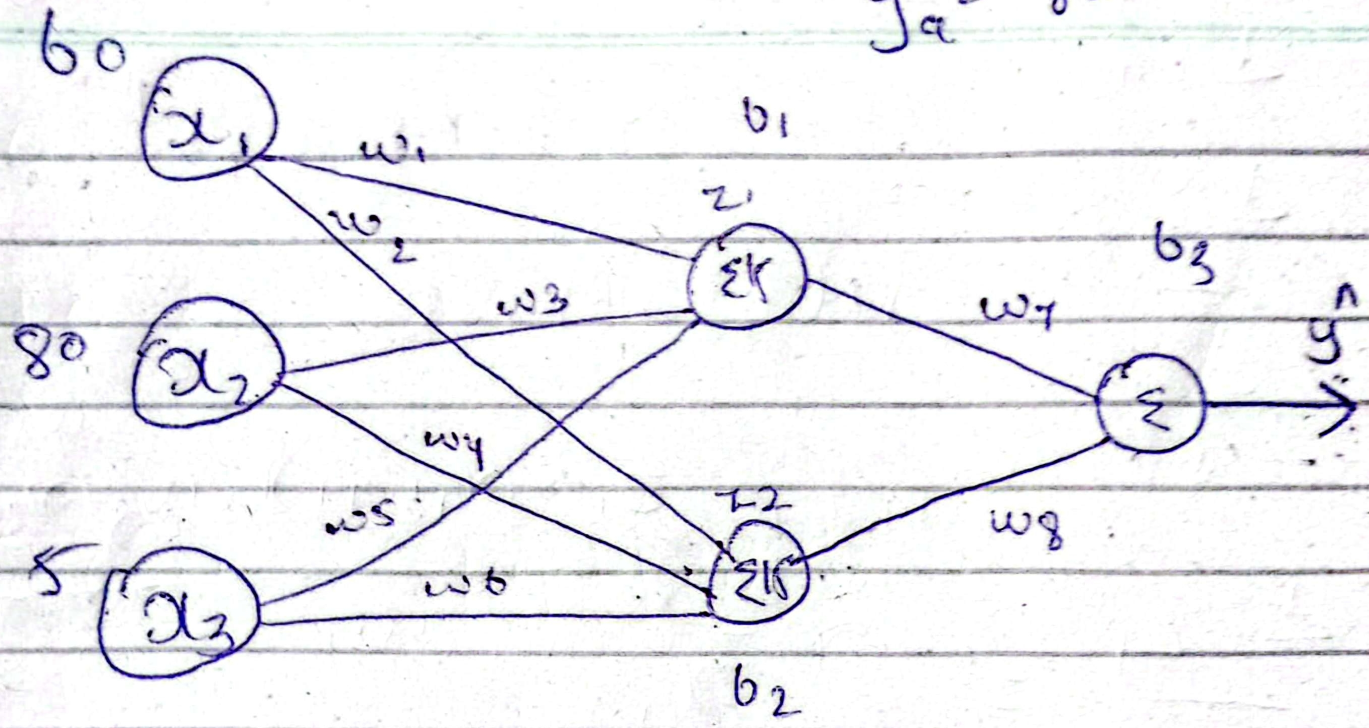
$\eta = 0.01$

$y_a = 82$



$w_1 = 0.1$ $\quad$ $w_3 = 0.1$ $\quad$ $w_5 = 0.1$

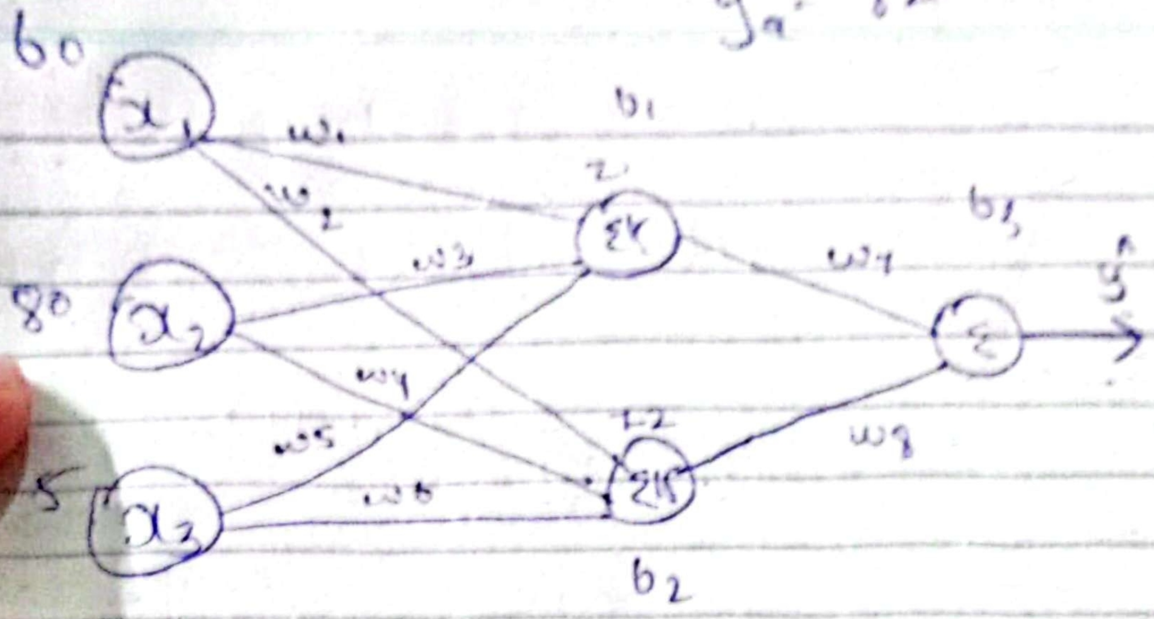
$w_2 = 0.15$ $\quad$ $w_4 = 0.05$ $\quad$ $w_6 = -0.2$

$w_7 = 12$ $\quad$ $w_8 = 9$ $\quad$ $b_1 = b_2 = -15$

$b_3 = 20$

$\eta = 0.01$

$y_a = 82$



$w_1 = 0.1$ $\quad w_3 = 0.1$ $\quad w_5 = 0.1$

$w_2 = 0.15$ $\quad w_4 = 0.05$ $\quad w_6 = -0.2$

$w_7 = 12$ $\quad w_8 = 9$ $\quad b_1 = b_2 = -15$

$b_3 = 20$

$$Z_1 = x_1 w_1 + x_2 w_3 + x_3 w_5 + b_1$$

$$Z_1 = 60 \times 0.1 + 80 \times 0.1 + 5 \times 0.1 + -15$$

$$\boxed{Z_1 = -0.5} \Rightarrow g_1(S(Z_1)) = \frac{1}{1+e^{-z}} = \frac{1}{1+e^{0.5}} = \boxed{0.37}$$

