Supplementary Notes #06

Data Mining and Data Warehousing

Solution to Exercises on Neural Networks (Supplementary Notes #9)

Question 1

Normalized Data

	Income Level	Average Number	Credit Rating
1	0.157143	0.358663	-1
2	0.514286	1	-1
3	0	0.717325	1
4	1	0.18541	1
5	0.4	0	1
6	0.785714	0.49848	1
7	0.485714	0.25228	-1
8	0.271429	0.635258	1
9	0.1	0.890578	-1
10	0.657143	0.617021	1

(a)

With $\theta = 0.9$ and $\alpha = 0.75$,

Original Input #1: <1, 0.16, 0.36>

Original Output for #1: <-1>

Original Weight: <0.1, 0.3, 0.2>

Weighted Sum: 0.22

Predicted Output: <-1>

New Weight: <0.1, 0.3, 0.2>

Original Input #2: <1, 0.51, 1>

Original Output for #2: <-1>

Original Weight: <0.1, 0.3, 0.2>

Weighted Sum: 0.45

Predicted Output: <-1>

New Weight: <0.1, 0.3, 0.2>

Original Input #3: <1, 0, 0.72>

Original Output for #3: <1>

Original Weight: <0.1, 0.3, 0.2>

Weighted Sum: 0.24

Predicted Output: <-1>

New Weight: <0.85, 0.3, 0.74>

Original Input #4: <1, 1, 0.19>

Original Output for #4: <1>

Original Weight: <0.85, 0.3, 0.74>

Weighted Sum: 1.29

Predicted Output: <1>

New Weight: <0.85, 0.3, 0.74>

Original Input #5: <1, 0.4, 0>

Original Output for #5: <1>

Original Weight: <0.85, 0.3, 0.74>

Weighted Sum: 0.97

Predicted Output: <1>

New Weight: <0.85, 0.3, 0.74>

Original Input #6: <1, 0.79, 0.50>

Original Output for #6: <1>

Original Weight: <0.85, 0.3, 0.74>

Weighted Sum: 1.45

Predicted Output: <1>

New Weight: <0.85, 0.3, 0.74>

Original Input #7: <1, 0.49, 0.25>

Original Output for #7: <-1>

Original Weight: <0.85, 0.3, 0.74>

Weighted Sum: 1.18

Predicted Output: <1>

New Weight: <0.1, -0.064, 0.55>

Original Input #8: <1, 0.27, 0.64>

Original Output for #8: <1>

Original Weight: <0.1, -0.064, 0.55>

Weighted Sum: 0.43

Predicted Output: <-1>

New Weight: <0.85, 0.14, 1.03>

Original Input #9: <1, 0.1, 0.89>

Original Output for #9: <-1>

Original Weight: <0.85, 0.14, 1.03>

Weighted Sum: 1.78

Predicted Output: <1>

New Weight: <0.1, 0.064, 0.36>

Original Input #10: <1, 0.66, 0.62>

Original Output for #10: <1>

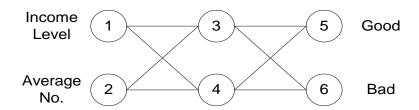
Original Weight: <0.1, 0.064, 0.36>

Weighted Sum: 0.36

Predicted Output: <-1>

New Weight: <0.85, 0.56, 0.82>

(b)



 w_{ii} = weight between nodes i and j

 b_i = bias value of node i

$$w_{13} = 0.1$$
, $w_{23} = -0.1$, $b_3 = 0.1$

$$w_{14} = 0.2$$
, $w_{24} = 0.1$, $b_4 = -0.1$

$$w_{35} = 0.2, w_{45} = -0.1, b_5 = 0.2$$

$$w_{36} = 0.1$$
, $w_{46} = 0.2$, $b_6 = 0.1$

With learning rate = 0.9,

Original Input #1: <1, 0.16, 0.36>

Original Output for #1: <0, 1>

Node 3: Input =
$$0.16(0.1) + 0.36(-0.1) + 1(0.1) = 0.08$$
, Output = $1/(1 + e^{-0.08}) = 0.52$

Node 4: Input = -0.03, Output = 0.49

Node 5: Input = 0.20, Output = 0.55

Node 6: Input = 0.19, Output = 0.55

Node 5: Error =
$$0.55 (1 - 0.55) (0 - 0.55) = -0.14$$

Node 6: Error =
$$0.55 (1 - 0.55) (1 - 0.55) = 0.11$$

Node 3: Error =
$$0.52 (1 - 0.52) (0.2 (-0.14) + 0.1 (0.11)) = -0.004$$

Node 4: Error =
$$0.49 (1 - 0.49) (-0.1 (-0.14) + 0.2 (0.11)) = 0.009$$

Node 5:
$$w_{35} = 0.2 + 0.9 (-0.14) (0.52) = 0.14$$
, $w_{45} = -0.1 + 0.9 (-0.14) (0.49) = -0.16$,

$$b_5 = 0.2 + 0.9 (-0.14) = 0.08$$

Node 6:
$$w_{36} = 0.1 + 0.9 (0.11) (0.52) = 0.15$$
, $w_{46} = 0.2 + 0.9 (0.11) (0.49) = 0.25$,

$$b_6 = 0.1 + 0.9 (0.11) = 0.20$$

Node 3:
$$w_{13} = 0.1 + 0.9 (-0.004) (0.16) = 0.10$$
, $w_{23} = -0.1 + 0.9 (-0.004) (0.36) = -0.10$,

