

Ex 5: Seven Layers, aka Multilayered Perceptron (MLP)

To simplify \rightarrow Assumptions ① All biases are zero

7 layer network.

① Input : the network takes the batch of 2 input vectors
 $[x_1, x_2]$

Input

| x_1 | x_2 |
|-------|-------|
| 3 | 5 |
| 4 | 4 |
| 5 | 3 |

3x2

W_1

| | | | |
|---|---|---|---|
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |

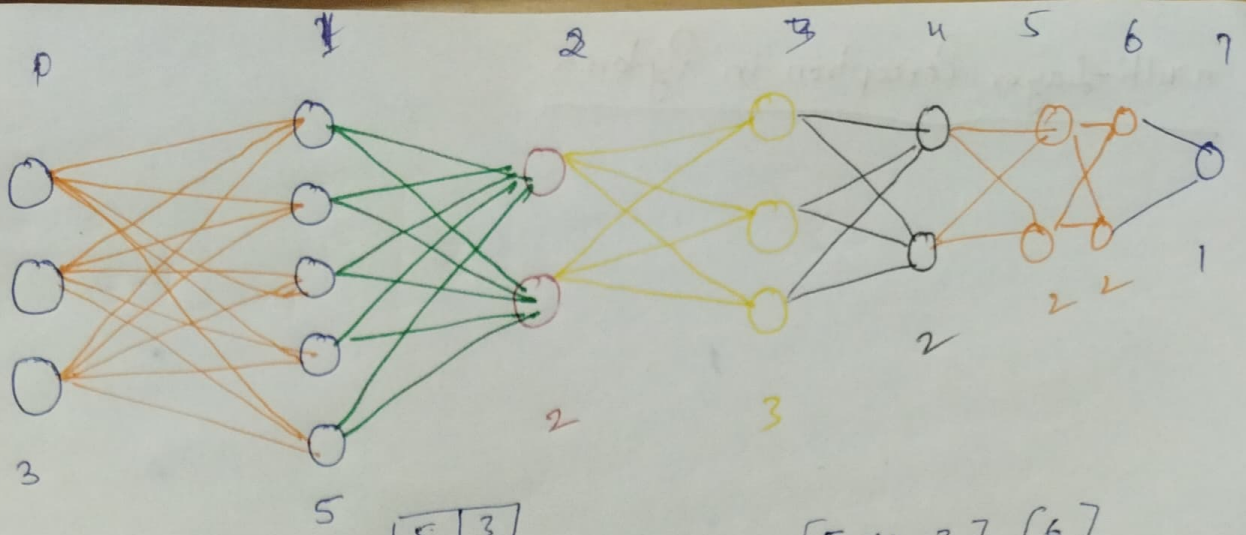
5x3

| | |
|---|---|
| 5 | 3 |
| 4 | 4 |
| 3 | 5 |
| 7 | 9 |
| 9 | 7 |

5x2

$$\begin{bmatrix} 3(0) + 4(0) + 5 + 0 \\ 0 + 4 + 0 + 0 \\ 3 + 0 + 0 + 0 \\ 3 + 4 + 0 + 0 \\ 0 + 4 + 5 + 0 \end{bmatrix} = \begin{bmatrix} 5 \\ 4 \\ 3 \\ 7 \\ 9 \end{bmatrix}$$

$$\begin{bmatrix} 3 \\ 4 \\ 5 \\ 5+4 \\ 4+3 \end{bmatrix} = \begin{bmatrix} 3 \\ 4 \\ 5 \\ 9 \\ 7 \end{bmatrix}$$



| | |
|---|---|
| 5 | 3 |
| 4 | 4 |
| 3 | 5 |
| 7 | 9 |
| 9 | 7 |

$$\begin{bmatrix} 5+4-3 \\ 3+7-9 \end{bmatrix} = \begin{bmatrix} 6 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} 3+4-5 \\ 5+9-7 \end{bmatrix} = \begin{bmatrix} 2 \\ 7 \end{bmatrix}$$

$$W_2 = \begin{bmatrix} 1 & 1 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & -1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 6 & 2 \\ 1 & 7 \end{bmatrix} \quad 2 \times 2$$

$$W_3 = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 1 & -1 & 0 & 0 & 0 \\ 1 & 2 & 0 & 0 & 0 \end{bmatrix} \quad 3 \times 5$$

$$\begin{bmatrix} 7 & 9 \\ 5 & 0 \\ 8 & 16 \end{bmatrix} \quad 3 \times 2$$

$$\begin{bmatrix} 6+1+0 \\ 6-1 \\ 6+2 \end{bmatrix} \quad 3 \times 2$$

$$W_4 = \begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & -1 & 1 & 0 \end{bmatrix} \quad 2 \times 4$$

$$\begin{bmatrix} 2 & 9 \\ 3 & 16 \end{bmatrix} \quad 2 \times 2$$

$$\begin{bmatrix} 2+7 \\ 2-7 \\ 2+14 \end{bmatrix} = \begin{bmatrix} 9 \\ -5 \\ 16 \end{bmatrix}$$

$$W_5 = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad 2 \times 3$$

$$\begin{bmatrix} 3 & 16 \\ 2 & 9 \end{bmatrix} \quad 2 \times 2$$

$$\begin{bmatrix} 7-5 \\ -5+8 \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$

$$\begin{bmatrix} 9 \\ 16 \end{bmatrix}$$

$$W_6 = \begin{bmatrix} 1 & -1 & 0 \\ 1 & 1 & 0 \end{bmatrix} \quad 2 \times 3$$

$$\begin{bmatrix} 1 & 7 \\ 5 & 25 \end{bmatrix} \quad 2 \times 2$$

$$\begin{bmatrix} 3 \\ 2 \\ 16 \\ 9 \end{bmatrix}$$

$$W_7 = \begin{bmatrix} 1 & -1 & 0 \end{bmatrix} \quad 1 \times 3$$

$$\begin{bmatrix} 0 & 0 \end{bmatrix} \quad 1 \times 2$$

$$\begin{bmatrix} 3-2 \\ 3+2 \end{bmatrix} = \begin{bmatrix} 1 \\ 5 \end{bmatrix}$$

$$\begin{bmatrix} 16-9 \\ 16+9 \end{bmatrix} = \begin{bmatrix} 7 \\ 25 \end{bmatrix}$$

$$\begin{bmatrix} 1-5 \\ 7-25 \end{bmatrix} = \begin{bmatrix} -4 \\ -18 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 1-5 \\ 7-25 \end{bmatrix} = \begin{bmatrix} -4 \\ -18 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$