California State University, Dominguez Hills
Department of Computer Science
CSC 595

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Cost Function

Cost Function

Training set

features: size in feet² (x)

targets: price \$1000's (y)

size in feet² (x)	price \$1000's (y)
2104	460
1416	232
1534	315
852	178
...	...

Model: $f_{w,b}(x) = wx + b$

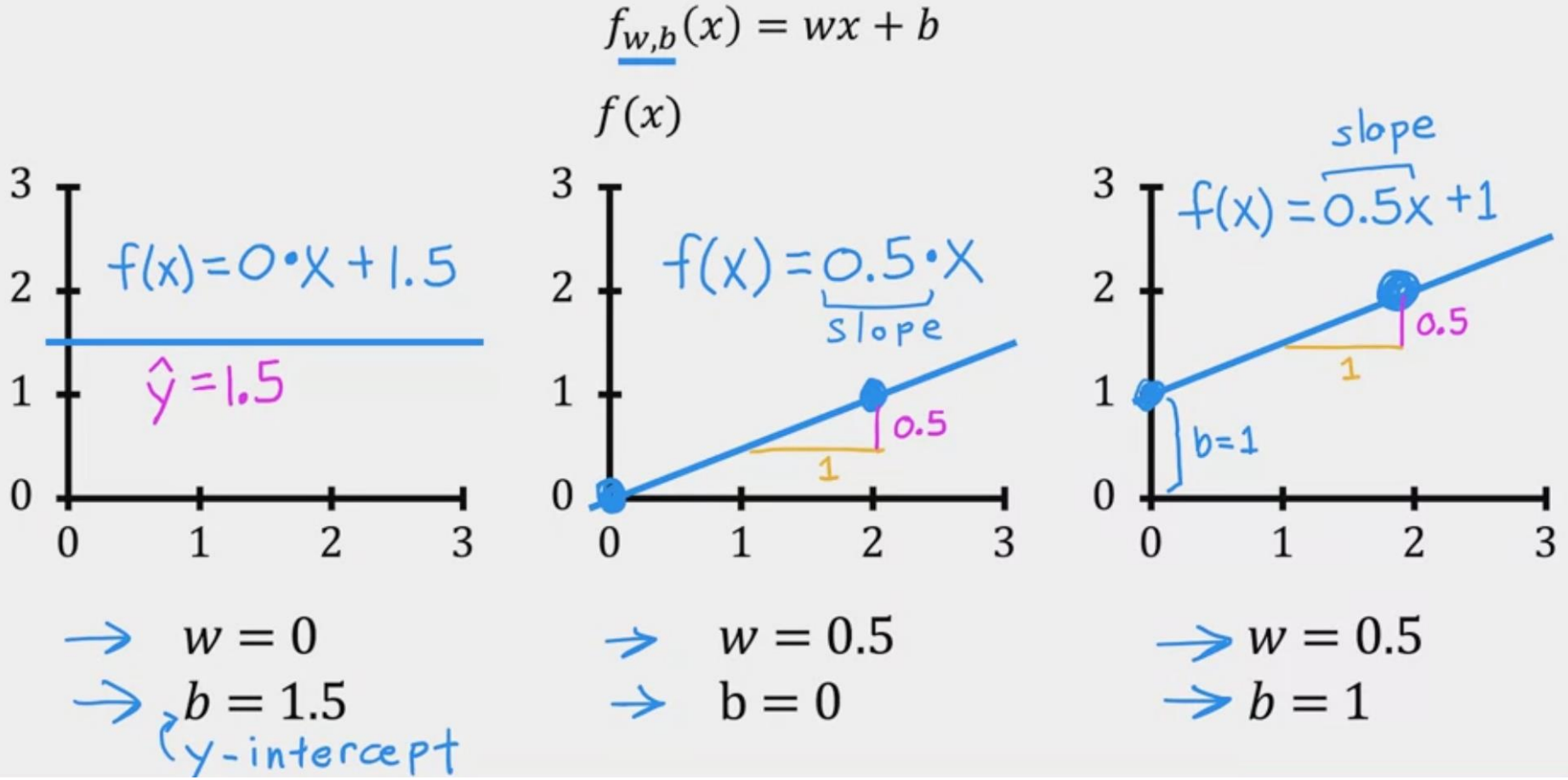
w, b: parameters

coefficients

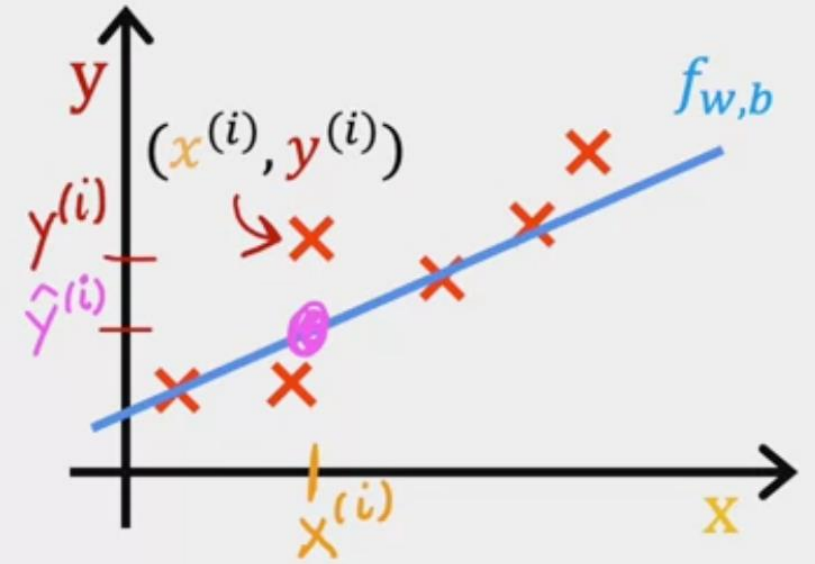
weights

What do w, b do?

