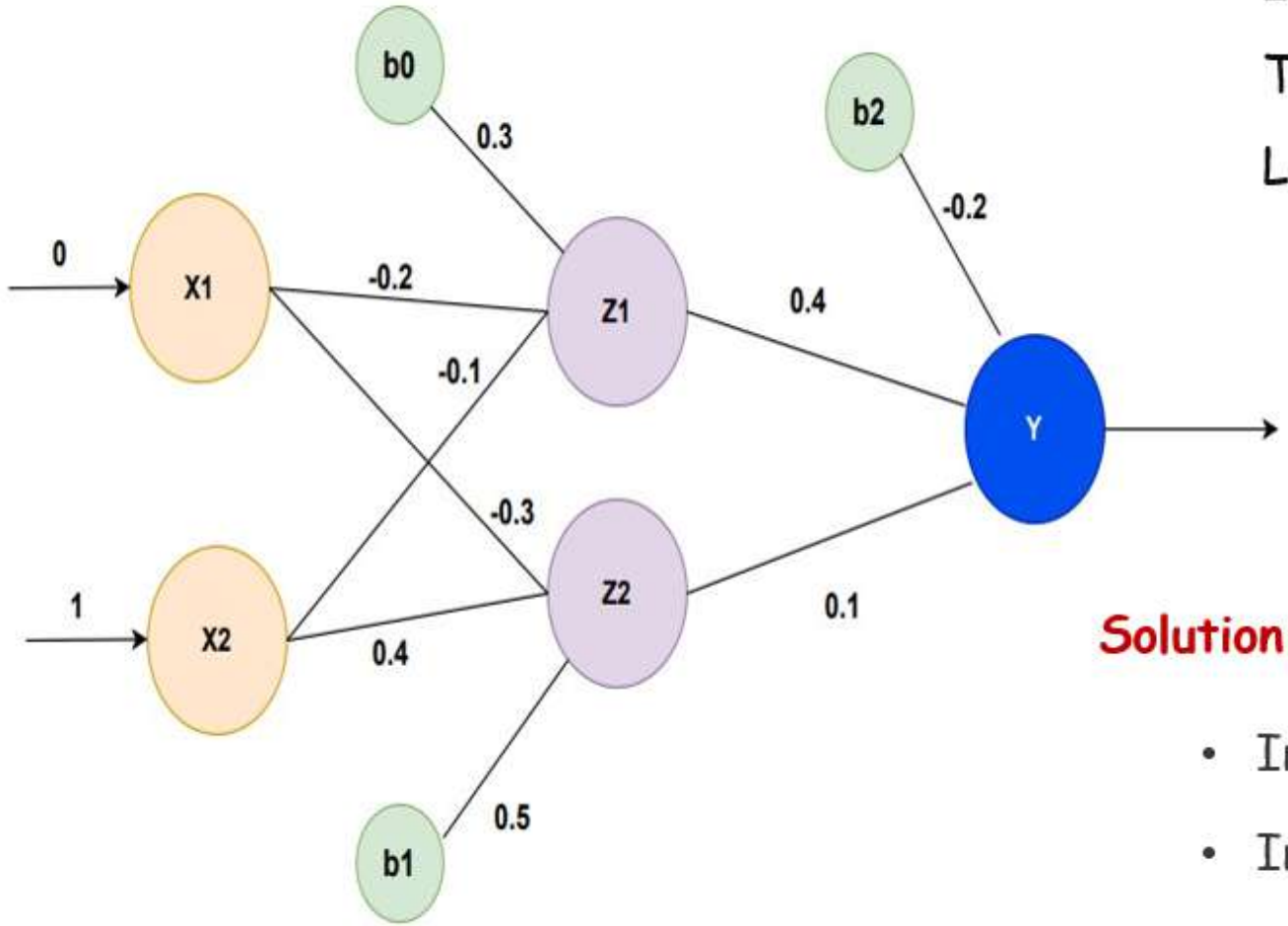


Input vector = [0,1]

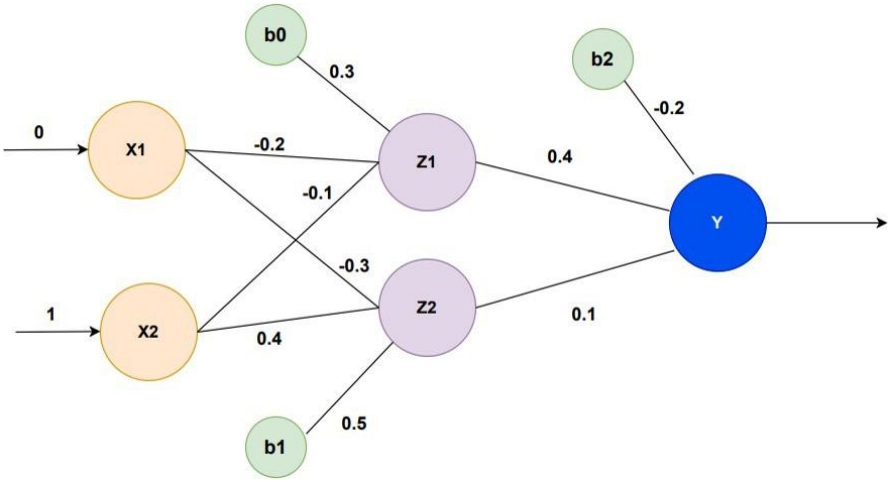
Target output = 1

Learning Rate = 0.25

Activation function= binary sigmoidal

Solution:

