

# Supervised Learning

$$\mathcal{X} = \{ (x_i, y_i) \}_{i=1}^N \quad \text{training set}$$

Task: predicting whether a car is a family car or not.

$$x_i = \begin{bmatrix} x_{i1} \\ x_{i2} \end{bmatrix}_{2 \times 1} \rightarrow \begin{array}{l} \text{price [10000\$ - 100000\$]} \\ \text{engine power [1500 - 4000 cc]} \end{array}$$

$$y_i = \begin{cases} +1 & \text{if } x_i \text{ is a family car} \\ -1 & \text{otherwise} \end{cases}$$

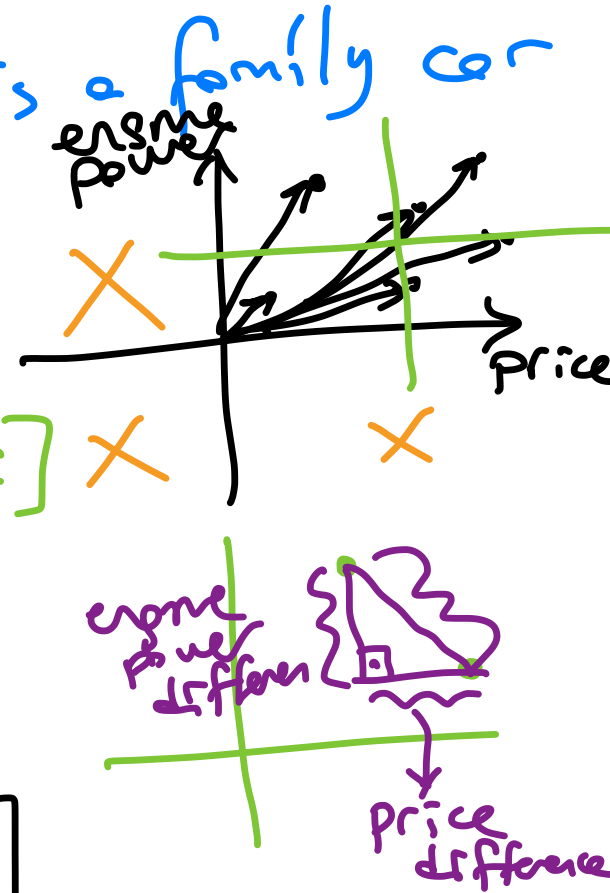
data matrix

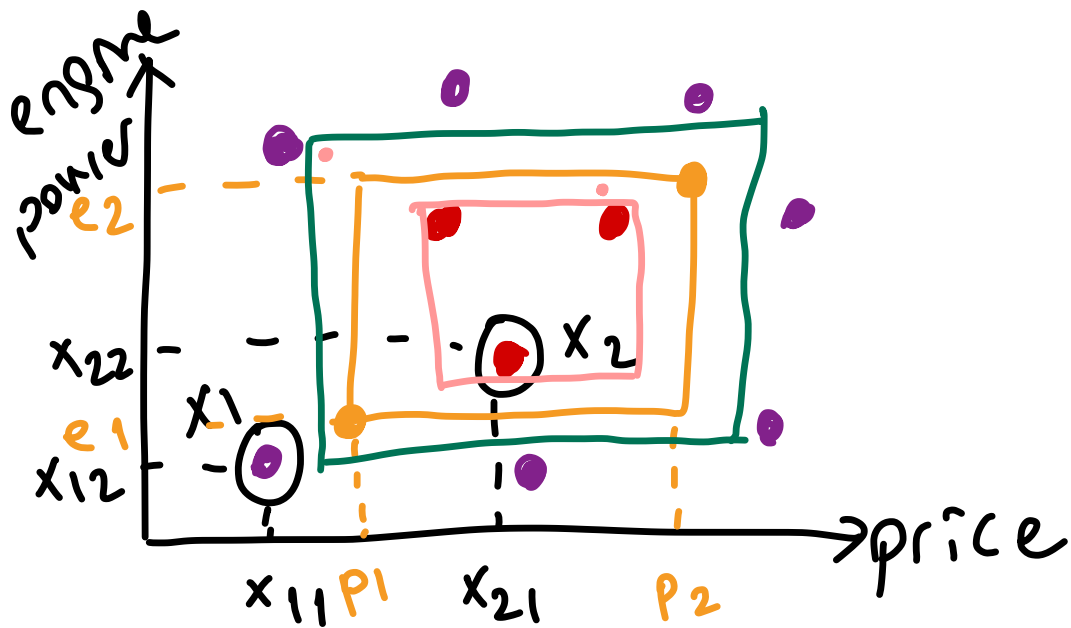
$$X = \begin{bmatrix} \boxed{x_{11} \quad x_{12}} \\ \boxed{x_{21} \quad x_{22}} \\ \vdots \\ \boxed{x_{N1} \quad x_{N2}} \end{bmatrix} \quad \begin{array}{l} \text{1st car} \\ \text{2nd car} \\ \vdots \\ \text{Nth car} \end{array}$$

$N \times 2$

label vector

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix}_{N \times 1}$$





- family car
- other type of car

$$x_1 = \begin{bmatrix} x_{11} \\ x_{12} \end{bmatrix} \quad y_1 = 0$$

$$x_2 = \begin{bmatrix} x_{21} \\ x_{22} \end{bmatrix} \quad y_2 = 1$$

Model family

FAMILY OF RECTANGLES

if  $p_1^* \leq x_{N+1,1} \leq p_2^* \text{ \& } e_1^* \leq x_{N+1,2} \leq e_2^*$   
 $\hat{y}_{N+1} = 1$

model parameters

LEARNING  $\Rightarrow$  finding the best  $\theta$

else  $\hat{y}_{N+1} = 0$

$$\theta^* = \{p_1^*, p_2^*, e_1^*, e_2^*\}$$

$$f(x_{N+1} | p_1^*, p_2^*, e_1^*, e_2^*) = \hat{y}_{N+1}$$