Question 1
(a)

A	B	Output
0	0	0
0	1	0
1	0	1
1	1	1

B

A

The perceptron

O

0.5

1

0

A

B
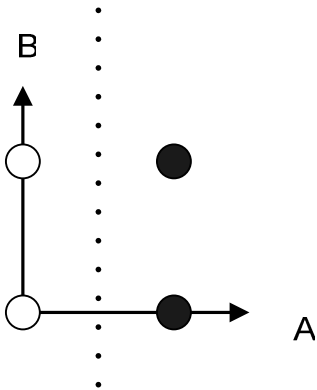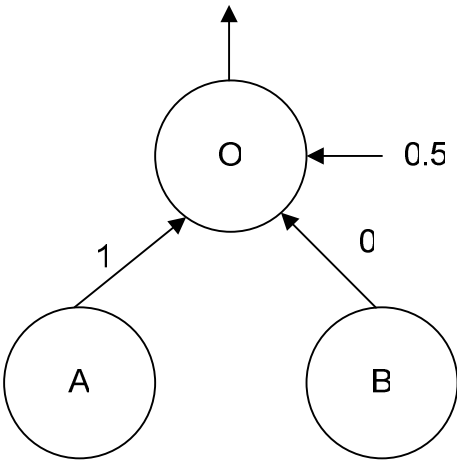
(b)

A	B	Output
0	0	0
0	1	1
1	0	1
1	1	0

B

A
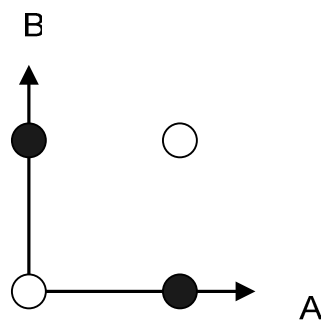
It is impossible to separate them and thus, we need to use a hidden layer
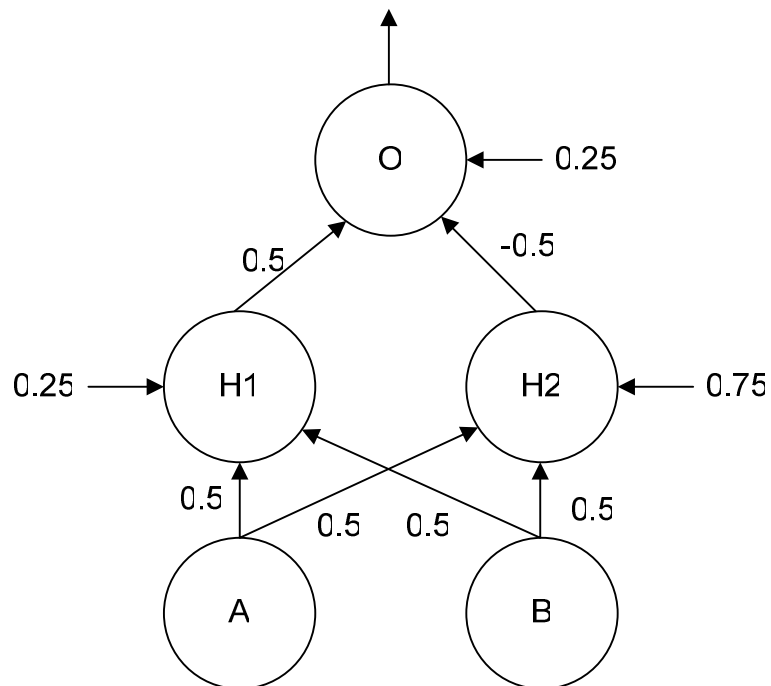
(c)

