Machine Learning

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https://github.com/safayani/machine_learning_course

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Supervised Learning

- Regression

- Classification

example

Notation:

m: number of training samples

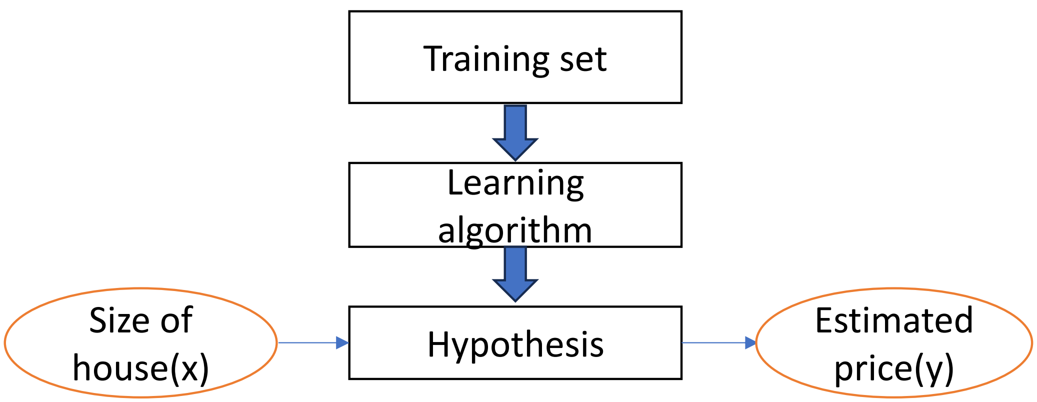
x: input variable

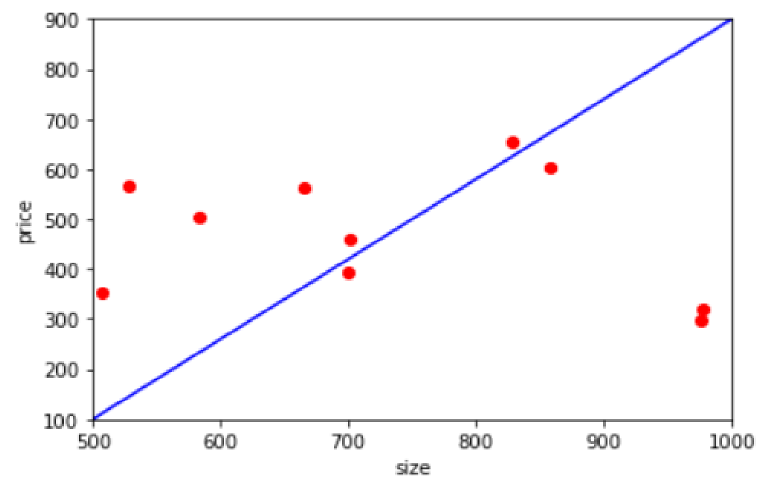
y: output variable
Or
target variable

(x_i, y_i): i th training sample

number	Size (x variable)	Price (y variable)	
1	100	500	(x_1, y_1)
2	750	2000	(x_2, y_2)
3	852	178	(x_3, y_3)
	…	…	
m	3210	870	(x_m, y_m)

