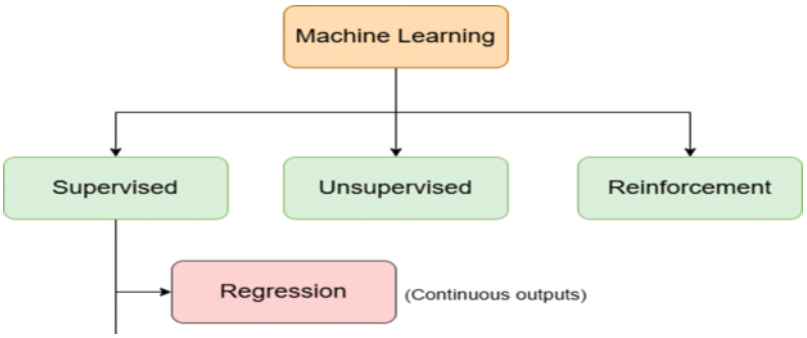
Simple Linear Regression

18 June 2025 18:49

◇ What is Regression?

Regression is a type of **supervised learning** used to **predict continuous values**. It maps input features to a real-valued output.



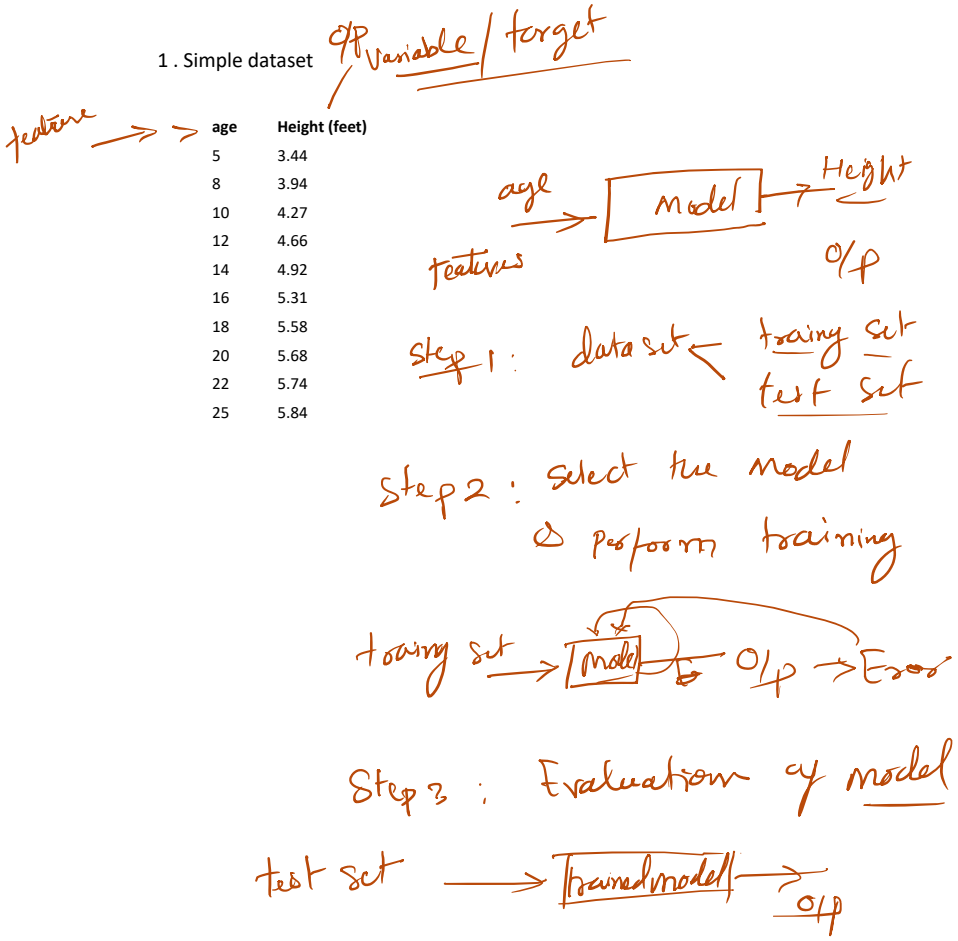
Example: Predicting house prices, stock prices, or temperature.

📌 Types of Regression

1. **Linear Regression**
2. **Multiple Regression**
3. **Polynomial Regression**
4. **Ridge and Lasso Regression**

1 . Simple dataset

age	Height (feet)
5	3.44
8	3.94
10	4.27
12	4.66
14	4.92
16	5.31
18	5.58
20	5.68
22	5.74
25	5.84



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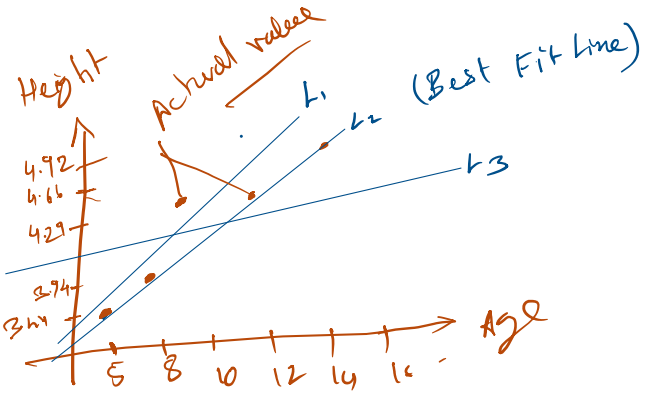


dependent → Independent variable

$y = mx + c$

slope, Intercept

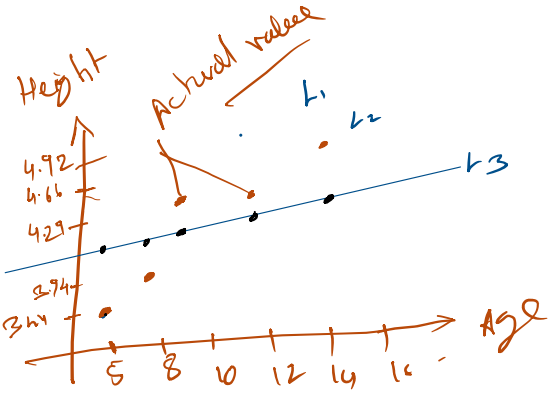
Best fit

$H(\theta) = \theta_0 + \theta_1 x$

$m \to \theta_1$

$\theta = c$

$m = 1, c = 0$

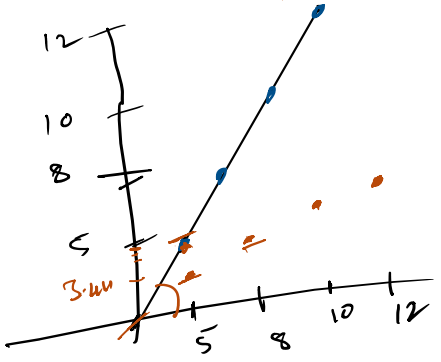


$y = mx + c$

$\hat{y} = 1 \times x + 0$

$\hat{y} = 1 \times 5 + 0$

$\hat{y} = 5$



$\hat{y} = 1 \times 8 + 0$

$\hat{y} = 8$

Error = |Actual − Predicted|

$= |y - \hat{y}|$

$= |\text{Height} - \hat{y}|$

$(5, 3.44) = |3.44 - 5|$

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$= |-1.561| = 1.56$

$(8, 3.94) = (|3.94 - 8|)$

$= 4.06$

$(10, 4.27) = |4.27 - 10| =$

MAE = Error = $\frac{1}{n} \sum_{i=1}^{n} |(y_i - \hat{y}_i)|$

Error = $\frac{1.56 + 4.06 + 5.73 + \cdots}{10}$

MSE = $\frac{1}{2n} \sum_{i=1}^{n} (y - \hat{y})^2$

Gradient Decent $\frac{\partial E}{\partial m}, \frac{\partial E}{\partial c}$

repeat until converge { (learning rate / step)

$m = m - \alpha \frac{dE}{\partial m}$

$E = C - \alpha \frac{dE}{\partial c}$

}

magnitute and direction

$E = |y - \hat{y}|$

$$E = |y - \hat{y}|$$

$$\frac{\partial E}{\partial m} = (mx + c) - \hat{y}$$

$$= x + 0 - 0$$

$$\frac{\partial E}{\partial m} = x$$

$$\frac{\partial E}{\partial c} = |y - \hat{y}|$$

$$= (mx + c) - \hat{y}$$

$$\frac{\partial E}{\partial c} = 1$$

$$m = m - \alpha \frac{\partial E}{\partial m}$$

Let $m = 1$, $\alpha = 0.1$

$x = 5$

$$m = 1 - 0.1 \times 5$$

$$m = 1 - 0.5 = 0.5$$

$$c = c - \alpha \times \frac{\partial E}{\partial c}$$

Let $c = 0$

$$c = 0 - 0.1 \times 1$$

$$c = -0.1$$

$$\hat{y} = mx + c$$

$\hat{y} = mx + c$

$= 0.5x + (-0.1)$

$y = 0.5x - 0.1$

$x = 5, y = 3.44$

$\hat{y} = 0.5 \times 5 - 0.1$

$\hat{y} = 2.5 - 0.1 = 2.41$

$F = |3.44 - 2.41| = 1.03$

SS_{res} Residual $(y - \hat{y})$

y	$\hat{y}$
1	1.1
2	2.0
3	3.9
4	4.1
5	4.5

$(y - \hat{y})$

$(1 - 1.1)^2 + (2 - 2)^2 + (3 - 3.9)^2 + (4 - 4.1)^2 + (5 - 4.5)^2$

SS_{res}

$SS_{Total} = (y - \bar{y})$

$\bar{y} = \frac{1+2+3+4+5}{5} =$