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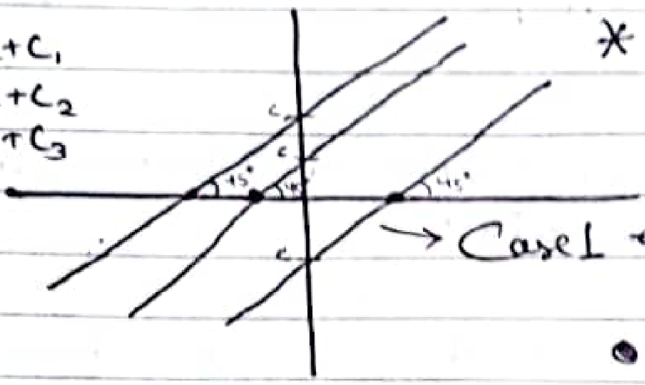
~~Hyperplane~~

$\Pi_d : w^T x + w_0 = 0$ ⇒ Hyperplane

d-dimension

* Significance of m & c *

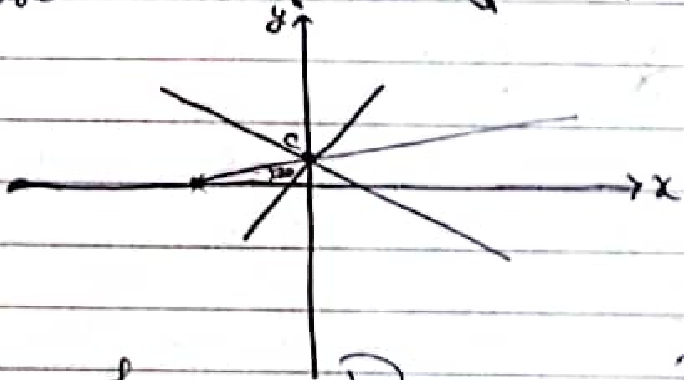
$y = mx + c_1$
$y = mx + c_2$
$y = mx + c_3$



→ Case 1 • Slop (m) is same
• Intercept (c) is different

Case 2 • Slop is different, intercept same

⇒ $y = m_1 x + c$
$y = m_2 x + c$
$y = m_3 x + c$



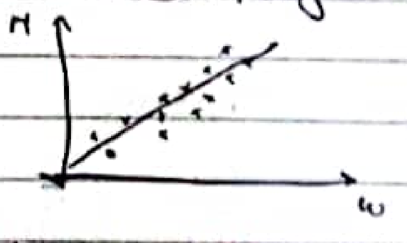
* Linear Regression Algorithm *

Supervised, Regression technique

$D_n = \{(x_i, y_i)\}_{i=1}^{n} \mid x_i \in \mathbb{R}^d, y_i \in \mathbb{R}$

Data (x_i, y_i) → Linear Reg → f → line (m, c)

$y = mx + c$
height = m * weight + c



weight → f(m,c) ⇒ → Height

Height = m × weight + c

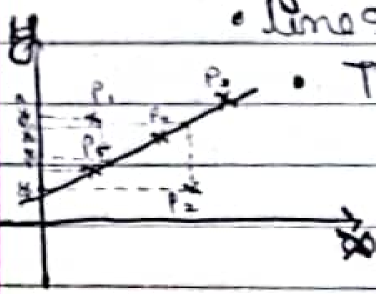
Here 2 variable, height & weight
i.e. called Simple linear regression

* Simple linear Regression *

$$D_n = \{ (x_i, y_i)_{i=1}^{n} \mid x_i \in \mathbb{R}^1, \ y_i \in \mathbb{R} \}$$

Task → to get m & C

- To find a line that passes through the given data.
- Line should be best fit all the dataset
- That line will be known as predictor



for $P_1 \rightarrow \overset{\text{error}}{e_1} = y_1 - \hat{y}_1$

$P_2 \rightarrow e_2 = y_2 - \hat{y}_2$

$P_3 \rightarrow e_3 = 0, \ e_4 = 0, \ e_5 = 0$

total error $= e_1 + e_2 + e_3 + e_4 + e_5$

$= y_1 - \hat{y}_1 + y_2 - y_2 + 0 + 0 + 0$

∵ +ve & -ve error can cancel out each other and give wrong result so lets square them

∴ Total error $= (y_1 - \hat{y}_1)^2 + (y_2 - \hat{y}_2)^2 + 0^2 + 0^2 + 0^2$

$$\boxed{\text{Total error} = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2}$$

Note :- line with least total error is the best predictor

* Optimization Theory

$$m^*, c^* = \underset{(m,c)}{\arg\min} \left\{ \sum_{i=1}^{n} (y_i - \hat{y}_i)^2 \right\} \quad \because \hat{y}_i = mx_i + c$$

$$m^*, c^* = \underset{(m,c)}{\arg\min} \left\{ \sum_{i=1}^{n} (y_i - (mx_i + c))^2 \right\}$$

Its, Ordinary Least Square