5) Linear Regression using Gradient Descent

- **Predicted Function** -

$$h_\theta(x^{(i)}) = \theta_0 + \theta_1 x_1^{(i)} + \theta_2 x_2^{(i)} + \theta_3 x_3^{(i)} + \theta_4 x_4^{(i)} + \theta_5 x_5^{(i)}$$

- **Cost Function - Mean Squared Error**

$$J(\theta_0, \theta_1, \ldots, \theta_5) = \frac{1}{m} \sum_{i=1}^{m} (h_\theta(x^{(i)}) - y^{(i)})^2$$

→ **Objective** - $\min_{\theta_i} J(\theta_i) \quad \forall\, i \in \{0,5\}$

- **Partial Derivatives of cost fn 'J' w.r.t different θ_i $\forall i \in \{0,5\}$** -

1.) $$\frac{\partial}{\partial \theta_0} J(\theta_0) = \frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\}$$

2.) $$\frac{\partial}{\partial \theta_1} J(\theta_1) = \frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\} \cdot x_1^{(i)}$$

3.) $$\frac{\partial}{\partial \theta_2} J(\theta_2) = \frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\} \cdot x_2^{(i)}$$

4.) $$\frac{\partial}{\partial \theta_3} J(\theta_3) = \frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\} \cdot x_3^{(i)}$$

5.) $$\frac{\partial}{\partial \theta_4} J(\theta_4) = \frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\} \cdot x_4^{(i)}$$

6.) $$\frac{\partial}{\partial \theta_5} J(\theta_5) = \frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\} \cdot x_5^{(i)}$$

- **Simultaneous update** -

1.) $$temp0 := \theta_0 - \alpha \frac{\partial}{\partial \theta_0} J(\theta_0, \theta_1, \ldots, \theta_5)$$

$$\Rightarrow temp0 := \theta_0 - \alpha \left[\frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\}\right]$$

2.) $$temp1 := \theta_1 - \alpha \frac{\partial}{\partial \theta_1} J(\theta_0, \theta_1, \ldots, \theta_5)$$

$$temp1 := \theta_1 - \alpha \left[\frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\} \cdot x_1^{(i)}\right]$$

3.) $$temp2 := \theta_2 - \alpha \frac{\partial}{\partial \theta_2} J(\theta_0, \theta_1, \ldots, \theta_5)$$

$$temp2 := \theta_2 - \alpha \left[\frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\} \cdot x_2^{(i)}\right]$$

4.) $$temp3 := \theta_3 - \alpha \left[\frac{2}{m} \sum_{i=1}^{m} \{h_\theta(x^{(i)}) - y^{(i)}\} \cdot x_3^{(i)}\right]$$