- Input vector to Z_1 [0.6, -0.1, 0.3]
- Input vector to Z_2 [-0.3, 0.3, 0.5]
- Input vector to Y: [0.4, 0.1, -0.2]



Step 1: Calculate the Net Input to Z_1 and Z_2

1. **For Z_1:**

$$Zin_1 = v_{01} + x_1 \cdot v_{11} + x_2 \cdot v_{21}$$

Substituting:

$$Zin_1 = 0.3 + 0 \cdot 0.6 + 1 \cdot 0.1 = 0.3 + 0.1 = 0.2$$

2. **For Z_2:**

$$Zin_2 = v_{02} + x_1 \cdot v_{12} + x_2 \cdot v_{22}$$

Substituting:

$$Zin_2 = 0.5 + 0 \cdot 0.6 + 1 \cdot 0.4 = 0.5 + 0.4 = 0.9$$

Step 2: Apply the Activation Function

Using the binary sigmoidal activation function:

$$z = \frac{1}{1 + e^{-Zin}}$$

1. For Z_1:

$$Z_1 = \frac{1}{1 + e^{-0.2}} \approx 0.5498$$

2. For Z_2:

$$Z_2 = \frac{1}{1 + e^{-0.9}} \approx 0.7109$$

Step 3: Calculate the Net Input to Output Layer (Y)

$$Y_{in} = w_0 + Z_1 \cdot w_1 + Z_2 \cdot w_2$$

Substituting:

$$Y_{in} = -0.2 + 0.5498 \cdot 0.4 + 0.7109 \cdot 0.1$$

$$Y_{in} = -0.2 + 0.21992 + 0.07109 = 0.09101$$

Step 4: Apply the Activation Function for Output Layer

$$Y = \frac{1}{1 + e^{-Y_{in}}}$$

Substituting:

$$Y = \frac{1}{1 + e^{-0.09101}} \approx 0.5227$$

Step 5: Calculate the Error at Output

Using:

$$Err_k = Y \cdot (1 - Y) \cdot (T - Y)$$

Substituting $T = 1$ and $Y = 0.5227$:

$$Err_k = 0.5227 \cdot (1 - 0.5227) \cdot (1 - 0.5227)$$

$$Err_k = 0.5227 \cdot 0.4773 \cdot 0.4773 \approx 0.119079$$

Step 6: Weight Update for Output Layer

Using:

$$\Delta W = \eta \cdot Err_k \cdot Z$$

Where $\eta = 0.25$.

1. For W_{31}:

$$\Delta W_{31} = 0.25 \cdot 0.119079 \cdot 0.5498 \approx 0.0164$$

$$W_{31,\text{new}} = W_{31,\text{old}} + \Delta W_{31} = 0.4 + 0.0164 = 0.4164$$

2. For W_{32}:

$$\Delta W_{32} = 0.25 \cdot 0.119079 \cdot 0.7109 \approx 0.0211$$

$$W_{32,\text{new}} = W_{32,\text{old}} + \Delta W_{32} = 0.1 + 0.0211 = 0.1211$$

Step 7: Calculate Error at Hidden Layer

For Z_1 and Z_2:

$$Err_z = Z \cdot (1 - Z) \cdot Err_k \cdot W$$

1. For Z_1:

$$Err_{Z_1} = 0.5498 \cdot (1 - 0.5498) \cdot 0.119079 \cdot 0.4$$

$$Err_{Z_1} = 0.5498 \cdot 0.4502 \cdot 0.119079 \cdot 0.4 \approx 0.011782$$

2. For Z_2:

$$Err_{Z_2} = 0.7109 \cdot (1 - 0.7109) \cdot 0.119079 \cdot 0.1$$

$$Err_{Z_2} = 0.7109 \cdot 0.2891 \cdot 0.119079 \cdot 0.1 \approx 0.002446$$

Step 8: Weight Update for Hidden Layer

Using:

$$\Delta W = \eta \cdot Err_z \cdot X$$

1. For W_{11} (connected to Z_1):

$$\Delta W_{11} = 0.25 \cdot 0.011782 \cdot 0 \approx 0$$

$$W_{11,\text{new}} = W_{11,\text{old}} + \Delta W_{11} = -0.2 + 0 = -0.2$$

2. For W_{21}:

$$\Delta W_{21} = 0.25 \cdot 0.011782 \cdot 1 \approx 0.002945$$

$$W_{21,\text{new}} = W_{21,\text{old}} + \Delta W_{21} = -0.1 + 0.002945 = -0.09705$$

3. For W_{12} (connected to Z_2):

$$\Delta W_{12} = 0.25 \cdot 0.002446 \cdot 0 \approx 0$$

$$W_{12,\text{new}} = W_{12,\text{old}} + \Delta W_{12} = -0.3 + 0 = -0.3$$

4. For W_{22}:

$$\Delta W_{22} = 0.25 \cdot 0.002446 \cdot 1 \approx 0.0006115$$

$$W_{22,\text{new}} = W_{22,\text{old}} + \Delta W_{22} = 0.4 + 0.0006115 = 0.4006$$

Updated Weights

- $W_{31} = 0.4164$, $W_{32} = 0.1211$
- $W_{11} = -0.2$, $W_{21} = -0.09705$
- $W_{12} = -0.3$, $W_{22} = 0.4006$
