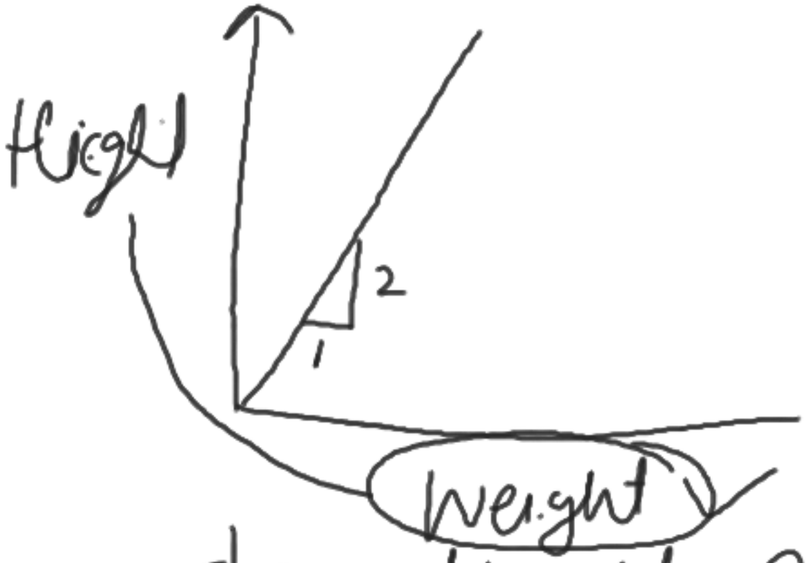
Chain Rule:



$$\text{slope} = \frac{d\,\text{height}}{d\,\text{weight}} = \frac{2}{1} = 2$$

20 → height

$H = 2 \times W$

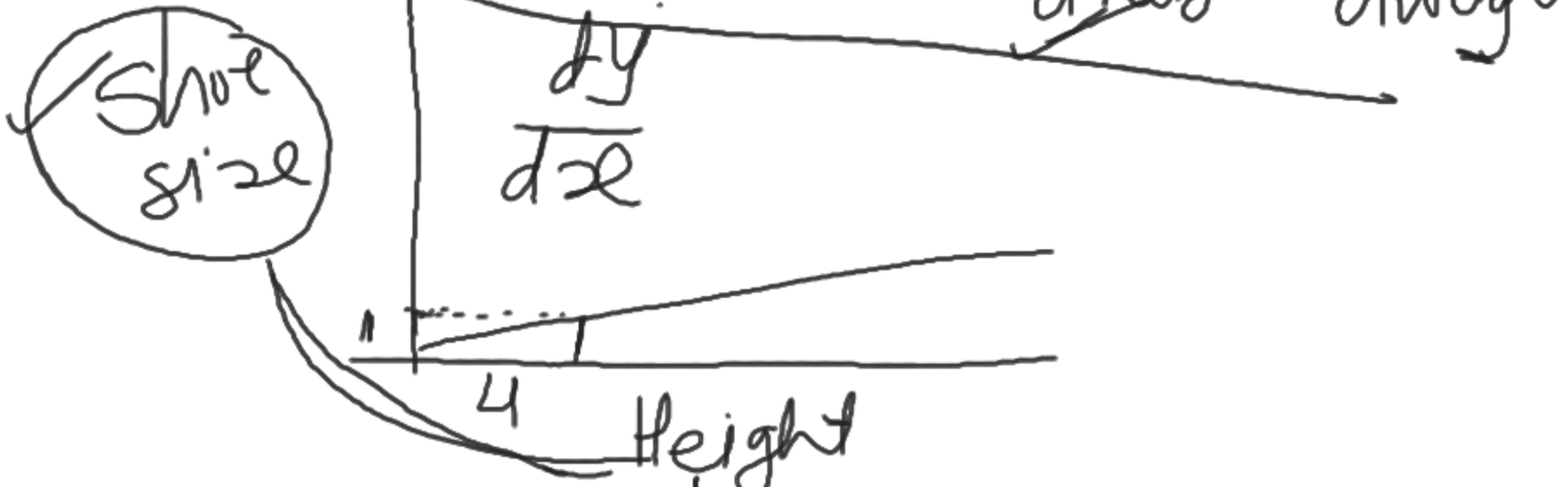
$20 = 2 \times W$

$10 = W$

$W = 40$

$H = \text{slop} \times W$

$= 2 \times 40 = 80$



$$\frac{-d\,\text{shoesize}}{d\,\text{weight}} = \frac{-d\,\text{shoesize}}{d\,\text{height}} \times \frac{d\,\text{height}}{d\,\text{weight}}$$

