HW #4

1.

Answer:
$$Y = \begin{bmatrix} 0 \\ 0 \\ .78 \\ 3.54 \\ 0 \\ 3.5 \end{bmatrix}$$
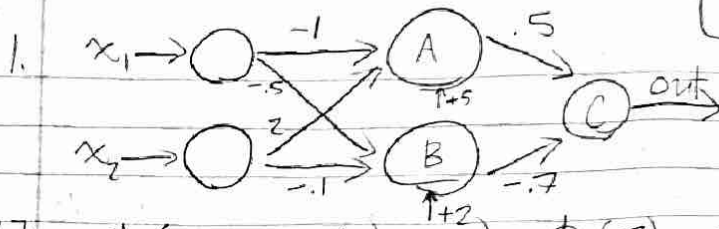
$\begin{bmatrix} 1 \\ -1 \end{bmatrix}$: $\phi(-1 \cdot 1 + 2 \cdot (-1) + 5) = \phi(2) = 2 \to A \Rightarrow 2$

$\phi(-.5 \cdot 1 + (-.1) \cdot (-1) + 2) = \phi(1.6) = 1.6 \to B \Rightarrow 1.6$

$\phi(.5 \cdot 2 + (-.7) \cdot 1.6) = \phi(-.12) = 0 \to C \Rightarrow 0$

So, $y_1 = 0$

$\begin{bmatrix} -2 \\ -3 \end{bmatrix}$: $\phi(-1 \cdot (-2) + 2(-3) + 5) = \phi(1) = 1 \to A \Rightarrow 1$

$\phi(-.5(-2) + (.1)(-3) + 2) = \phi(3.3) = 3.3 \to B \Rightarrow 3.3$

$\phi(.5(1) + (-.7)(3.3)) = \phi(-1.8) = 0 \to C \Rightarrow 0$

So, $y_2 = 0$

$\begin{bmatrix} -5 \\ -1 \end{bmatrix}$: $\phi(-1(-5) + 2(-1) + 5) = \phi(8) = 8$

$\phi(-.5(-5) + (-.1)(-1) + 2) = \phi(4.6) = 4.6$

$\phi(.5(8) + (-.7)(4.6)) = \phi(.78) = .78 \to C \Rightarrow .78$

So, $y_3 = .78$

$\begin{bmatrix} -2 \\ 2 \end{bmatrix}$: $\phi(-1(-2) + 2(2) + 5) = \phi(11) = 11$

$\phi(-.5(-2) + (-.1)(2) + 2) = \phi(2.8) = 2.8$

$\phi(.5(11) + (-.7)(2.8)) = \phi(3.54) = 3.54$

So, $y_4 = 3.54$

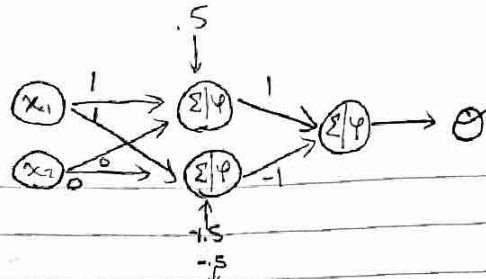$\begin{bmatrix} 6 \\ -2 \end{bmatrix}$: $\phi(-1(6) + 2(-2) + 5) = \phi(-5) = 0$

$\phi(-.5(6) + (-.1)(-2) + 2) = \phi(-.8) = 0$

$\phi(.5(0) + (-.7)(0)) = \phi(0) = 0$

So, $y_5 = 0$

$\begin{bmatrix} 4 \\ 3 \end{bmatrix}$: $\phi(-1(4) + 2(3) + 5) = \phi(7) = 7$

$\phi(-.5(4) + (-.1)(3) + 2) = \phi(-.3) = 0$
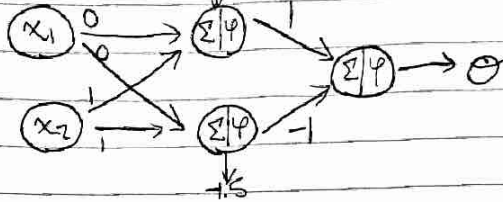
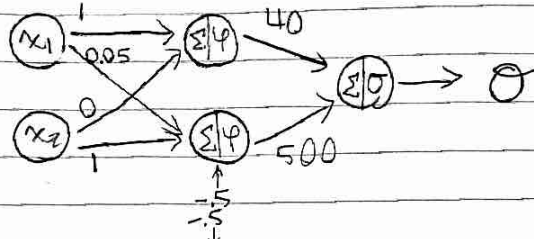$\phi(.5(7) + (-.7)(0)) = \phi(3.5) = 3.5$

So, $y_6 = 3.5$

2.
i)
1.