Cost Function



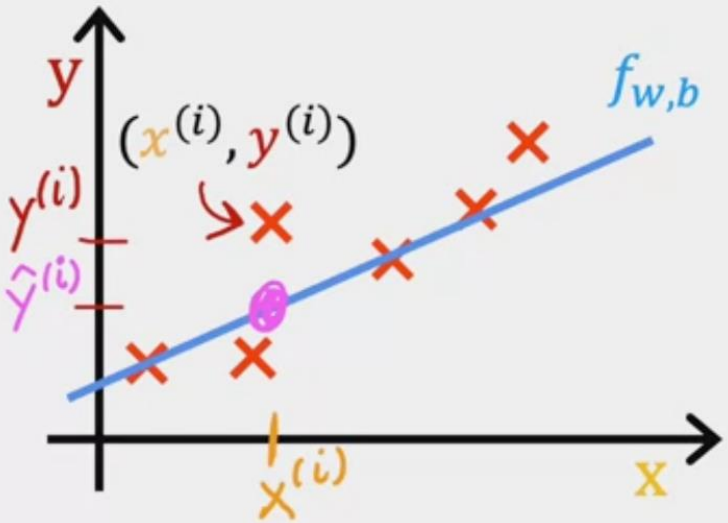
Cost Function



$$\hat{y}^{(i)} = f_{w,b}\left(x^{(i)}\right)$$

$$f_{w,b}\left(x^{(i)}\right) = wx^{(i)} + b$$

Cost Function

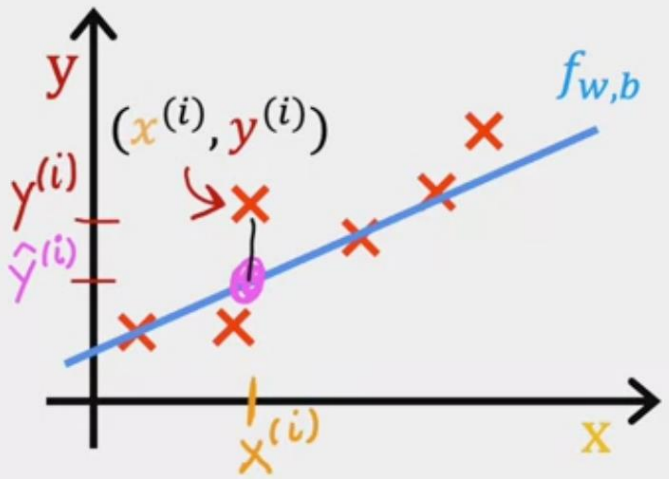


$$\hat{y}^{(i)} = f_{w,b}\left(x^{(i)}\right)$$

$$f_{w,b}\left(x^{(i)}\right) = wx^{(i)} + b$$

Find w, b:
$\hat{y}^{(i)}$ is close to $y^{(i)}$ for all $(x^{(i)}, y^{(i)})$.

Cost Function



$$\hat{y}^{(i)} = f_{w,b}(x^{(i)})$$

$$f_{w,b}(x^{(i)}) = wx^{(i)} + b$$

Cost function: Squared error cost function

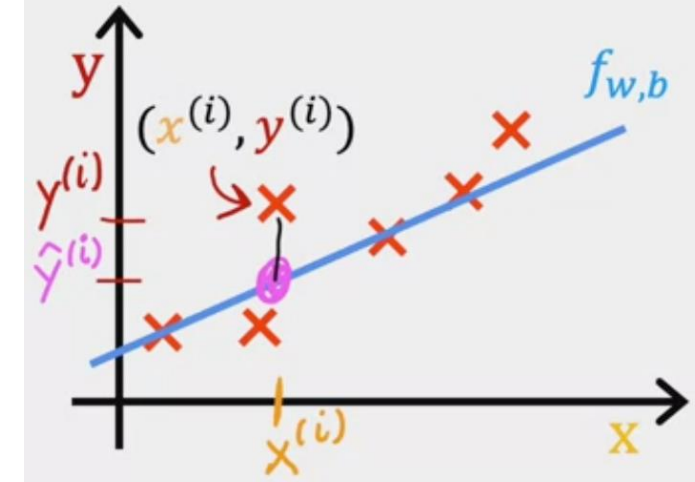
$$J(w,b) = \frac{1}{2m} \sum_{i=1}^{m} \left(\underbrace{\hat{y}^{(i)} - y^{(i)}}_{\text{error}} \right)^2$$

m = number of training examples

Find w, b:

$\hat{y}^{(i)}$ is close to $y^{(i)}$ for all $(x^{(i)}, y^{(i)})$.

Cost Function



$$\hat{y}^{(i)} = f_{w,b}(x^{(i)})$$

$$f_{w,b}(x^{(i)}) = wx^{(i)} + b$$

Cost function: Squared error cost function

$$J(w,b) = \frac{1}{2m}\sum_{i=1}^{m}\left(\hat{y}^{(i)} - y^{(i)}\right)^2$$

$\hat{y}^{(i)}$ ↑ error

m = number of training examples

$$J(w,b) = \frac{1}{2m}\sum_{i=1}^{m}\left(f_{w,b}(x^{(i)}) - y^{(i)}\right)^2$$

$J(w,b)$ ↑ intuition (next!)

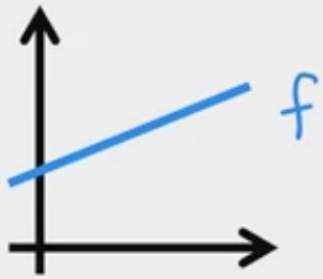
Find w, b:

$\hat{y}^{(i)}$ is close to $y^{(i)}$ for all $(x^{(i)}, y^{(i)})$.

