$\Longrightarrow$ Linear Regression using Gradient Descent

<u>linear regression</u> :

$h(x) = \theta_0 + \theta_1 x_i$

$= \frac{1}{m} \sum_{i=1}^{m} \left(h(x_i) - y_i \right)$ MSE (Mean squared error)

<u>Input function:</u>

$J(\theta_0, \theta_1) = \frac{1}{m} \left(\sum_{i=1}^{m} \left(h(x_i) - y_i \right)^2 \right.$ // MSE

intercept slope

$J(\theta_0, \theta_1) = \frac{1}{m} \sum_{i=1}^{m} \left(\left(\theta_0 + \theta_1 \boxed{x_i} \right) - \boxed{y_i} \right)^2$

<u>Goal</u> :

$\min_{\theta_0, \theta_1} J(\theta_0, \theta_1)$

<u>loop until precision</u> (0.000001)

$\theta_0 = \theta_0 - \alpha \frac{\partial}{\partial \theta_0} \left[J(\theta_0, \theta_1) \right]$

$\theta_1 = \theta_1 - \alpha \frac{\partial}{\partial \theta_1} \left[J(\theta_0, \theta_1) \right]$

Scanned with CamScanner

$$\theta_0 = \frac{\partial}{\partial \theta_0}\left[\frac{1}{m}\sum_{i=1}^{m}\left((\theta_0+\theta_1 x_i)-y_i\right)^2\right]$$

$$\theta_0 = \frac{2}{m}\sum(\theta_0+\theta_1 x_i)-y_i\left[\frac{\partial}{\partial \theta_0}(\theta_0+\theta_1 x_i-y_i)\right]$$

$$\boxed{\theta_0} = \frac{1}{m}\sum(\theta_0+\theta_1 x_i)-y_i$$

$$\theta_1 = \frac{\partial}{\partial \theta_1}\left[\frac{1}{m}\sum_{i=1}^{m}\left((\theta_0+\theta_1 x_i)-y_i\right)^2\right]$$

$$\theta_1 = \frac{2}{m}\sum(\theta_0+\theta_1 x_i)-y_i\left[\frac{\partial}{\partial \theta_1}(\theta_0+\theta_1 x_i-y_i)\right]$$

$$\boxed{\theta_1} = \frac{1}{m}\sum(\theta_0+\theta_1 x_i-y_i)(x_i) \Rightarrow \frac{1}{m}\sum\left(\theta_0 x_i+\theta_1 x_i^2-y_i x_i\right)$$

Logistic Regression

- → Classification
- → Binary classes
  - 0/1
  - M/F
  - Spam/Not spam
- → Multiple classes
  - 0/1/2/3
  - M/F/S

Class Models:

$\hat{y} = h_{\theta_1 \theta_2}(x)$ — input vector

values

value/continuous/Mapping/Classes

- $\leq 0.5 \rightarrow$ class 1
- $> 0.5 \rightarrow$ class 2

$$y = \frac{e^{\wedge(b_0 + b_1 x)}}{1 + e^{\wedge(b_0 + b_1 x)}}$$

- e:g $b_0 = -100$, $b_1 = 0.6$, $P(M/H) = 150$

$$y = \frac{e^{-100 + 0.6(150)}}{1 + e^{-100 + 0.6(150}}$$

$$y = 0.000045$$

- e:g $b_0 = -50$, $b_1 = 0.5$, $P(H/T) = 250$

$$y = \frac{e^{-50 + 0.5(250)}}{1 + e^{-50 + 0.5(250)}}$$

$$y = 1$$