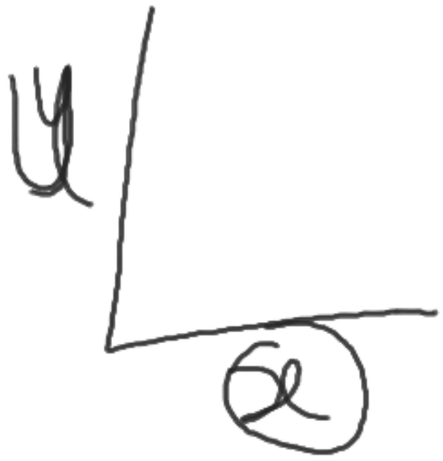
$$\frac{dy}{dx}$$

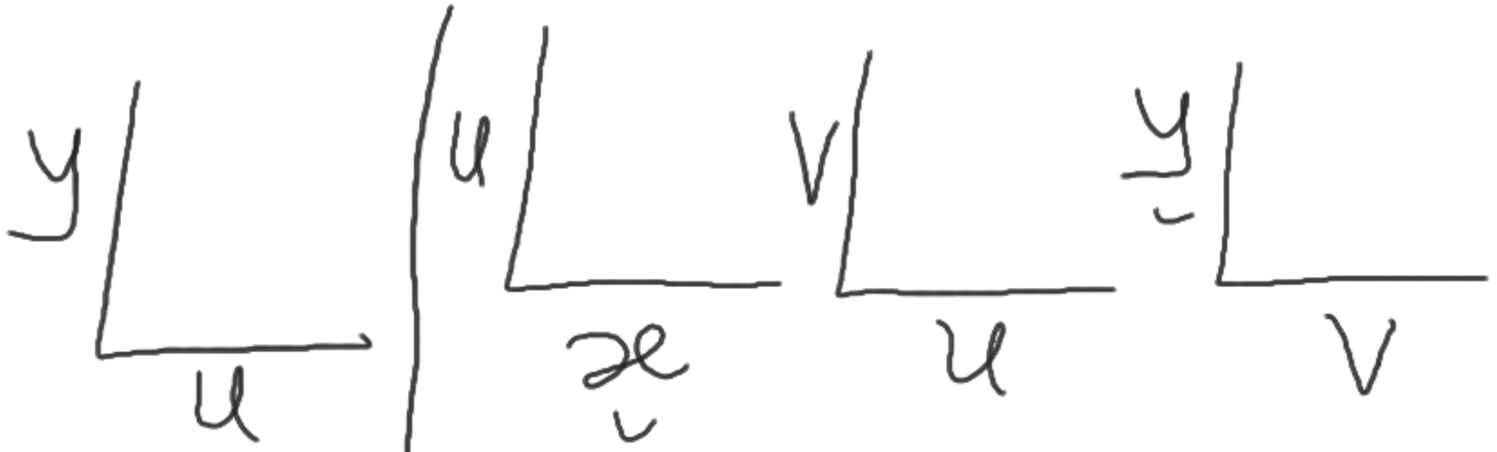
$$\text{slope} = \frac{d\,\text{shoesize}}{d\,\text{height}} = \frac{1}{4}$$