Cost Function

model:

$$f_{w,b}(x) = wx + b$$



parameters:

w, b

cost function:

$$J(w,b) = \frac{1}{2m}\sum_{i=1}^{m}(f_{w,b}(x^{(i)}) - y^{(i)})^2$$

goal:

$$\underset{w,b}{\text{minimize}}\, J(w,b)$$

Cost Function

model:

$$f_{w,b}(x) = wx + b$$

parameters:

w, b

cost function:

$$J(w,b) = \frac{1}{2m}\sum_{i=1}^{m}(f_{w,b}(x^{(i)}) - y^{(i)})^2$$

goal:

$$\underset{w,b}{\text{minimize}}\, J(w,b)$$

simplified

$$f_w(x) = wx \qquad b = \emptyset$$

w

$$J(w) = \frac{1}{2m}\sum_{i=1}^{m}(f_w(x^{(i)}) - y^{(i)})^2$$

$wx^{(i)}$

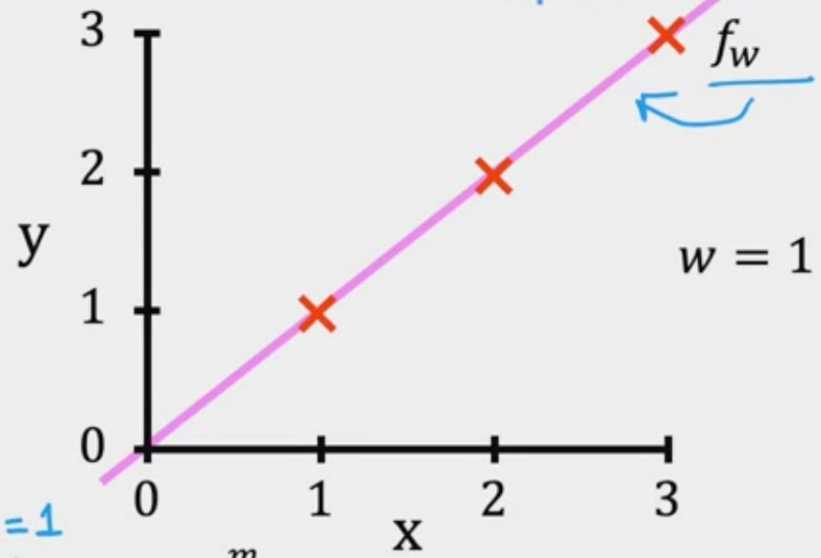
$$\underset{w}{\text{minimize}}\, J(w)$$

Cost Function

$f_w(x)$

(for fixed w, function of x)

input



$w = 1$

$$J(w) = \frac{1}{2m}\sum_{i=1}^{m}(f_w(x^{(i)}) - y^{(i)})^2$$

$wx^{(i)}$

$J(w)$

(function of w)

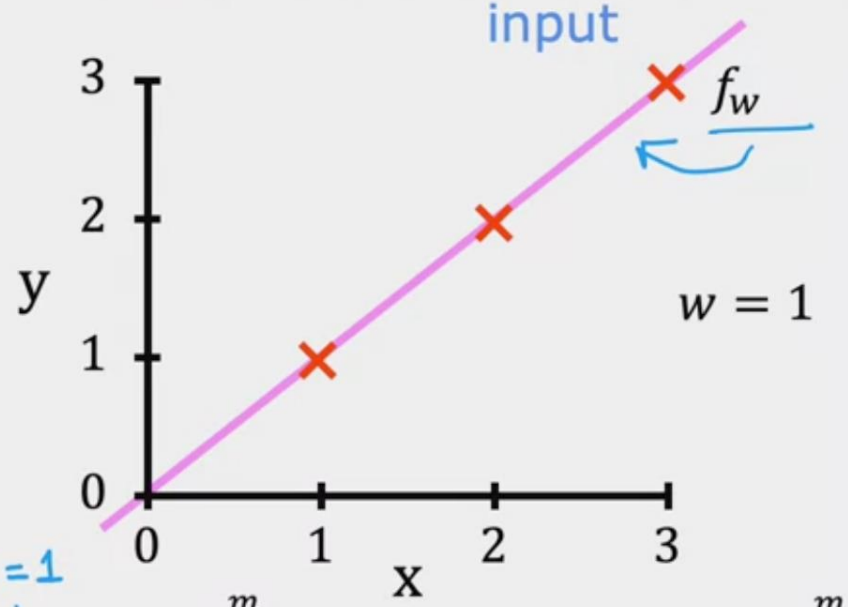
parameter

Cost Function

$f_w(x)$

(for fixed w, function of x)

input



$J(w)$

(function of w)