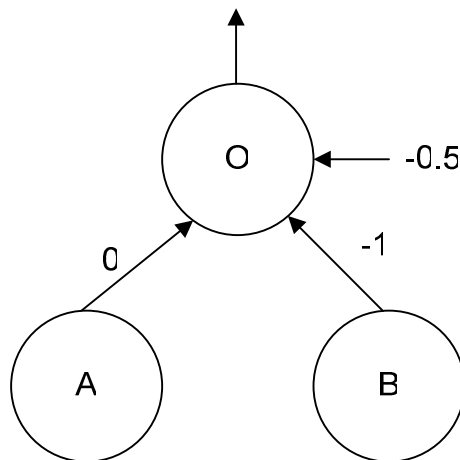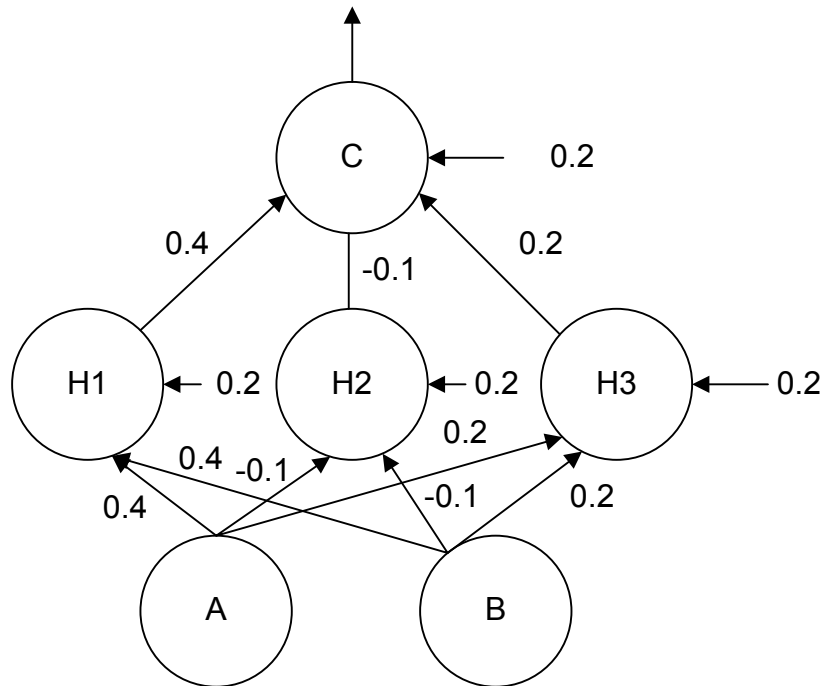| A	B	Output
0	0	1
0	1	0
1	0	1
1	1	0

B
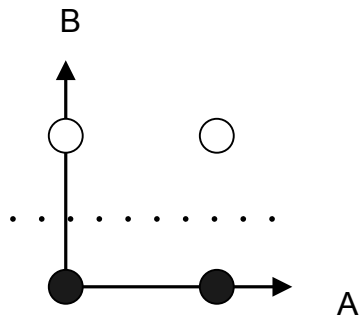
The perceptron is

Question 2: If you give me something reasonable such as the procedure of calculation or
　　　　　a program, you receive the full credit

Question 3:
(a)

(b)
Forward pass:
　　Input to H1: 0.4 * 0.3 +0.4 *(-0.6)-0.2 = -0.32
　　Output of H1: Sigmod(-0.32) = 0.4207

　　Input to H2: -0.17
　　Output of H2: 0.4576

　　Input to H3: -0.26
　　Output of H3: 0.4354

　　Input of C: 0.0096
　　Output of C: 0.5024
Back-propagation:
　　del_C = 0.5024 * (1-0.5024)*(1-0.5024) = 0.1244
　　W_{H1c} = 0.4 +(0.2 * 0.4207 * 0.1244) = 0.4105
　　W_{H2c} = -0.1 +(0.2 * 0.4576 * 0.1244) = -0.0886
　　W_{H3c} = 0.2 +(0.2 * 0.4354 * 0.1244) = 0.2108
　　W_{bias} = 0.2 +(0.2 * -1 * 0.1244) = 0.1751

　　del_H_1 = 0.4207 * (1 − 0.4207)*(0.4 * 0.1244) = 0.0121
　　W_{AH1} = 0.4 +(0.2 * 0.3 * 0.0121) = 0.4007

W_{BH1} = 0.4 +(0.2 * -0.6 * 0.0121) = 0.3985
W_{BiasH1} = 0.2 +(0.2 * -1 * 0.0121) = 0.1976