example



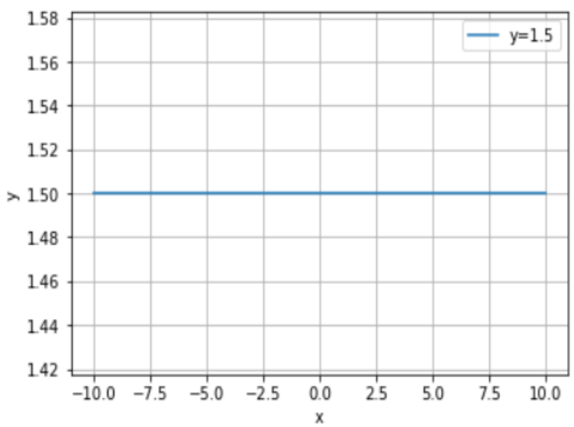


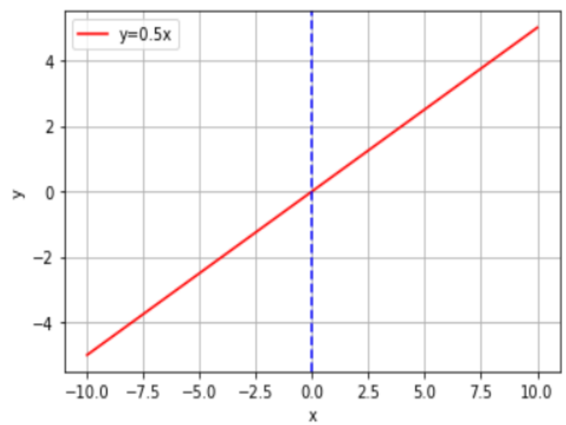
$$h(x) = \theta_0 + \theta_1 x$$

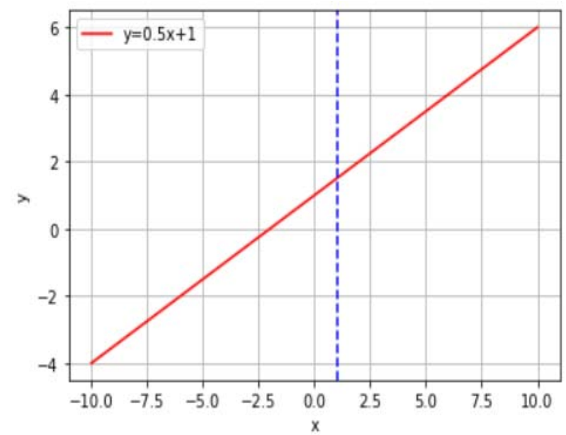
parameters= $\{ \theta_0 , \theta_1 \}$

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

parameters=







$h(x) = 1.5$

$\theta_0 = 1.5$
$\theta_1 = 0$

$h(x) = 0.5x$

$\theta_0 = 0$
$\theta_1 = 0.5$

$h(x)=0.5x+1$

$\theta_0 = 1$
$\theta_1 = 0.5$

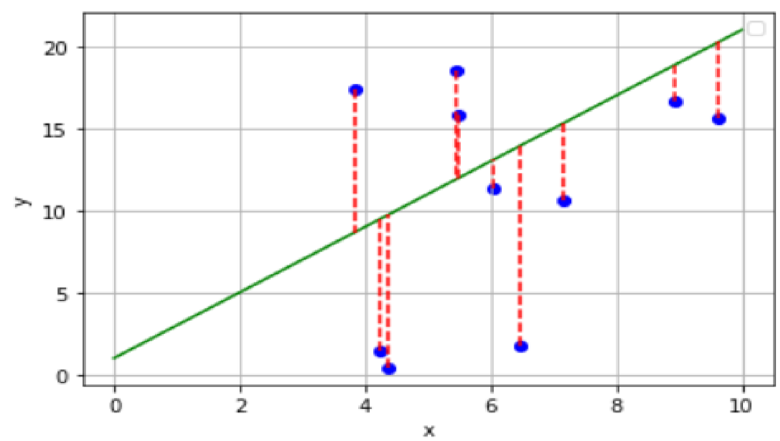
Cost Function

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

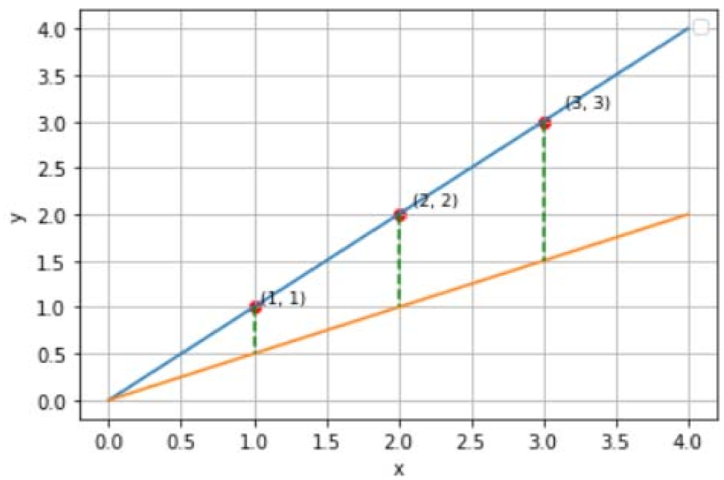
Mean square error(MSE)