$$b_3 = 0.1 + 0.9 (-0.004) = 0.096$$

Node 4:
$$w_{14} = 0.2 + 0.9 (0.009) (0.16) = 0.20$$
, $w_{24} = 0.1 + 0.9 (0.009) (0.36) = 0.10$,

$$b_4 = 0.1 + 0.9 (0.009) = -0.092$$

Original Input #2: <1, 0.51, 1>

Original Output for #2: <0, 1>

Node 3: Input = 0.05, Output = 0.51

Node 4: Input = 0.11, Output = 0.53

Node 5: Input = -0.01, Output = 0.50

Node 6: Input = 0.53, Output = 0.63

Node 5: Error = -0.12

Node 6: Error = 0.09

Node 3: Error = -0.0009

Node 4: Error = 0.01

Node 5:
$$w_{35} = 0.08$$
, $w_{45} = -0.22$, $b_5 = -0.03$

Node 6:
$$w_{36} = 0.19$$
, $w_{46} = 0.29$, $b_6 = 0.28$

Node 3:
$$w_{13} = 0.10$$
, $w_{23} = -0.10$, $b_3 = 0.096$

Node 4:
$$w_{14} = 0.21$$
, $w_{24} = 0.11$, $b_4 = -0.08$

Original Input #3: <1, 0, 0.72>

Original Output for #3: <1, 0>

Node 3: Input =
$$0.02$$
, Output = 0.51

Node 4: Input =
$$-0.002$$
, Output = 0.50

Node 5: Input =
$$-0.19$$
, Output = 0.45

Node 6: Input =
$$0.49$$
, Output = 0.62

Node 5:
$$Error = 0.14$$

Node 6: Error =
$$-0.15$$

Node 3:
$$Error = -0.004$$

Node 4: Error =
$$-0.02$$

Node 5:
$$w_{35} = 0.15$$
, $w_{45} = -0.16$, $b_5 = 0.09$

Node 6:
$$w_{36} = 0.13$$
, $w_{46} = 0.23$, $b_6 = 0.15$

Node 3:
$$w_{13} = 0.10$$
, $w_{23} = -0.10$, $b_3 = 0.092$

Node 4:
$$w_{14} = 0.21$$
, $w_{24} = 0.10$, $b_4 = -0.099$

Original Input #4: <1, 1, 0.19>

Original Output for #4: <1, 0>

Node 3: Input =
$$0.17$$
, Output = 0.54

Node 4: Input =
$$0.13$$
, Output = 0.53

Node 5: Input =
$$0.20$$
, Output = 0.55

Node 6: Input =
$$0.32$$
, Output = 0.58

Node 5:
$$Error = 0.11$$

Node 6: Error =
$$-0.14$$

Node 3:
$$Error = -0.0005$$

Node 4:
$$Error = -0.01$$

Node 5:
$$w_{35} = 0.20$$
, $w_{45} = -0.10$, $b_5 = 0.19$

Node 6:
$$w_{36} = 0.06$$
, $w_{46} = 0.16$, $b_6 = 0.02$

Node 3:
$$w_{13} = 0.10$$
, $w_{23} = -0.11$, $b_3 = 0.091$

Node 4:
$$w_{14} = 0.19$$
, $w_{24} = 0.10$, $b_4 = -0.11$

Original Input #5: <1, 0.4, 0>

Original Output for #5: <1, 0>

Node 3: Input =
$$0.13$$
, Output = 0.53

Node 4: Input =
$$-0.03$$
, Output = 0.49

Node 5: Input =
$$0.27$$
, Output = 0.57

Node 6: Input =
$$0.04$$
, Output = 0.51

Node 5:
$$Error = 0.11$$

Node 6: Error =
$$-0.13$$

Node 3:
$$Error = 0.003$$

Node 4:
$$Error = -0.007$$

Node 5:
$$w_{35} = 0.24$$
, $w_{45} = -0.06$, $b_5 = 0.28$

Node 6:
$$w_{36} = -0.004$$
, $w_{46} = 0.10$, $b_6 = -0.09$

Node 3:
$$w_{13} = 0.10$$
, $w_{23} = -0.11$, $b_3 = 0.094$

Node 4:
$$w_{14} = 0.19$$
, $w_{24} = 0.10$, $b_4 = -0.12$

Original Input #6: <1, 0.79, 0.50>

Original Output for #6: <1, 0>

Node 3: Input =
$$0.12$$
, Output = 0.53

Node 4: Input =
$$0.08$$
, Output = 0.52

Node 5: Input =
$$0.45$$
, Output = 0.61

Node 6: Input =
$$-0.05$$
, Output = 0.49

Node 5:
$$Error = 0.09$$

Node 6: Error =
$$-0.12$$

Node 3:
$$Error = 0.006$$

Node 4:
$$Error = -0.004$$

Node 5:
$$w_{35} = 0.29$$
, $w_{45} = -0.01$, $b_5 = 0.37$