parameter

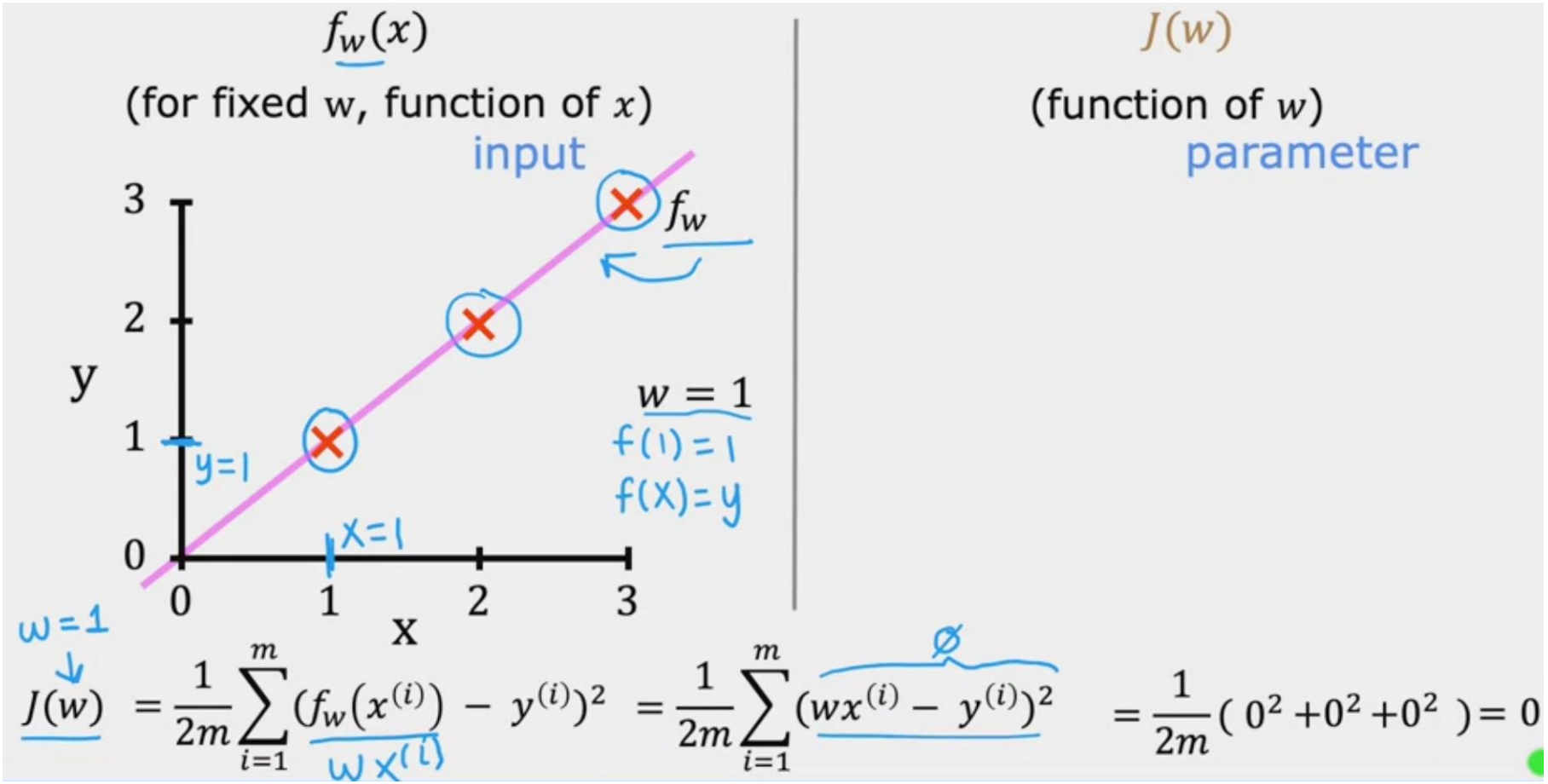
$w = 1$

$$J(w) = \frac{1}{2m}\sum_{i=1}^{m}(f_w(x^{(i)}) - y^{(i)})^2 = \frac{1}{2m}\sum_{i=1}^{m}(wx^{(i)} - y^{(i)})^2$$