Minimize $\boldsymbol{J(\theta_0 , \theta_1)}$

$\boldsymbol{\theta_0 , \theta_1}$



example



$$J(\theta_0{=}0\ ,\ \theta_1{=}0.5\ ) = \frac{1}{2m}\sum_{i=1}^{m}(0.5x_i - y_i)^2$$

$$= \frac{1}{2*3}\ [(0.5-1)^2 + (1-2)^2 + (1.5-3)^2]$$

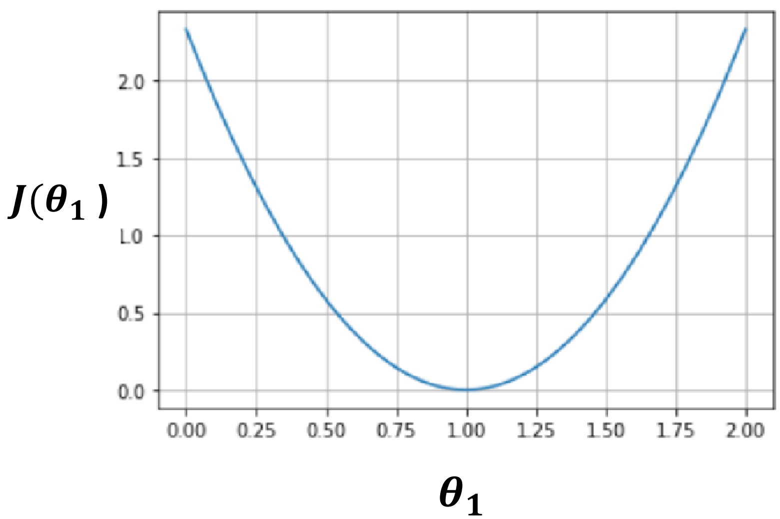
$$= \frac{1}{6}\,(3.5) = 0.58$$

$$J(\theta_0{=}0\ ,\ \theta_1{=}1\ ) = \frac{1}{2m}\sum_{i=1}^{m}(x_i - y_i)^2$$

$$= \frac{1}{2*3}\ [(1-1)^2 + (2-2)^2 + (3-3)^2]$$

$$= \frac{1}{6}\,(0) = 0$$

example



θ_1	$J(\theta_1)$
0	14/6
0.5	0.58
1	0
1.5	0.58
2	14/6

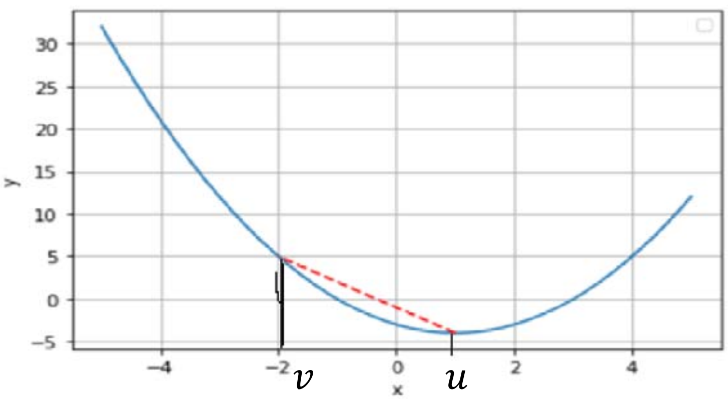
- Plotting the cost for each value of θ_1
- The minimum point: θ_1=1
- Using Grid Search to find best values of parameters