Heil = 120

$\text{shoe} = \text{slope} \times 120 =$

$= 1/4 \times 120 = 30$



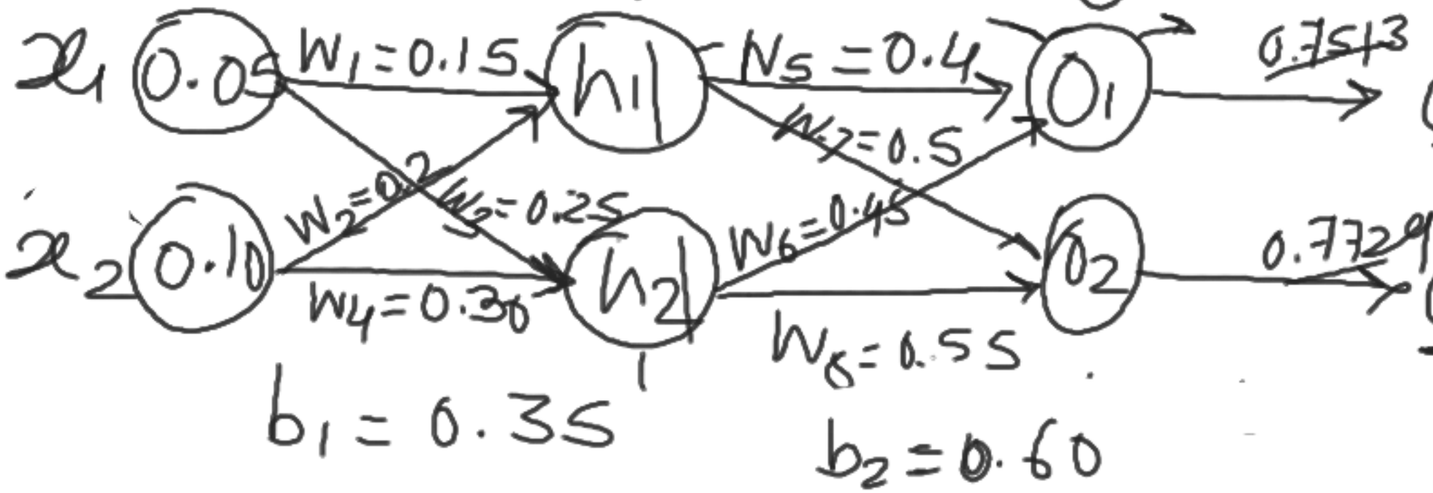


$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{dy}{dv} \frac{dv}{du} \frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{dy}{dv} \frac{dx}{du} \frac{dy}{dz} \frac{dz}{dx}$$