Node 6:
$$w_{36} = -0.06$$
, $w_{46} = 0.04$, $b_6 = -0.20$

Node 3:
$$w_{13} = 0.10$$
, $w_{23} = -0.10$, $b_3 = 0.099$

Node 4:
$$w_{14} = 0.19$$
, $w_{24} = 0.10$, $b_4 = -0.12$

Original Input #7: <1, 0.49, 0.25>

Original Output for #7: <0, 1>

Node 3: Input =
$$0.12$$
, Output = 0.53

Node 4: Input =
$$-0.005$$
, Output = 0.50

Node 5: Input =
$$0.50$$
, Output = 0.62

Node 6: Input =
$$-0.22$$
, Output = 0.44

Node 5: Error =
$$-0.15$$

Node 6:
$$Error = 0.14$$

Node 3:
$$Error = -0.01$$

Node 4:
$$Error = 0.002$$

Node 5:
$$w_{35} = 0.22$$
, $w_{45} = -0.08$, $b_5 = 0.24$

Node 6:
$$w_{36} = 0.003$$
, $w_{46} = 0.11$, $b_6 = -0.08$

Node 3:
$$w_{13} = 0.10$$
, $w_{23} = -0.11$, $b_3 = 0.088$

Node 4:
$$w_{14} = 0.19$$
, $w_{24} = 0.10$, $b_4 = -0.12$

Original Input #8: <1, 0.27, 0.64>

Original Output for #8: <1, 0>

Node 3: Input =
$$0.05$$
, Output = 0.51

Node 4: Input =
$$-0.006$$
, Output = 0.50

Node 5: Input =
$$0.24$$
, Output = 0.56

Node 6: Input =
$$-0.01$$
, Output = 0.50

Node 5:
$$Error = 0.11$$

Node 6: Error =
$$-0.12$$

Node 3:
$$Error = 0.006$$

Node 4:
$$Error = -0.006$$

Node 5:
$$w_{35} = 0.27$$
, $w_{45} = -0.03$, $b_5 = 0.33$

Node 6:
$$w_{36} = -0.05$$
, $w_{46} = 0.05$, $b_6 = -0.19$

Node 3:
$$w_{13} = 0.10$$
, $w_{23} = -0.10$, $b_3 = 0.093$

Node 4:
$$w_{14} = 0.19$$
, $w_{24} = 0.09$, $b_4 = -0.12$

Original Input #9: <1, 0.1, 0.89>

Original Output for #9: <0, 1>

Node 3: Input =
$$0.01$$
, Output = 0.50

Node 4: Input =
$$-0.02$$
, Output = 0.49

Node 5: Input =
$$0.33$$
, Output = 0.58

Node 6: Input =
$$-0.15$$
, Output = 0.46

Node 5: Error =
$$-0.14$$

Node 6: Error =
$$0.13$$

Node 3:
$$Error = -0.01$$

Node 4:
$$Error = 0.003$$

Node 5:
$$w_{35} = 0.21$$
, $w_{45} = -0.09$, $b_5 = 0.21$

Node 6:
$$w_{36} = 0.007$$
, $w_{46} = 0.11$, $b_6 = -0.07$

Node 3:
$$w_{13} = 0.10$$
, $w_{23} = -0.11$, $b_3 = 0.083$

Node 4:
$$w_{14} = 0.19$$
, $w_{24} = 0.10$, $b_4 = -0.12$

Original Input #10: <1, 0.66, 0.62>

Original Output for #10: <1, 0>

Node 3: Input =
$$0.08$$
, Output = 0.52

Node 4: Input =
$$0.06$$
, Output = 0.52

Node 5: Input =
$$0.28$$
, Output = 0.57

Node 6: Input =
$$-0.0001$$
, Output = 0.50

Node 5:
$$Error = 0.11$$

Node 6: Error =
$$-0.12$$

Node 3:
$$Error = 0.005$$

Node 4:
$$Error = -0.006$$

Node 5: $w_{35} = 0.26$, $w_{45} = -0.05$, $b_5 = 0.30$

Node 6: $w_{36} = -0.05$, $w_{46} = 0.05$, $b_6 = -0.18$

Node 3: $w_{13} = 0.10$, $w_{23} = -0.11$, $b_3 = 0.088$

Node 4: $w_{14} = 0.19$, $w_{24} = 0.09$, $b_4 = -0.13$

Question 2

Normalized Data

								Not			
	Low	Medium	High	Visa	Cheque	AMEX	Frequent	Frequent	Yes	No	Credit
1	1	0	0	1	0	0	1	0	1	0	-1
2	1	0	0	0	1	0	1	0	0	1	-1
3	0	0	1	0	1	0	0	1	0	1	1
4	1	0	0	0	0	1	1	0	1	0	1
5	0	1	0	1	0	0	0	1	0	1	1
6	0	1	0	0	1	0	0	1	0	1	1
7	1	0	0	1	0	0	1	0	1	0	-1
8	0	0	1	1	0	0	0	1	0	1	1
9	0	0	1	0	1	0	0	1	1	0	-1
10	0	1	0	0	0	1	1	0	1	0	1

(a)