$$Z_2 = x_1 w_2 + x_2 w_4 + x_3 w_6 + b_2$$

$$Z_2 = 60 \times 0.15 + 80 \times 0.05 + 5 \times -0.2 - 15$$

$$\boxed{Z_2 = -3}$$

$$g_2(S(Z_2)) = \frac{1}{1+e^{-z}} = \frac{1}{1+e^{3}} = \boxed{0.047}$$

$$yp = g_1 \times w_7 + g_2 \times w_8 + b_3$$

$$yp = 0.377 \times 12 + 0.047 \times 9 + 20$$

$$yp = 24.947$$

$$Cost/Loss = (yp - ya)^2$$

$$Cost = (24.947 - 82)^2$$

$$cost = 3255.044$$

Back Propagation

$$Cost \rightarrow \hat{y}p \rightarrow w_7$$

$$\frac{d\,cost}{d\,w_7} = \frac{d\,cost}{d\,yp} \times \frac{d\,yp}{d\,w_7}$$

$$\frac{d\,cost}{d\,w_7} = 2(yp - ya) \times g_1$$

$$\frac{d\,cost}{d\,w_7} = 2(24.94 - 82) \times 0.377$$

$$\frac{d\,cost}{d\,w_7} = -43$$

$$\frac{d\,cost}{d\,w8} = \frac{d\,cost}{d\,yp} \times \frac{d\,yp}{d\,w8}$$

$$\frac{d\,cost}{d\,w8} = 2(yp - ya) \times g_2$$

$$\frac{d\,cost}{d\,w8} = 2(24.94 - 82) \times 0.047$$

$$\frac{d\,cost}{d\,w8} = -5.36$$

$Cost \rightarrow yp \rightarrow b_3$

$$\frac{d\,cost}{d\,b3} = \frac{d\,cost}{d\,yp} \times \frac{d\,yp}{d\,b3}$$

$$\frac{d\,cost}{d\,b3} = 2(yp - ya) \times 1$$

$$\frac{d\,cost}{d\,b3} = 2(24.94 - 82) \times 1$$

$$\frac{d\,cost}{d\,b3} = -114.12$$

$$\frac{dg_1}{dz_1} = g_1(1-g_1)$$

$$w_7^+ = w_7 - \eta\left(\frac{d\,cost}{dw_7}\right) \qquad b_2^+ = b_2 - \eta\left(\frac{d\,cost}{db_2}\right)$$

$$w_7^+ = 12 - 0.01(-43) \qquad = 21.141$$

$$w_7^+ = 12.43$$

$$w_8^+ = w_8 - \eta\left(\frac{d\,cost}{dw_8}\right)$$

$$w_8^+ \; 9 - 0.01(-5.37$$

$$w_8^+ = 9.05$$

w_1 so

Cost → yp → w7 → g_1 → z_1 → w_1

Since we have updated w7 already

$\frac{d\,Cost}{d}$ Cost → yp → g_1 → z_1 → w_1

$$\frac{d\,cost}{dw_1} = \frac{d\,cost}{dyp} \times \frac{dyp}{dg_1} \times \frac{dg_1}{dz_1} \times \frac{dz_1}{dw_1}$$

$$\frac{d\,cost}{dw_1} = 2(yp - ya) \times w_7 \times g_1(1-g_1) \times x_1$$

$$\frac{d\,cost}{dw_1} = 2(24.94 - 82) \times 12 \times 0.377(1-0.377) \times 60$$

$$\frac{d\,cost}{dw_1} = -19298.50$$

$\underline{\underline{w_2}}$

$cost \rightarrow yp \rightarrow g_2 \rightarrow z_2 \rightarrow w_2$

$$\frac{d\,cost}{dw_2} = \frac{d\,cost}{dyp} \times \frac{dyp}{dg_2} \times \frac{dg_2}{dz_2} \times \frac{dz_2}{dw_2}$$

$$\frac{d\,cost}{dw_2} = 2(yp-ya) \times w8 \times g_2(1-g_2) \times x_1$$

$$= -114.12 \times 9 \times 0.047(1-0.047) \times 60$$

$$\frac{d\,cost}{dw_2} = -2760.236$$

$$\frac{d\,cost}{}$$

w_3 so $cost \rightarrow yp \rightarrow g_1 \rightarrow z_1 \rightarrow w_3$

$$\frac{d\,cost}{dw_3} = \frac{d\,cost}{dyp} \times \frac{dyp}{dg_1} \times \frac{dg_1}{dz_1} \times \frac{dz_1}{dw_3}$$

$$\frac{d\,cost}{dw_3} = 2(y_p - y_a) \times w_7 \times g_1(1-g_1) \times x_2$$

$$\frac{d\,cost}{dw_3} = -114.12 \times 12 \times 0.377(1-0.377) \times 20$$

$$\frac{d\,cost}{dw_3} = -25731$$

$$w_1^+ = w_1 - \eta\left(\frac{d\,cost}{dw_1}\right)$$

$$w_1^+ = 0.1 - 0.01(-19298.50)$$

$$w_1^+ = 193.58$$

$$w_3^+ = w_3 - \eta\left(\frac{d\,cost}{dw_3}\right)$$

$$w_3^+ = 0.1 - 0.01(-25731)$$

$$w_3^+ = 257.41$$

$$\cancel{\frac{d\,cost}{d b_2}} = \frac{d\,cost}{d yp} \times \cancel{\frac{d yp}{d}}$$

w_4 so $Cost \to yp \to g_2 \to z_2 \to w_4$

$$\frac{d\,cost}{d w_4} = \frac{d\,cost}{d yp} \times \frac{d yp}{d g_2} \times \frac{d g_2}{d z_2} \times \frac{d z_2}{d w_4}$$