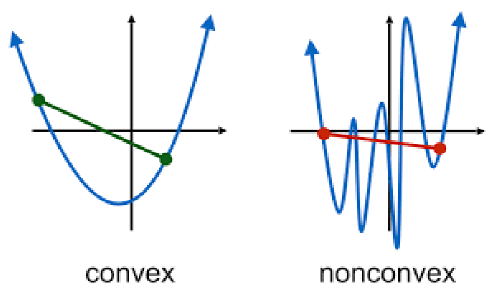
Cost Function

- $J(\theta_0 , \theta_1) = \frac{1}{m} \sum_{i=1}^{m} |h(x_i) - y_i|$ Mean absolute error(MAE)

- Better for outliers compared with MSE

Convexity

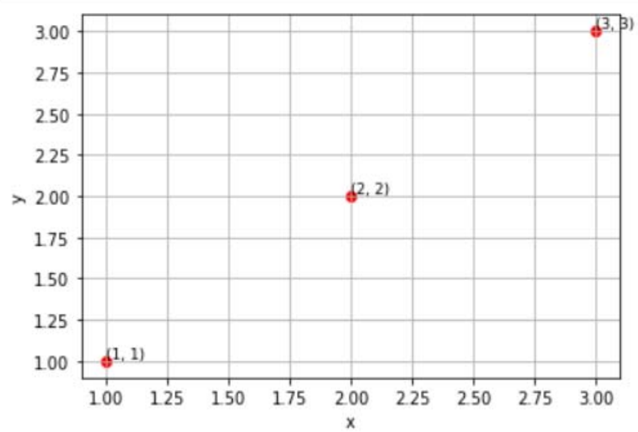




Function h(u) with u$\in$ X is convex if for any u, v $\in$ X and for any $0 \le \lambda \le 1$ we have:

h(λu +(1- λ)v) $\le$ λ h(u) + (1- λ) h(v)

example



$if\ \theta_1 = -1$:

MAE= $\frac{1}{3}$ [|1 - (-1)| + |2 - (-2)| +|3 - (-3)|] = 4

$if\ \theta_1 = 0$:

MAE= $\frac{1}{3}$ [|1 - 0| + |2 - 0| +|3 - 0|] = 2

$if\ \theta_1 = 1$:

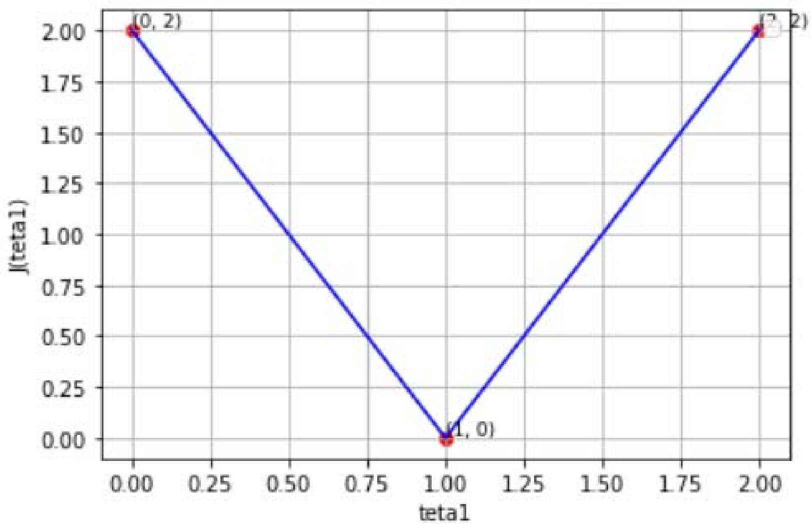
MAE= $\frac{1}{3}$ [|1 - 1| + |2 - 2| +|3 - 3|] = 0

$if\ \theta_1 = 2$:

MAE= $\frac{1}{3}$ [|1 - 2| + |2 - 4| +|3 - 6|] = 2

//

example



MAE is convex

θ_1	$J(\theta_1)$
-1	4
-0.5	3
0	2
0.5	1
1	0
1.5	1
2	2
2.5	3
3	4

/0