With $\theta = 0.9$ and $\alpha = 0.75$,

Original Input #1: <1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0>

Original Output for #1: <-1>

Original Weight: <0.1, 0.2, 0.3, 0.2, 0.25, 0.15, 0.1, 0.1, 0.05, 0.2, 0.3>

Weighted Sum: 0.85
Predicted Output: <-1>

New Weight: <0.1, 0.2, 0.3, 0.2, 0.25, 0.15, 0.1, 0.1, 0.05, 0.2, 0.3>

Original Input #2: <1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1>

Original Output for #2: <-1>

Original Weight: <0.1, 0.2, 0.3, 0.2, 0.25, 0.15, 0.1, 0.1, 0.05, 0.2, 0.3>

Weighted Sum: 0.85

Predicted Output: <-1>

New Weight: <0.1, 0.2, 0.3, 0.2, 0.25, 0.15, 0.1, 0.1, 0.05, 0.2, 0.3>

Original Input #3: <1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1>

Original Output for #3: <1>

Original Weight: <0.1, 0.2, 0.3, 0.2, 0.25, 0.15, 0.1, 0.1, 0.05, 0.2, 0.3>

Weighted Sum: 0.8

Predicted Output: <-1>

New Weight: <0.85, 0.2, 0.3, 0.95, 0.25, 0.9, 0.1, 0.1, 0.8, 0.2, 1.05>

Original Input #4: <1, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0>

Original Output for #4: <1>

Original Weight: <0.85, 0.2, 0.3, 0.95, 0.25, 0.9, 0.1, 0.1, 0.8, 0.2, 1.05>

Weighted Sum: 1.45
Predicted Output: <1>

New Weight: <0.85, 0.2, 0.3, 0.95, 0.25, 0.9, 0.1, 0.1, 0.8, 0.2, 1.05>

Original Input #5: <1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1>

Original Output for #5: <1>

Original Weight: <0.85, 0.2, 0.3, 0.95, 0.25, 0.9, 0.1, 0.1, 0.8, 0.2, 1.05>

Weighted Sum: 3.25
Predicted Output: <1>

New Weight: <0.85, 0.2, 0.3, 0.95, 0.25, 0.9, 0.1, 0.1, 0.8, 0.2, 1.05>

Original Input #6: <1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1>

Original Output for #6: <1>

Original Weight: <0.85, 0.2, 0.3, 0.95, 0.25, 0.9, 0.1, 0.1, 0.8, 0.2, 1.05>

Weighted Sum: 3.9

Predicted Output: <1>

New Weight: <0.85, 0.2, 0.3, 0.95, 0.25, 0.9, 0.1, 0.1, 0.8, 0.2, 1.05>

Original Input #7: <1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0>

Original Output for #7: <-1>

Original Weight: <0.85, 0.2, 0.3, 0.95, 0.25, 0.9, 0.1, 0.1, 0.8, 0.2, 1.05>

Weighted Sum: 1.6

Predicted Output: <1>

New Weight: <0.1, -0.55, 0.3, 0.95, -0.5, 0.9, 0.1, -0.65, 0.8, -0.55, 1.05>

Original Input #8: <1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1>

Original Output for #8: <1>

Original Weight: <0.1, -0.55, 0.3, 0.95, -0.5, 0.9, 0.1, -0.65, 0.8, -0.55, 1.05>

Weighted Sum: 2.4

Predicted Output: <1>

New Weight: <0.1, -0.55, 0.3, 0.95, -0.5, 0.9, 0.1, -0.65, 0.8, -0.55, 1.05>

Original Input #9: <1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0>

Original Output for #9: <-1>

Original Weight: <0.1, -0.55, 0.3, 0.95, -0.5, 0.9, 0.1, -0.65, 0.8, -0.55, 1.05>

Weighted Sum: 2.2

Predicted Output: <1>

New Weight: <-0.65, -0.55, 0.3, 0.2, -0.5, 0.15, 0.1, -0.65, 0.05, -1.3, 1.05>

Original Input #10: <1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 0>

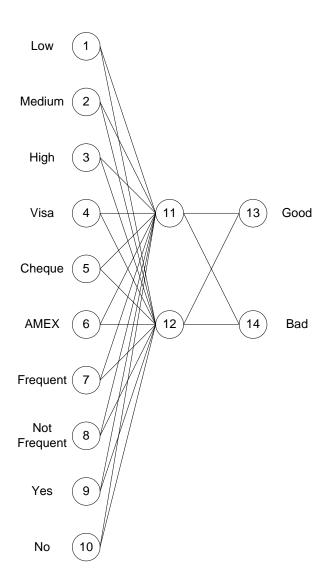
Original Output for #10: <1>

Original Weight: <-0.65, -0.55, 0.3, 0.2, -0.5, 0.15, 0.1, -0.65, 0.05, -1.3, 1.05>

Weighted Sum: -2.2

Predicted Output: <-1>

New Weight: <0.1, -0.55, 1.05, 0.2, -0.5, 0.15, 0.85, 0.1, 0.05, -0.55, 1.05>



 w_{ij} = weight between nodes i and j b_i = bias value of node i

 $w_{(11)(14)} = 0.1, w_{(12)(14)} = 0.2, b_{14} = 0.1$

$$\begin{split} &w_{1(11)} = 0.1, \, w_{2(11)} = -0.1, \, w_{3(11)} = 0.1, \, w_{4(11)} = -0.2, \, w_{5(11)} = -0.1, \, w_{6(11)} = 0.1, \, w_{7(11)} = 0.2, \, w_{8(11)} = 0.1, \, w_{9(11)} \\ &= 0.2, \, w_{10(11)} = 0.1, \, b_{11} = 0.1 \\ &w_{1(12)} = 0.1, \, w_{2(12)} = 0.2, \, w_{3(12)} = 0.1, \, w_{4(12)} = -0.2, \, w_{5(12)} = -0.1, \, w_{6(12)} = 0.1, \, w_{7(12)} = 0.2, \, w_{8(12)} = 0.1, \, w_{9(12)} \\ &= 0.2, \, w_{10(12)} = 0.1, \, b_{12} = 0.1 \\ &w_{(11)(13)} = 0.2, \, w_{(12)(13)} = -0.1, \, b_{13} = 0.2 \end{split}$$