Cost Function

$f_w(x)$

(for fixed w, function of x)

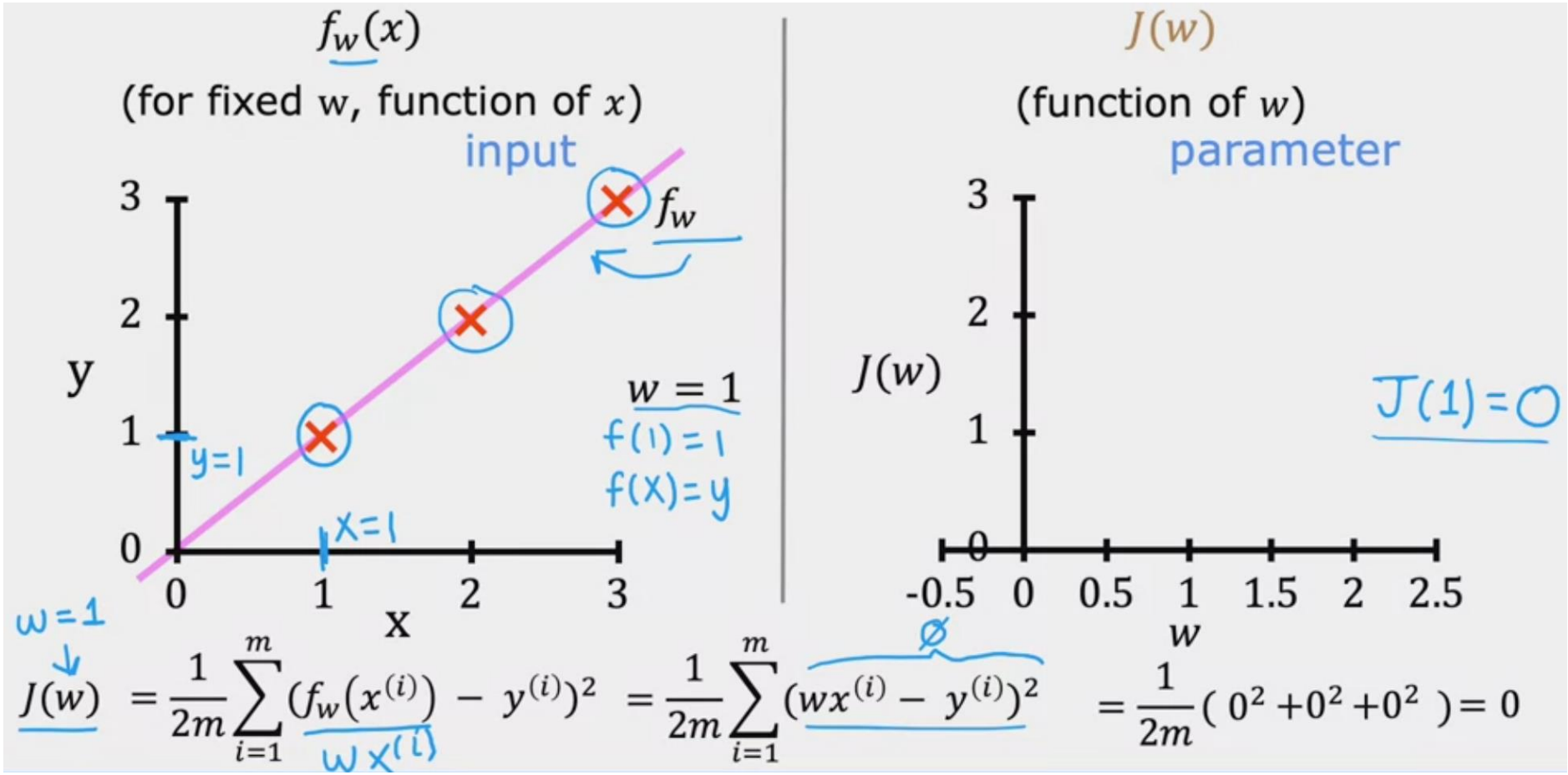