$$w/ \ \Psi(x) = \begin{cases} 1, & x \geq 0 \\ 0, & else \end{cases}$$
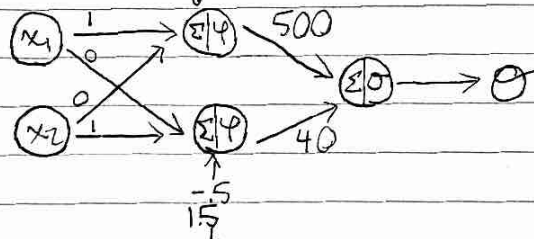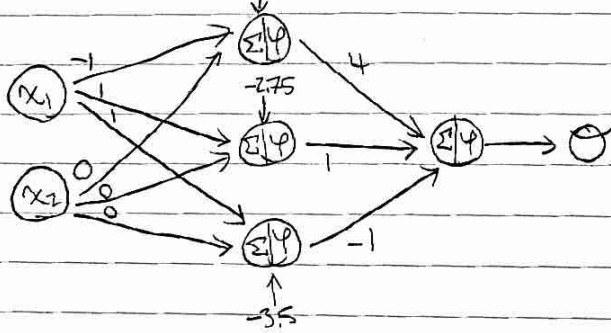
2.

ii.)
1.

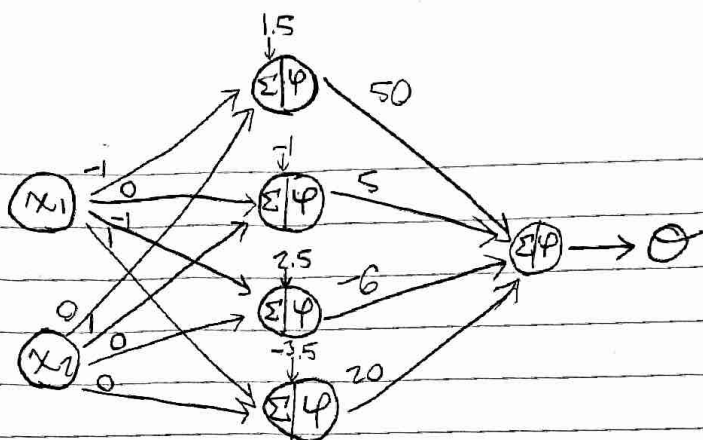$$w/ \ \sigma(x) = \begin{cases} 2, & x \geq 500 \\ 1, & 0 < x < 500 \\ 0, & x < 0 \end{cases}$$

2.

iii)
1.

2.

Neural network diagram:

Inputs x_1, x_2 connect to four hidden units ($\Sigma | \varphi$).

Biases on hidden units: 1.5, -1, 2.5, -3.5

Weights from x_1: -1, 0, -1
Weights from x_2: 0, 1, 0, 0

Weights from hidden units to output: 50, 5, -6, 20
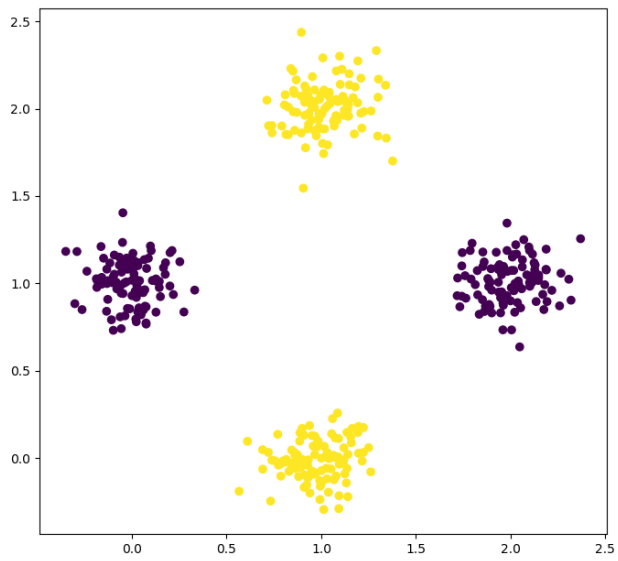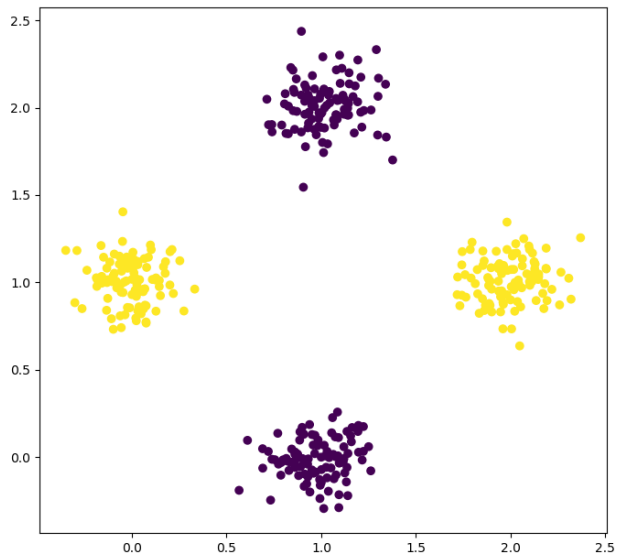
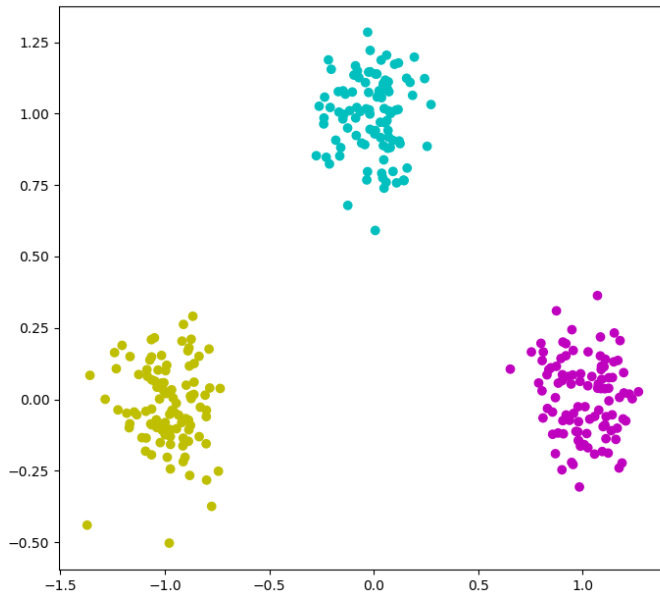Output: $\Sigma | \varphi \rightarrow O$