With learning rate = 0.9, #1 9 bias 2 3 5 6 7 8 10 1 0 1 0 Original Input 1 0 0 0 0 **Original Output** 0 1 2 3 5 6 11 14 Node 1 4 7 8 9 10 12 13 1 0 0 1 0 0 1 0 0 0.400 0.400 0.260 0.280 Input 1 0.500 0.500 0.731 0.599 0.599 (1/1+exp(-input))Output 0.731 0.500 0.731 0.500 0.500 0.731 0.500 0.565 0.569 Error Node 13 -0.139 (original output - node output)(node output)(1-node output) Node 14 0.106 (original output - node output)(node output)(1-node output) Node 11 -0.004 $[\Sigma(\text{Error*weight})]$ (node output)(1-node output) $[\Sigma(\text{Error*weight})]$ (node output)(1-node output) Node 12 0.008 (old weight) + (learning rate) * (error of node y) * (output of node x) **New weights** w(x)(y)=2 3 5 9 10 11 12 bias 1 6 7 Node 13 0.075 0.125 -0.175 Node 14 0.195 0.157 0.257 Node 11 0.096 0.097 -0.103 0.097 -0.203 -0.103 0.097 0.197 0.097 0.197 0.097 Node 12 0.206 -0.194 -0.094 0.108 0.106 0.106 0.106 0.206 0.106 0.206 0.106 #2 2 10 bias 3 5 6 8 9 1 4 Original Input 1 0 0 0 1 0 1 0 0 1 **Original Output** 0 1 Node 1 2 3 4 5 6 7 8 9 10 11 12 13 14

0

0.500

1

0.731

0

0.500

0

0.500

1

0.731

0.385

0.595

0.430

0.606

0.044

0.511

0.444

0.609

Node 13 Node 14 Node 11 Node 12	Error -0.128 0.093 -0.0003 0.011	(original [Σ(Error	output - *weight)]	node out (node οι	put)(node put)(node itput)(1-n itput)(1-n	e output) ode outp	(1-node o out)	. ,					
New weights	w(x)(y)=	(old wei	ght) + (lea	arning ra	te) * (erro	or of node	e y) * (ou	tput of no	ode x)				
	bias	1	2	3	4	5	6	7	8	9	10	11	12
Node 13	-0.040											0.057	-0.244
Node 14	0.279											0.207	0.308
Node 11	0.096	0.097	-0.103	0.097	-0.203	-0.103	0.097	0.197	0.097	0.197	0.097		
Node 12	0.117	0.113	0.213	0.113	-0.187	-0.087	0.113	0.213	0.113	0.213	0.113		

1

0.731

0

0.500

Input

Output

(1/1+exp(-input))

1

0.731

0

0.500

0

0.500

#3	bias	1	2	3	4	5	6	7	8	9	10				
Original Input Original Output	1 1	0 0	0	1	0	1	0	0	1	0	1				
	Node Input	1 0	2 0	3 1	4 0	5 1	6 0	7 0	8 1	9 0	10 1	11 0.284	12 0.369	13 -0.152	14 0.579
(1/1+exp(-input))	Output	0.500	0.500	0.731	0.500	0.731	0.500	0.500	0.731	0.500	0.731	0.571	0.591	0.462	0.641
Node 13 Node 14 Node 11 Node 12	Error 0.134 -0.147 -0.0056 -0.019	(origina [Σ(Erro	al output - al output - or*weight) or*weight)	node ou (node o	ıtput)(nod utput)(1-ı	le output)	(1-node out)								
New weights	w(x)(y)=		eight) + (le					-	-	0	40	4.4	40		
Node 13	bias 0.081	1	2	3	4	5	6	7	8	9	10	11 0.125	12 -0.173		
Node 14 Node 11	0.146 0.091	0.095	-0.105	0.095	-0.205	-0.105	0.095	0.195	0.095	0.195	0.095	0.131	0.229		
Node 12	0.101	0.104	0.204	0.104	-0.196	-0.096	0.104	0.204	0.104	0.204	0.104				
#4	bias	1	2	3	4	5	6	7	8	9	10				
Original Input Original Output	1	1	0	0	0	0	1	1	0	1	0				
	Node	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(1/1+exp(-input))	Input Output	1 0.731	0 0.500	0 0.500	0 0.500	0 0.500	1 0.731	1 0.731	0 0.500	1 0.731	0 0.500	0.669 0.661	0.718 0.672	0.047 0.512	0.387 0.595
Node 13 Node 14 Node 11 Node 12	Error 0.122 -0.143 -0.0008 -0.012	(origina [Σ(Erro	al output - al output - or*weight) or*weight)	node ou (node o	ıtput)(nod utput)(1-ı	le output) node outp)(1-node out)	output) output)							
New weights	w(x)(y)=		eight) + (le								4.0		40		
	bias	1	2	3	4	5	6	7	8	9	10	11	12		
Node 13 Node 14	0.190 0.017											0.198 0.046	-0.099 0.142		