Forward Propogation



$b_1 = 0.35$ $\quad b_2 = 0.60$

$h_1(in) = W_1 x_1 + W_2 x_2 + b_1$

$= 0.15 \times 0.05 + 0.2 \times 0.1 + 0.35$

$h_1(in) = 0.377$

$h_2(in) = W_3 x_1 + W_4 x_2 + b_1$

$= 0.25 \times 0.05 + 0.30 \times 0.1 + 0.35$

$= 0.3925$

$O_1(in) = W_5 \times h_1(out) + W_7 \times h_2(out) + b_2$

$= 0.4 \times 0.5932 + 0.45(0.596) + 0.6$

$O_1(in) = 1.105$

$O_1(out) = \frac{1}{1+e^{-O_1(in)}} = 0.7513$

$O_2(in) = W_7 h_1(out) + W_8 (h_2(out)) + b_2$

$O_2(out) = \frac{1}{1+e^{-O_2(in)}} = 0.7729$

$h_1(out) = \frac{1}{1+e^{-h_1(in)}} \quad \frac{1}{1+e^{0.377}} = 0.593$

Sigmoid

$h_2(out) = \frac{1}{1+e^{h_2(in)}} \quad \frac{1}{1+e^{0.392}} = 0.596$

$E_{Total} = \sum \frac{1}{2}(Actual - Pred)^2$

$E_{O_1} = \frac{1}{2}(0.01 - 0.7513)^2 = 0.27$

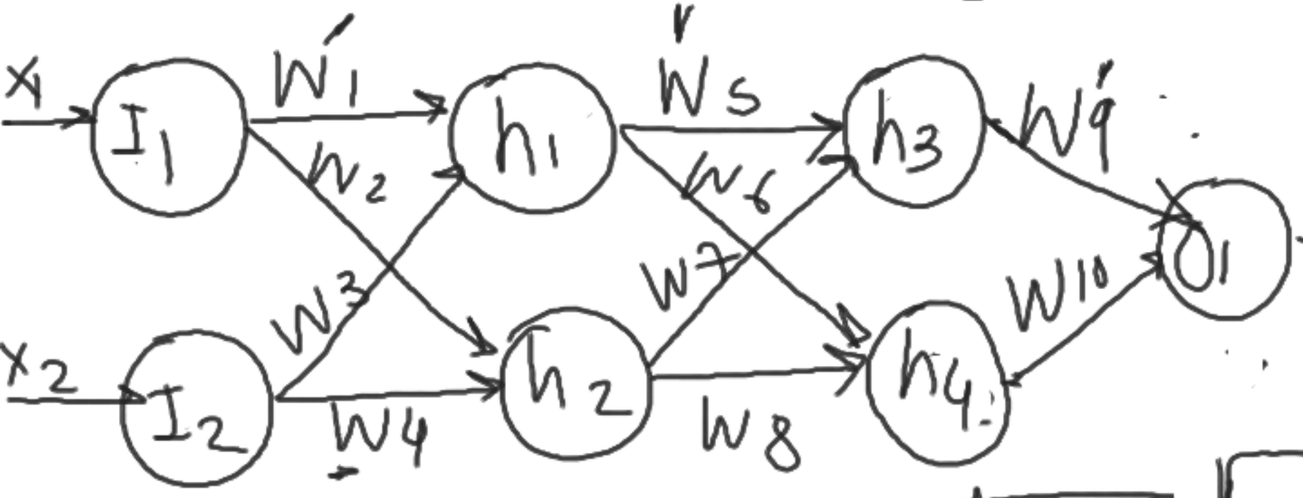
$E_{O_2} = \frac{1}{2}(0.99 - 0.7729)^2 = 0.23$

$E_{Total} = E_{O_1} + E_{O_2}$

$E_{total} = 0.50$ ✓

Backword Propogation

Blame share by weight in error



$$O_1 = \hat{y} \quad \text{Loss} = (y - \hat{y})^2$$

$$W_{g_{new}} = W_{g_{old}} - \eta \frac{dL}{dW_g}$$

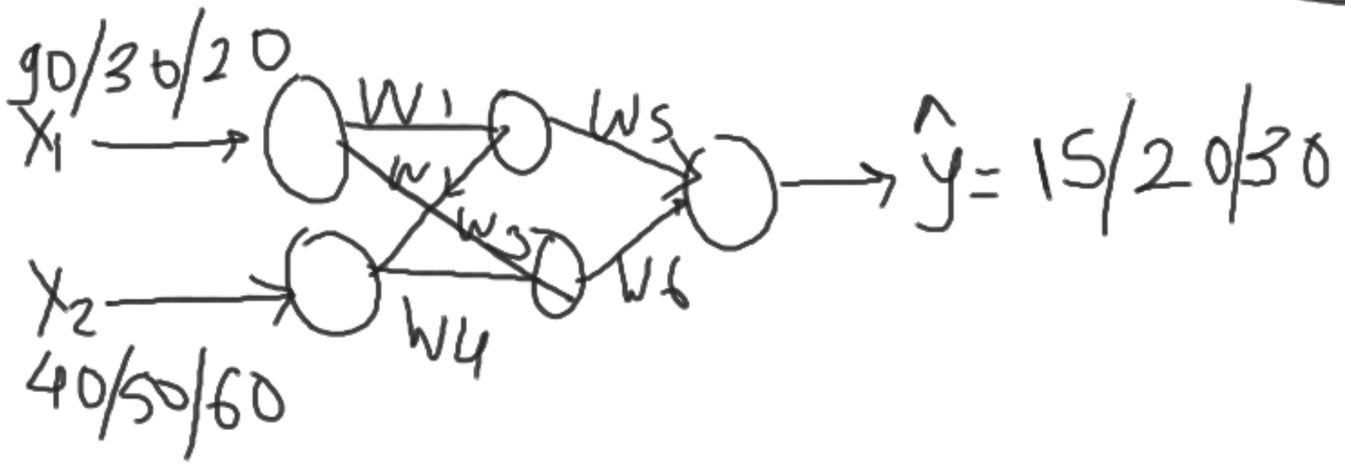
$$W_{5_{new}} = W_{5_{old}} - \eta \frac{dL}{dW_5}$$

$$\frac{dL}{dW_g} = \frac{dL}{dO_1} \times \frac{dO_1}{dW_g}$$

$$\frac{dL}{dW_5} = \frac{dL}{dO_1} \times \frac{dO_1}{dW_g} \frac{dW_g}{dW_5}$$

Is Backpropogation Done After every forward propogation ?

X_1	X_2	y
90	40	10
30	50	25
20	60	36



X_1	X_2	Y
90	40	10
30	50	25
20	60	36

Random weight (1)

1) $X_1 = 90$, $X_2 = 40$ → $\hat{y} = 20$ | $E_1 = 10$

2) $X_1 = 30$, $X_2 = 50$ → $\hat{y} = 30$ | $E_2 = 5$

3) $X_1 = 20$, $X_2 = 60$ → $\hat{y} = 40$ | $E_3 = 4$

Total error = $E_1 + E_2 + E_3$

New weight ⇐ Backpropogation ⇒

New weight (2)

1) $X_1 = 90$, $X_2 = 40$ → $\hat{y} = 15$ | $E_1 = 5$

2) $X_1 = 30$, $X_2 = 5$ → $\hat{y} = 22$ | $E_2 = 3$

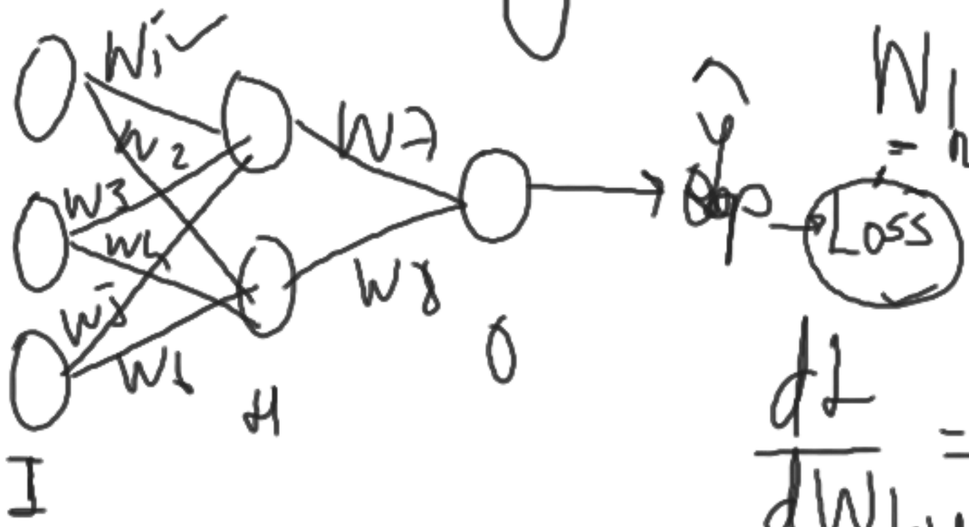
3) $X_1 = 20$, $X_2 = 60$ → $\hat{y} = 36$ | $E_3 = 0$

(3) (4)

Epoch

Backpropogation ⇒ New weight

Vanishing Gradient ⇒



$$W_{1\,new} = W_{1\,old} - \eta \frac{dL}{dW_{1\,old}} = W_{1\,old} - 1 \times 0.001 =$$

$W_{1\,new} \approx W_{1\,old}$

$$\frac{dL}{dW_{1\,old}} = \frac{dL}{d\hat{y}_i} \times \frac{d\hat{y}}{\partial W_7} \times \frac{\partial W_7}{\partial W_{1\,old}}$$

Assume = Activation Function = Sigmoid

$$\frac{dL}{dW_{1\,old}} = 0.20 \times 0.10 \times 0.05 = 0.001$$

NumRange = 0 to 1

derr Range = 0 to 0.25

5 hidden =

$0.25 \times 0.25 \times 0.25 \times 0.25 \times 0.25 =$

1 hidd

$1 \times 0.25 =$