$$\frac{d\,cost}{d w_4} = 2(yp - ya) \times w_8 \times g_2(1-g_2) \times x_2$$

$$\frac{d\,cost}{d w_4} = -114.12 \times 9 \times 0.047(1-0.047) \times 80$$

$$\frac{d\,cost}{d w_4} = -3680.37$$

$$\frac{d\,cost}{d\,b_2} = \frac{d\,cost}{d\,yp} \times \frac{d\,yp}{d\,g_2} \times \frac{d\,g_2}{d\,z_2} \times \frac{d\,z_2}{d\,b_2}$$

$$\frac{d\,cost}{d\,b_2} = 2(yp - ya) \times w8 \times g_2(1 - g_2) \times 1$$

$$\frac{d\,cost}{d\,b_2} = 2(-114.12) \times 9 \times 0.047(1 - 0.047)$$

$$= -46.00$$

$$b^{2+} = b^2 - \eta\left(\frac{d\,cost}{d\,b_2}\right)$$

$$b^{2+} = -15 - 0.01(-46)$$

$$b^{2+} = -14.54$$

b_1 :- cost → yp → g_1 → z_1 → b_1

$$\frac{d\,cost}{d\,b_1} = \frac{d\,cost}{d\,yp} \times \frac{d\,yp}{d\,g_1} \times \frac{d\,g_1}{d\,z_1} \times \frac{d\,z_1}{d\,b_1}$$

$$= 2(yp - ya) \times w7 \times g_1(1 - g_1) \times 1$$

$$= -321.64 \longrightarrow -17.783$$

Mid exam Question

$\sqrt{\frac{\sum(x-\mu)^2}{n}}$

$x_1 = 1500$

$x_2 = 3$

$x_3 = 2$

$x_4 = 10$

$x_5 = 5$

$y_a = 350,000$

Sqft	Bed	Baths	age	distance	Price
1500	3	2	10	5	350,000
0.23	0.33	0.5	0.44	0.333	350,000

min - max Normalization:

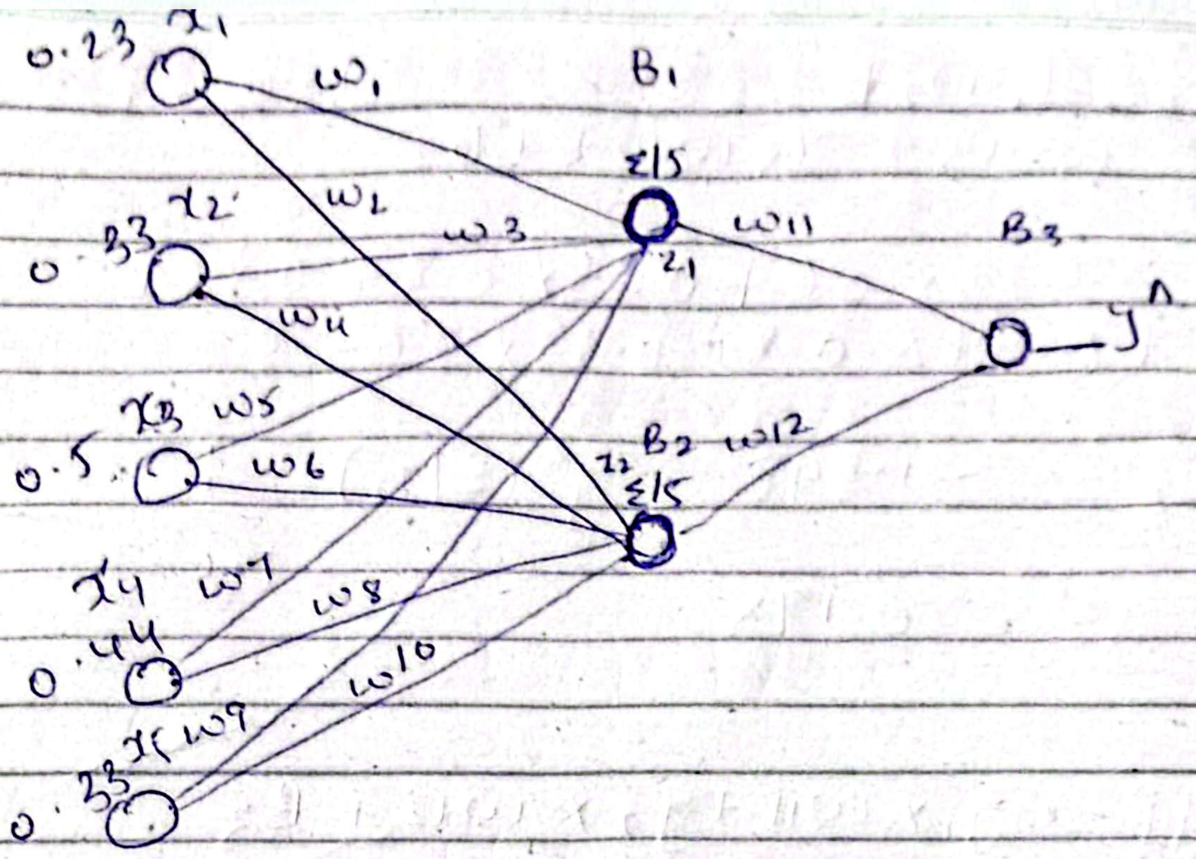
$$\frac{x - x_{min}}{x_{max} - x_{min}} = \cancel{1200}$$