For 2.i) network 1, the output of the neural network on the first dataset looks like:
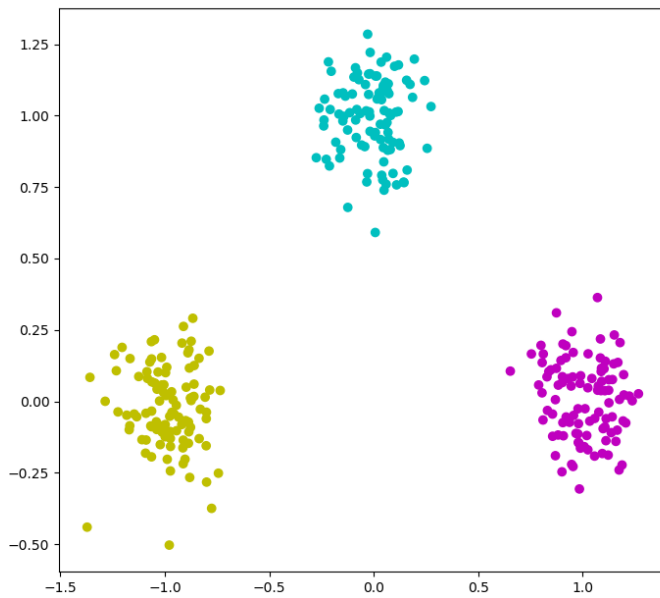

For 2.i) network 2, the output of the neural network on the first dataset looks like:
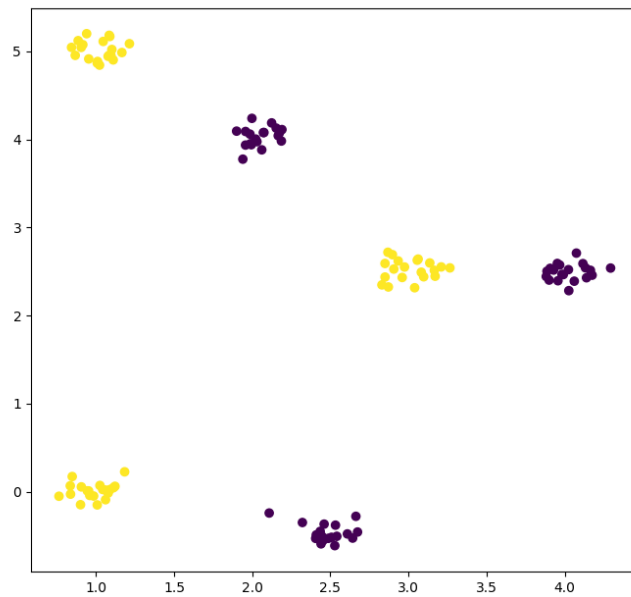
For 2.ii) network 1, the output of the neural network on the second dataset looks like:

For 2.ii) network 2, the output of the neural network on the second dataset looks like:

For 2.iii) network 1, the output of the neural network on the third dataset looks like:

For 2.iii) network 2, the output of the neural network on the third dataset looks like: