

# Linear Regression (Least Square Error)

$$\mathbf{w} = (\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{y}$$

## Linear Regression with Polynomial Result

$$\mathbf{w} = \begin{bmatrix} c \\ b \\ a \end{bmatrix}$$

$$\mathbf{X} = \begin{bmatrix} 1 & x_1 & x_1^2 \\ 1 & x_2 & x_2^2 \\ \cdots & \cdots & \cdots \\ 1 & x_n & x_n^2 \end{bmatrix}$$

$$\mathbf{y} = \begin{bmatrix} y_1 \\ y_2 \\ \cdots \\ y_p \end{bmatrix}$$

$$\mathbf{w} = (\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{y}$$

## Example 1

$$\mathbf{d}_1 = \begin{bmatrix} 1 \\ 5 \end{bmatrix}$$

$$\mathbf{d}_2 = \begin{bmatrix} 2 \\ 4 \end{bmatrix}$$

$$\mathbf{d}_3 = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$

$$\mathbf{d}_4 = \begin{bmatrix} 5 \\ 2 \end{bmatrix}$$

## Fit a Line

$$X = \begin{bmatrix} 1 & 1 \\ 1 & 2 \\ 1 & 2 \\ 1 & 5 \end{bmatrix}$$

$$\vec{y} = \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \end{bmatrix}$$

$$\vec{w} = \begin{bmatrix} c \\ m \end{bmatrix}$$

## Fit a Polynomial of degree 2

$$X = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 4 \\ 1 & 2 & 4 \\ 1 & 5 & 25 \end{bmatrix}$$

$$\vec{y} = \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \end{bmatrix}$$

$$\vec{w} = \begin{bmatrix} c \\ b \\ a \end{bmatrix}$$