#5	bias	1	2	3	4	5	6	7	8	9	10				
Original Input	1	0	1	0	1	0	0	0	1	0	1				
Original Output	1	0													
	Node	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Input	0	2 1	0	1	0	0	0	1	0	10	-0.034	0.276	0.231	0.120
(1/1+exp(-input))	Output	0.500	0.731	0.500	0.731	0.500	0.500	0.500	0.731	0.500	0.731	0.492	0.568	0.558	0.530
	•														
	Error	,													
Node 13	0.109		l output -												
Node 14 Node 11	-0.132 0.004		ıl output - r*weight)					output)							
Node 11 Node 12	-0.007		r*weight)												
14000 12	0.001	[2(2110	woigin,	(Hode o	αιραι)(Τ	iodo odiț	July								
New weights	w(x)(y)=	(old we	ight) + (le				e y) * (oı	utput of n	ode x)						
N. 1. 40	bias	1	2	3	4	5	6	7	8	9	10	11	12		
Node 13 Node 14	0.289 -0.102											0.246 -0.013	-0.044		
Node 14 Node 11	0.094	0.096	-0.104	0.096	-0.204	-0.104	0.096	0.196	0.096	0.196	0.096	-0.013	0.075		
Node 12	0.083	0.093	0.193	0.093	-0.207	-0.107	0.093	0.193	0.093	0.193	0.093				
#6	bias	1	2	3	4	5	6	7	8	9	10				
Original Input	1	0	2	3 0	4 0	5 1	6 0	7 0	8	9	10 1				
				3 0											
Original Input	1	0		3 0											
Original Input	1 1 Node	0 0	2	3	0	1 5	6	7	1	9	10	11	12	13	14
Original Input Original Output	1 1 Node Input	0 0 1 0	2	3 0	0 4 0	1 5 1	6 0	7 0	1 8 1	9	10	0.077	0.356	0.391	-0.065
Original Input	1 1 Node	0 0	2	3	0	1 5	6	7	1	9	10				
Original Input Original Output	1 1 Node Input Output	0 0 1 0	2	3 0	0 4 0	1 5 1	6 0	7 0	1 8 1	9	10	0.077	0.356	0.391	-0.065
Original Input Original Output	1 1 Node Input	0 0 1 0 0.500	2 1 0.731	3 0 0.500	0 4 0 0.500	5 1 0.731	0 6 0 0.500	7 0 0.500	1 8 1	9	10	0.077	0.356	0.391	-0.065
Original Input Original Output (1/1+exp(-input))	Node Input Output Error 0.097	0 0 1 0 0.500	2	3 0 0.500	0 4 0 0.500 tput)(noo	5 1 0.731	6 0 0.500	7 0 0.500	1 8 1	9	10	0.077	0.356	0.391	-0.065
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11	Node Input Output Error 0.097 -0.121 0.006	0 0 1 0 0.500 (origina (origina [Σ(Erro	2 1 0.731 al output - al output - r*weight)	3 0 0.500 node ou node ou (node o	4 0 0.500 tput)(noc tput)(noc utput)(1-i	5 1 0.731 le output) le output)	6 0 0.500 0(1-node out)	7 0 0.500	1 8 1	9	10	0.077	0.356	0.391	-0.065
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14	Node Input Output Error 0.097	0 0 1 0 0.500 (origina (origina [Σ(Erro	2 1 0.731 al output -	3 0 0.500 node ou node ou (node o	4 0 0.500 tput)(noc tput)(noc utput)(1-i	5 1 0.731 le output) le output)	6 0 0.500 0(1-node out)	7 0 0.500	1 8 1	9	10	0.077	0.356	0.391	-0.065
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11 Node 12	Node Input Output Error 0.097 -0.121 0.006 -0.003	0 0 1 0 0.500 (origina (origina [Σ(Erro	2 1 0.731 al output - al output - r*weight) r*weight)	3 0 0.500 node ou node ou (node o	4 0 0.500 tput)(noc tput)(1-oc utput)(1-i utput)(1-i	5 1 0.731 le output) le output) node outp	6 0 0.500 0(1-node 0(1-node out)	7 0 0.500 output) output)	8 1 0.731	9	10	0.077	0.356	0.391	-0.065
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11	Node Input Output Error 0.097 -0.121 0.006	0 0 1 0 0.500 (origina (origina [Σ(Erro	2 1 0.731 al output - al output - r*weight)	3 0 0.500 node ou node ou (node o	4 0 0.500 tput)(noc tput)(1-oc utput)(1-i utput)(1-i	5 1 0.731 le output) le output) node outp	6 0 0.500 0(1-node 0(1-node out)	7 0 0.500 output) output)	8 1 0.731	9	10	0.077	0.356	0.391	-0.065
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11 Node 12 New weights Node 13	Node Input Output Error 0.097 -0.121 0.006 -0.003 w(x)(y)= bias 0.376	0 0 0 0.500 (origina (origina [Σ(Erro [Σ(Erro	2 1 0.731 al output - r*weight) r*weight) ight) + (le	3 0 0.500 node ou node ou (node o (node o	4 0 0.500 tput)(noc tput)(1-i utput)(1-i	5 1 0.731 le output) node outp node outp	6 0 0.500 0(1-node out) out) e y) * (ou	7 0 0.500 output) output)	8 1 0.731	9 0 0.500	1 10 1 0.731	0.077 0.519 11 0.292	0.356 0.588 12 0.008	0.391	-0.065
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11 Node 12 New weights Node 13 Node 13 Node 14	Node Input Output Error 0.097 -0.121 0.006 -0.003 w(x)(y)= bias 0.376 -0.211	0 0 1 0 0.500 (origina (origina [Σ(Erro [Σ(Erro (old we	2 1 0.731 output - r*weight) r*weight) ight) + (le	3 0 0.500 node ou node ou (node o (node o	4 0 0.500 tput)(noc tput)(1-i utput)(1-i utput)(1-i	5 1 0.731 le output) node outp node outp or of nod 5	6 0 0.500 0(1-node out) out) e y) * (ou	7 0 0.500 output) output)	8 1 0.731	9 0 0.500	1 10 1 0.731	0.077 0.519	0.356 0.588	0.391	-0.065
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11 Node 12 New weights Node 13	Node Input Output Error 0.097 -0.121 0.006 -0.003 w(x)(y)= bias 0.376	0 0 0 0.500 (origina (origina [Σ(Erro [Σ(Erro	2 1 0.731 al output - r*weight) r*weight) ight) + (le	3 0 0.500 node ou node ou (node o (node o	4 0 0.500 tput)(noc tput)(1-i utput)(1-i	5 1 0.731 le output) node outp node outp	6 0 0.500 0(1-node out) out) e y) * (ou	7 0 0.500 output) output)	8 1 0.731	9 0 0.500	1 10 1 0.731	0.077 0.519 11 0.292	0.356 0.588 12 0.008	0.391	-0.065

