

Answers for Assignment10(5 pts)

1.
 - The way to get features. (0.5')
 - On lecture note 16.(0.5)
2. (a) $output = \sigma(x_1w_1 + x_2w_2 + x_3w_3 + b)$

$$(b) \begin{aligned} z_1 &= \frac{1}{1+e^{-(1-2+2)}} = \frac{1}{1+e^{-1}} \\ z_2 &= \frac{1}{1+e^{-(2+1-4)}} = \frac{1}{1+e^1} \\ y &= \frac{1}{1+e^{-(z_1+z_2+1)}} = \frac{1}{1+e^{-2}} \approx 0.88 \end{aligned}$$

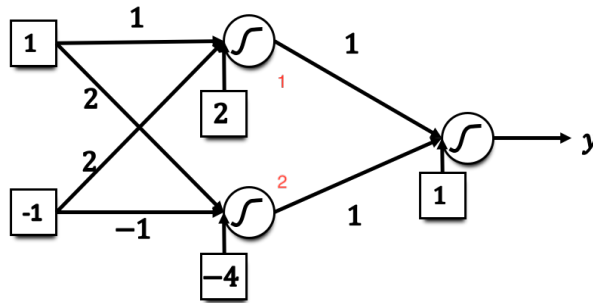


Figure 1

3. (a) What are the values of outputs y_1, y_2 during **training**?(0.5')

$$\begin{aligned} z_1 &= \max\{0, (-1)\} = 0 \\ z_2 &= \max\{0, (2+2)\} = 4 \\ z_4 &= \max\{0, 1\} = 1 \end{aligned}$$

$$\begin{aligned} y_1 &= \max\{0, (-z_1 + 2z_2 - 4z_3)\} = \max\{0, (0 + 8 - 4)\} = 4 \\ y_2 &= \max\{0, (z_1 + 0 - 2z_4)\} = \max\{0, (0 + 0 - 2)\} = 0 \end{aligned}$$

- (b) What are the values of outputs y_1, y_2 during **testing**?(0.5')

$$\begin{aligned} z_1 &= \max\{0, (-1 + 2 * 2.5) * 0.75\} = 3 \\ z_2 &= \max\{0, (2 + 2) * 0.75\} = 3 \\ z_3 &= \max\{0, (3 - 2 - 2) * 0.75\} = 0 \\ z_4 &= \max\{0, 1 * 0.75\} = 0.75 \end{aligned}$$

$$\begin{aligned} y_1 &= \max\{0, 0.75 * (-z_1 + 2z_2 + 0 - 4z_3)\} = \max\{0, 0.75 * (-3 + 6 + 0 - 3)\} = 0 \\ y_2 &= \max\{0, 0.75 * (z_1 + 0 - z_3 - 2z_4)\} = \max\{0, 0.75 * (3 + 0 - 0 - 1.5)\} = 1.125 \end{aligned}$$

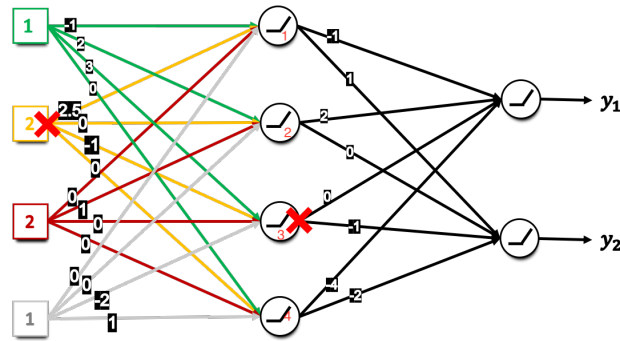


Figure 2

4. $y = \sigma(x)$ When $x > 5$, $y \approx 1$. When $x < -5$, $y \approx 0$.

$$z_1 = \frac{1}{e^{-10x_1}} = \begin{cases} 1, & x_1 > 0 \\ 0.5, & x_1 = 0 \\ 0, & x_1 < 0 \end{cases}$$

$$z_2 = \frac{1}{e^{-10x_2}} = \begin{cases} 1, & x_2 > 0 \\ 0.5, & x_2 = 0 \\ 0, & x_2 < 0 \end{cases}$$

$$z_3 = \frac{1}{e^{-(30-x_1-x_2)}} = \begin{cases} 1, & x + 1 + x_2 < 30 \\ 0.5, & x_1 + x_2 = 30 \\ 0, & x_1 + x_2 > 30 \end{cases}$$

$$y = \frac{1}{e^{-(40z_1+40z_2+40z_3-100)}} = \begin{cases} 1, & z_1 + z_2 + z_3 = 3 \\ 0.5, & z_1 + z_2 + z_3 = 2.5 \\ 0, & z_1 + z_2 + z_3 < 2.5 \end{cases}$$

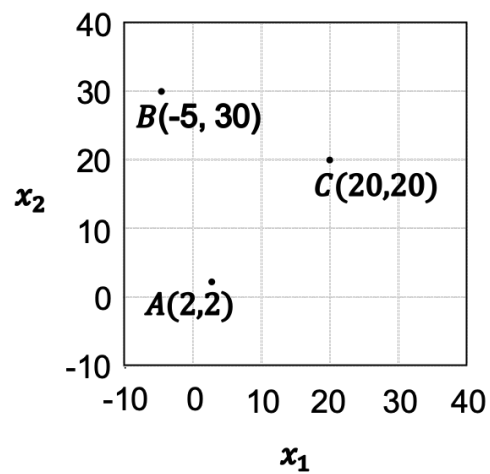
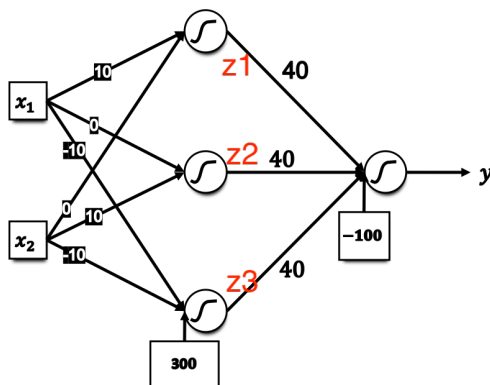


Figure 3

(a) $y_A = 1, y_B = 0, y_C = 0$

(b) Figure 4.

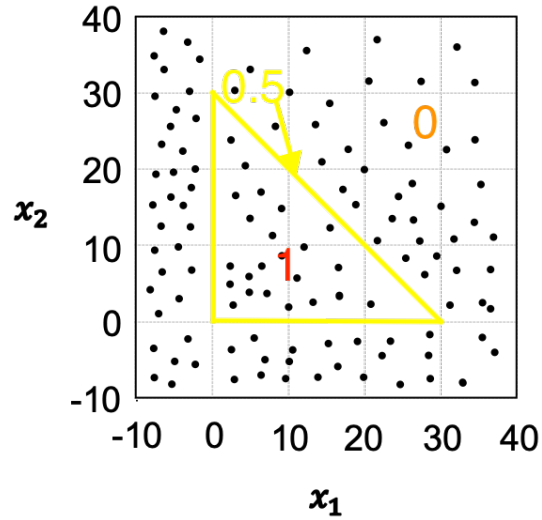


Figure 4

The decision boundary is $\begin{cases} x + y = 30 \\ x = 0 \\ y = 0 \end{cases}$

Note: There is no data points in the decision boundary. Therefore, the data points in Figure 4 can be divided into two parts. If you divide them into three parts and write the corresponding explanation, you can also get a full mark.