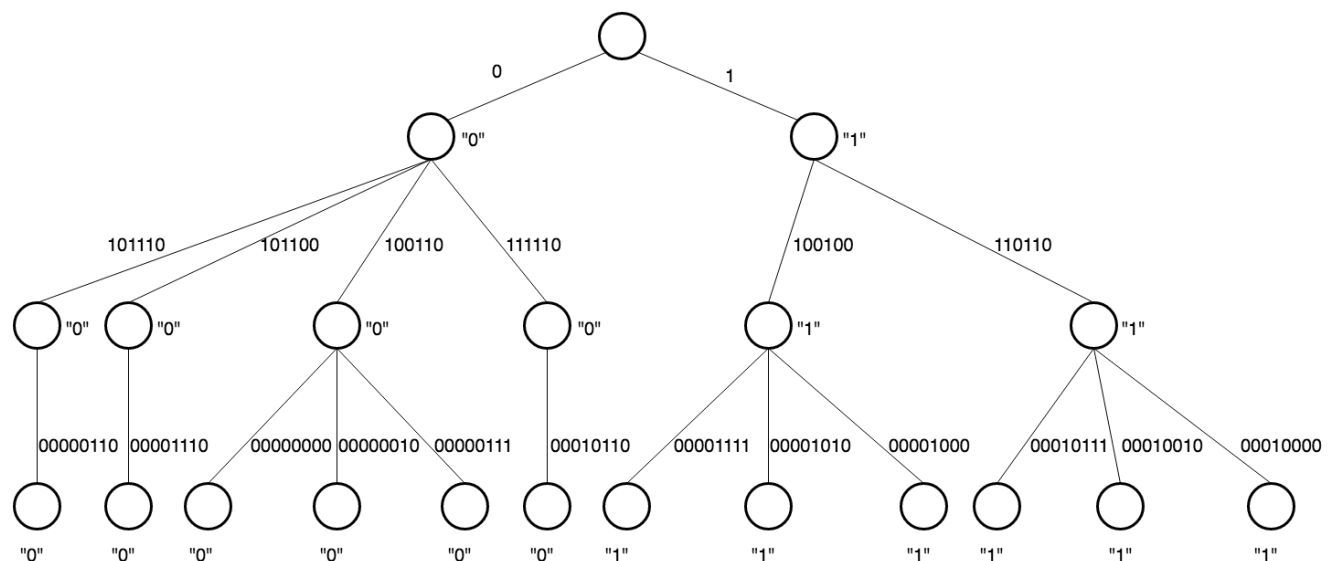
weight

```
Layer: 1
Neural: 0   Weight: (1.58758,0.17485,-7.45502)
Neural: 1   Weight: (1.27613,0.17607,-5.10045)
Neural: 2   Weight: (0.66183,-1.95066,-11.42035)
Neural: 3   Weight: (-13.61823,1.16879,3.92540)
Neural: 4   Weight: (13.89148,-0.31627,-9.06953)
Neural: 5   Weight: (0.03513,18.45650,-6.66365)
Neural: 6   Weight: (-0.00377,6.93202,-1.70082)
Neural: 7   Weight: (-0.16512,14.29733,-9.16551)

Layer: 2
Neural: 0   Weight: (0.38737,-0.75185,0.28925,1.74947,-2.19403,-1.97182,-0.94343,1.46400,6.73203)
Neural: 1   Weight: (-1.24061,-1.53571,1.58844,11.76524,-8.94724,-6.13225,2.00449,2.38505,-4.91384)
Neural: 2   Weight: (-0.53499,-0.61167,-0.05448,2.47204,2.24927,10.29477,-2.08754,-10.30869,-4.88174)
Neural: 3   Weight: (0.34055,-0.29927,-0.15333,-0.47003,0.90174,-0.06701,0.64000,-0.27220,6.21163)
Neural: 4   Weight: (-0.12185,-0.53949,1.16632,4.60608,-11.31110,5.41916,-3.07773,-3.94008,6.68872)
Neural: 5   Weight: (-1.21109,-0.03270,-0.53208,0.22777,-1.07603,1.28876,0.42496,-1.39186,-2.16893)

Layer: 3
Neural: 0   Weight: (1.37013,14.20848,-13.88353,0.01412,-13.97986,-1.67589,5.89238)
```

hidden tree



No mixed region.

In first hidden layer, “1-th”, “2-th” and “3-th” nuerals are redundant.

In second hidden layer, “1-th” and “6-th” nuerals are redundant.

Compare the error curve we can find that the error in “2-8-6-1 network” was decrease faster than the error in “2-4-3-1 network”.