#7	bias	1	2	3	4	5	6	7	8	9	10				
Original Input	1	1	0	0	1	0	0	1	0	1	0				
Original Output	0	1													
	Node	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(4 (4 ()))	Input	1	0	0	1	0	0	1	0	1	0	0.394	0.347	0.555	-0.246
(1/1+exp(-input))	Output	0.731	0.500	0.500	0.731	0.500	0.500	0.731	0.500	0.731	0.500	0.597	0.586	0.635	0.439
	Error														
Node 13	-0.147	(origina	ıl output -	node ou	tnut)(nod	le outnut)	(1-node	output)							
Node 14	0.138		ıl output -												
Node 11	-0.013		r*weight)]					output)							
Node 12	0.000		r*weight)												
			0 /.		1 /		,								
New weights	w(x)(y)=	-	ight) + (le					-	-						
	bias	1	2	3	4	5	6	7	8	9	10	11	12		
Node 13	0.243											0.213	-0.070		
Node 14	-0.086	0.000	0.440	0.000	0.040	0.440	0.000	0.400	0.000	0.400	0.000	0.005	0.084		
Node 11	0.088	0.090	-0.110	0.090	-0.210	-0.110	0.090	0.190	0.090	0.190	0.090				
Node 12	0.080	0.092	0.192	0.092	-0.208	-0.108	0.092	0.192	0.092	0.192	0.092				
#8	hias	1	2	3	4	5	6	7	8	9	10				
#8 Original Input	bias 1	1	2	3	4	5 0	6	7	8	9	10				
Original Input	bias 1 1	1 0 0	2 0	3 1		5 0					10 1				
	1	0	2 0	3		5 0									
Original Input	1	0	0	1	1	0	0	0	1	0	1				
Original Input	1 1 Node	0 0	2	3	1	5	6	7	1	9	10	11	12	13	14
Original Input Original Output	1 1 Node Input	0 0 1 0	2 0	1 3 1	1 4 1	0 5 0	0 6 0	7 0	1 8 1	9	10	0.149	0.148	0.320	-0.039
Original Input	1 1 Node	0 0	2	3	1	5	6	7	1	9	10				
Original Input Original Output	1 1 Node Input Output	0 0 1 0	2 0	1 3 1	1 4 1	0 5 0	0 6 0	7 0	1 8 1	9	10	0.149	0.148	0.320	-0.039
Original Input Original Output (1/1+exp(-input))	1 1 Node Input Output Error	0 0 1 0 0.500	0 2 0 0.500	3 1 0.731	1 4 1 0.731	5 0 0.500	0 6 0 0.500	7 0 0.500	1 8 1	9	10	0.149	0.148	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13	Node Input Output Error 0.103	0 0 1 0 0.500	0 2 0 0.500	3 1 0.731	1 4 1 0.731 tput)(noo	5 0 0.500	0 6 0 0.500	7 0 0.500	1 8 1	9	10	0.149	0.148	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14	Node Input Output Error 0.103 -0.123	0 0 1 0 0.500 (origina (origina	2 0 0.500 al output -	3 1 0.731 node ou node ou	1 4 1 0.731 tput)(nootput)(nootput)(nootput)	5 0 0.500 le output)	6 0 0.500 0(1-node)(1-node	7 0 0.500	1 8 1	9	10	0.149	0.148	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11	Node Input Output Error 0.103 -0.123 0.005	0 0 1 0 0.500 (origina (origina [Σ(Erro	2 0 0.500 al output - al output - r*weight)]	3 1 0.731 node ou node ou (node o	4 1 0.731 tput)(noc tput)(noc utput)(1-i	5 0 0.500 le output) le output)	6 0 0.500 0(1-node 0(1-node out)	7 0 0.500	1 8 1	9	10	0.149	0.148	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14	Node Input Output Error 0.103 -0.123	0 0 1 0 0.500 (origina (origina [Σ(Erro	2 0 0.500 al output - al output - r*weight)]	3 1 0.731 node ou node ou (node o	1 4 1 0.731 tput)(noc tput)(noc utput)(1-i utput)(1-i	5 0 0.500 le output) le output) node outp	6 0 0.500 0(1-node 0(1-node out)	7 0 0.500 output) output)	8 1 0.731	9	10	0.149	0.148	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11	Node Input Output Error 0.103 -0.123 0.005 -0.004 w(x)(y)=	0 0 0 0.500 (origina (origina [Σ(Erro [Σ(Erro	0 2 0 0.500 al output - r*weight)] r*weight)]	3 1 0.731 node ou node ou (node o (node o	1 4 1 0.731 tput)(noc tput)(noc utput)(1-i utput)(1-i	5 0 0.500 le output) node outp node outp	6 0 0.500 0(1-node out) out)	7 0 0.500 output) output)	8 1 0.731	9 0 0.500	1 10 1 0.731	0.149 0.537	0.148 0.537	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11 Node 12 New weights	Node Input Output Error 0.103 -0.123 0.005 -0.004 w(x)(y)= bias	0 0 1 0 0.500 (origina (origina [Σ(Erro	2 0 0.500 al output - al output - r*weight)]	3 1 0.731 node ou node ou (node o	1 4 1 0.731 tput)(noc tput)(noc utput)(1-i utput)(1-i	5 0 0.500 le output) le output) node outp	6 0 0.500 0(1-node 0(1-node out)	7 0 0.500 output) output)	8 1 0.731	9	10	0.149 0.537	0.148 0.537	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11 Node 12 New weights Node 13	Node Input Output Error 0.103 -0.123 0.005 -0.004 w(x)(y)= bias 0.336	0 0 0 0.500 (origina (origina [Σ(Erro [Σ(Erro	0 2 0 0.500 al output - r*weight)] r*weight)]	3 1 0.731 node ou node ou (node o (node o	4 1 0.731 tput)(noc tput)(1-i utput)(1-i utput)(1-i	5 0 0.500 le output) node outp node outp	6 0 0.500 0(1-node out) out)	7 0 0.500 output) output)	8 1 0.731	9 0 0.500	1 10 1 0.731	0.149 0.537 11 0.262	0.148 0.537 12 -0.020	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11 Node 12 New weights Node 13 Node 13 Node 14	Node Input Output Error 0.103 -0.123 0.005 -0.004 w(x)(y)= bias 0.336 -0.197	0 0 1 0 0.500 (origina (origina [Σ(Erro [Σ(Erro (old we 1	2 0 0.500 al output - r*weight)] r*weight)] ight) + (le	3 1 0.731 node ou node ou (node o (node o	4 1 0.731 tput)(noc tput)(1-i utput)(1-i utput)(1-i 4	5 0 0.500 le output) node outp node outp or of nod 5	6 0 0.500 0(1-node out) out) le y) * (ou	7 0 0.500 output) output)	8 1 0.731	9 0 0.500	1 10 1 0.731	0.149 0.537	0.148 0.537	0.320	-0.039
Original Input Original Output (1/1+exp(-input)) Node 13 Node 14 Node 11 Node 12 New weights Node 13	Node Input Output Error 0.103 -0.123 0.005 -0.004 w(x)(y)= bias 0.336	0 0 0 0.500 (origina (origina [Σ(Erro [Σ(Erro	0 2 0 0.500 al output - r*weight)] r*weight)]	3 1 0.731 node ou node ou (node o (node o	4 1 0.731 tput)(noc tput)(1-i utput)(1-i utput)(1-i	5 0 0.500 le output) node outp node outp	6 0 0.500 0(1-node out) out)	7 0 0.500 output) output)	8 1 0.731	9 0 0.500	1 10 1 0.731	0.149 0.537 11 0.262	0.148 0.537 12 -0.020	0.320	-0.039