$$\frac{1500 - 1200}{2500 - 1200} = \frac{300}{1300} \quad 0.23$$

(2) Z Score Normalization: $Z = \frac{x - \mu}{\sigma}$

$$\text{Means} = \frac{1500 + 1700 + 1200 + 2500 + 1400}{5}$$

$$S.D = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$$



$w_1 = 0.5$ $\quad$ $w6 = 1$

$w_2 = 0.6$ $\quad$ $w7 = 0.9$

$w_3 = 0.7$ $\quad$ $w8 = 0.8$

$w4 = 0.8$ $\quad$ $w9 = 0.7$

$w5 = 0.9$ $\quad$ $w10 = 0.6$

$w11 = 0.5$ $\quad$ $w12 = 0.7$

$B_1 = + 2$ $\quad$ $B_2 = -3$

$B_3 = +5$

$$Z_1 = x_1 w_1 + x_2 w3 + x_3 w5 + x_4 w7 + x_5 w9 + B_1$$

$$Z_1 = 0.23 \times 0.5 + 0.33 \times 0.7 + 0.5 \times 0.9 + 0.44 \times 0.9 + 0.33 \times 0.7 + 2$$

$$Z_1 = 3.423$$

$$g_1(\Sigma|Z_1) = \frac{1}{1+e^{-z}}$$

$$\boxed{0.968}$$

$Z_2 = x_1 \cdot w_2 + x_2 \cdot w_4 + x_3 \cdot w_6 + x_4 \cdot w_8 + x_5 w_{10} + + b_2$

$Z_2 = 0.23 \times 0.6 + 0.33 \times 0.8 + 0.5 \times 1 + 0.44 \times 0.8 + 0.33 \times 0.6 - 3$

$Z_2 = -1.548$ $\quad g^2(\varepsilon | z_2) = \frac{1}{1+e^{-z}}$

$g_2 = 0.175$

$yp = g_1 \times w_{11} + g_2 \times w_{12} + B_3$

$yp = 0.968 \times 0.5 + 0.175 \times 0.7 + 5$

1) $\boxed{yp = 5.606}$

$ya = 350{,}000$

$ya \longrightarrow$ Normalized $= \frac{350{,}000 - 250000}{600000 - 250000}$

$ya = 0.28$

$LOSS = (yp - ya)^2$

$LOSS = (5.60 - 0.28)^2$

$\boxed{LOSS = 28.30}$

$\eta = 0.01$

Back Propagation 3D

Loss → yp → w_{11}

$$\frac{d\,loss}{d\,w_{11}} = \frac{d\,loss}{d\,yp} \times \frac{d\,yp}{d\,w_{11}}$$

$$\frac{d\,loss}{d\,w_{11}} = 2(yp - ya) \times g_1$$

$$\frac{d\,loss}{d\,w_{11}} = 2(5.60 - 0.28) \times 0.968$$

$$\frac{d\,loss}{d\,w_{11}} = 10.299$$

$$w_{11}^{+} = w_{11} - \eta\left(\frac{d\,loss}{d\,w_{11}}\right)$$

$$w_{11}^{+} = 0.5 - 0.01(10.299)$$

$$\boxed{w_{11}^{+} = 0.397}$$