del_H_2 = 0.4576 * (1 – 0.4576)*(-0.1 * 0.1244) = -0.0031
W_{AH2} = -0.1 +(-0.2 * 0.3 * 0.0031) = -0.1002
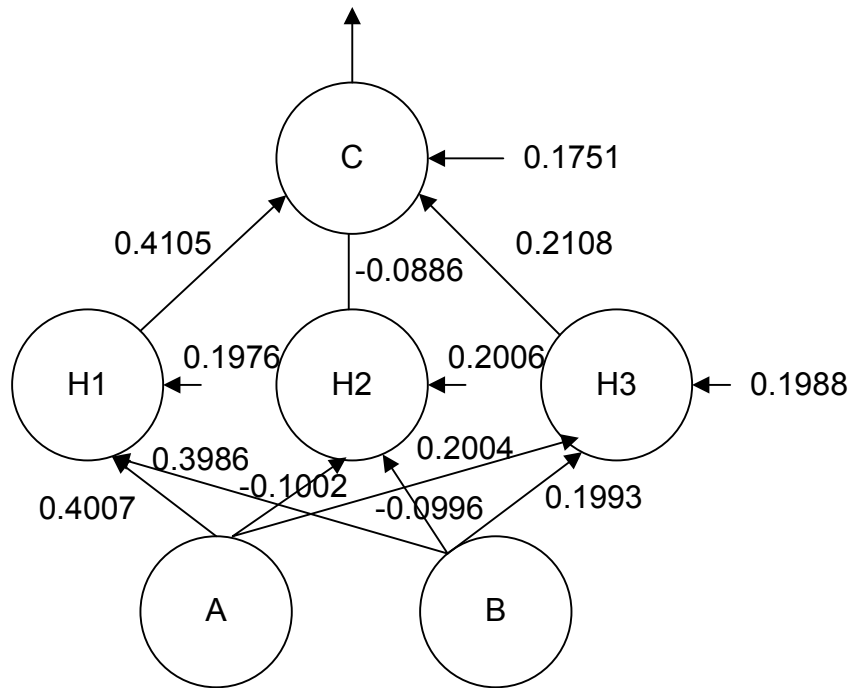W_{BH2} = -0.1 +(-0.2 * -0.6 * 0.0031) = -0.0996
W_{BiasH2} = 0.2 +(0.2 * 1 * 0.0031) = 0.2006

del_H_3 = 0.4354 * (1 – 0.4354)*(0.2 * 0.1244) = 0.0061
W_{AH3} = 0.2 +(0.2 * 0.3 * 0.0061) = 0.2004
W_{BH3} = 0.2 +(0.2 * -0.6 * 0.0061) = 0.1993
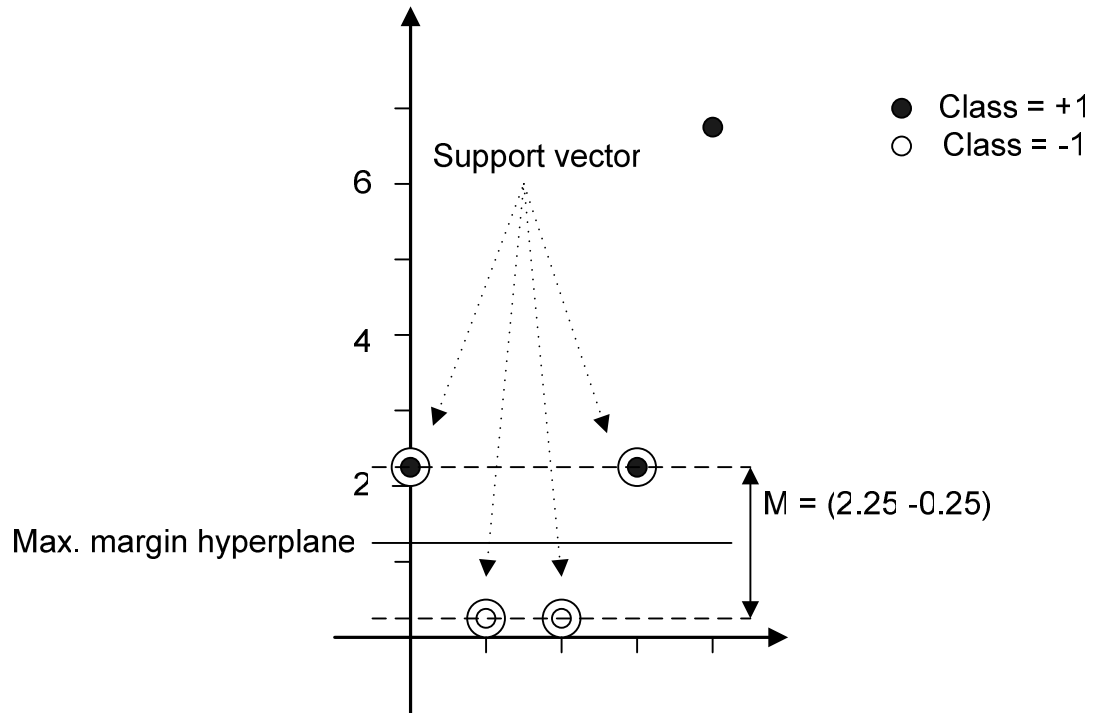W_{BiasH3} = 0.2 +(0.2 * -1 * 0.0061) = 0.1988

Question 4
The mapping functions are

$$\begin{cases} X_1 = x \\ X_2 = (x-1.5)^2 \end{cases}$$

The equation for the hyperplane is $X_2 = 1.25$

Question 5
1. Discussion: 15 Points
2. Reasonable: figure of SSE and accuracy 15 Points
3. Working code: 10 Points