#9	bias	1	2	3	4	5 1	6 0	7 0	8	9	10				
Original Input Original Output	1 0	0 1	0	T	U	1	U	U	T	1	0				
(1/1+exp(-input))	Node Input Output	1 0 0.500	2 0 0.500	3 1 0.731	4 0 0.500	5 1 0.731	6 0 0.500	7 0 0.500	8 1 0.731	9 1 0.731	10 0 0.500	11 0.364 0.590	12 0.336 0.583	13 0.479 0.617	14 -0.214 0.447
Node 13 Node 14 Node 11 Node 12	Error -0.146 0.137 -0.011 0.002	(origina [Σ(Erro	al output - al output - r*weight) r*weight)	node ou (node o	itput)(noc utput)(1-i	le output node out	(1-node out)								
New weights Node 13	w(x)(y)= bias 0.204	(old we	eight) + (le 2	earning ra 3	ate) * (err 4	or of nod 5	le y) * (oı 6	utput of n 7	ode x) 8	9	10	11 0.185	12 -0.097		
Node 14 Node 11 Node 12	-0.074 0.083 0.078	0.088 0.091	-0.112 0.191	0.088 0.091	-0.212 -0.209	-0.112 -0.109	0.088 0.091	0.188 0.191	0.088 0.091	0.188 0.191	0.088 0.091	0.018	0.096		
#10 Original Input Original Output	bias 1 1	1 0 0	2	3	4 0	5 0	6 1	7 1	8	9 1	10 0				
(1/1+exp(-input))	Node Input Output	1 0 0.500	2 1 0.731	3 0 0.500	4 0 0.500	5 0 0.500	6 1 0.731	7 1 0.731	8 0 0.500	9 1 0.731	10 0 0.500	11 0.434 0.607	12 0.740 0.677	13 0.251 0.562	14 0.003 0.501
Node 13 Node 14 Node 11 Node 12	Error 0.108 -0.125 0.004 -0.005	(origina [Σ(Erro	al output - al output - r*weight) r*weight)	node ou (node o	itput)(noc utput)(1-i	le output node outp	(1-node out)								
New weights Node 13 Node 14	w(x)(y)= bias 0.301 -0.186	(old we	eight) + (le 2	earning ra 3	ate) * (err 4	or of nod 5	le y) * (oı 6	utput of n 7	ode x) 8	9	10	11 0.244 -0.050	12 -0.031 0.020		
Node 11 Node 12	0.087 0.074	0.090 0.088	-0.110 0.188	0.090 0.088	-0.210 -0.212	-0.110 -0.112	0.090 0.088	0.190 0.188	0.090 0.088	0.190 0.188	0.090 0.088	0.000	2.020		