$J(w)$

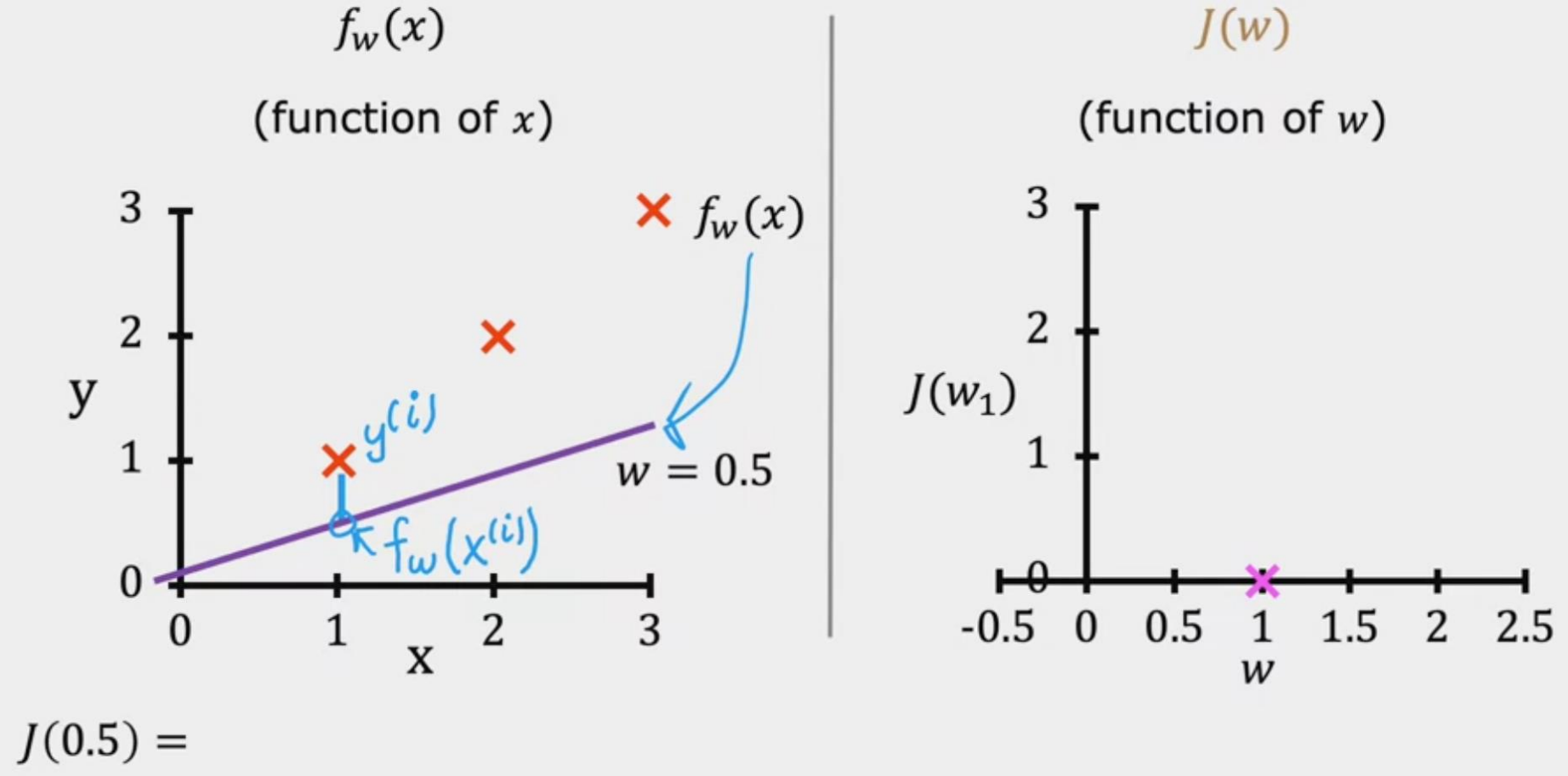
(function of w)

parameter

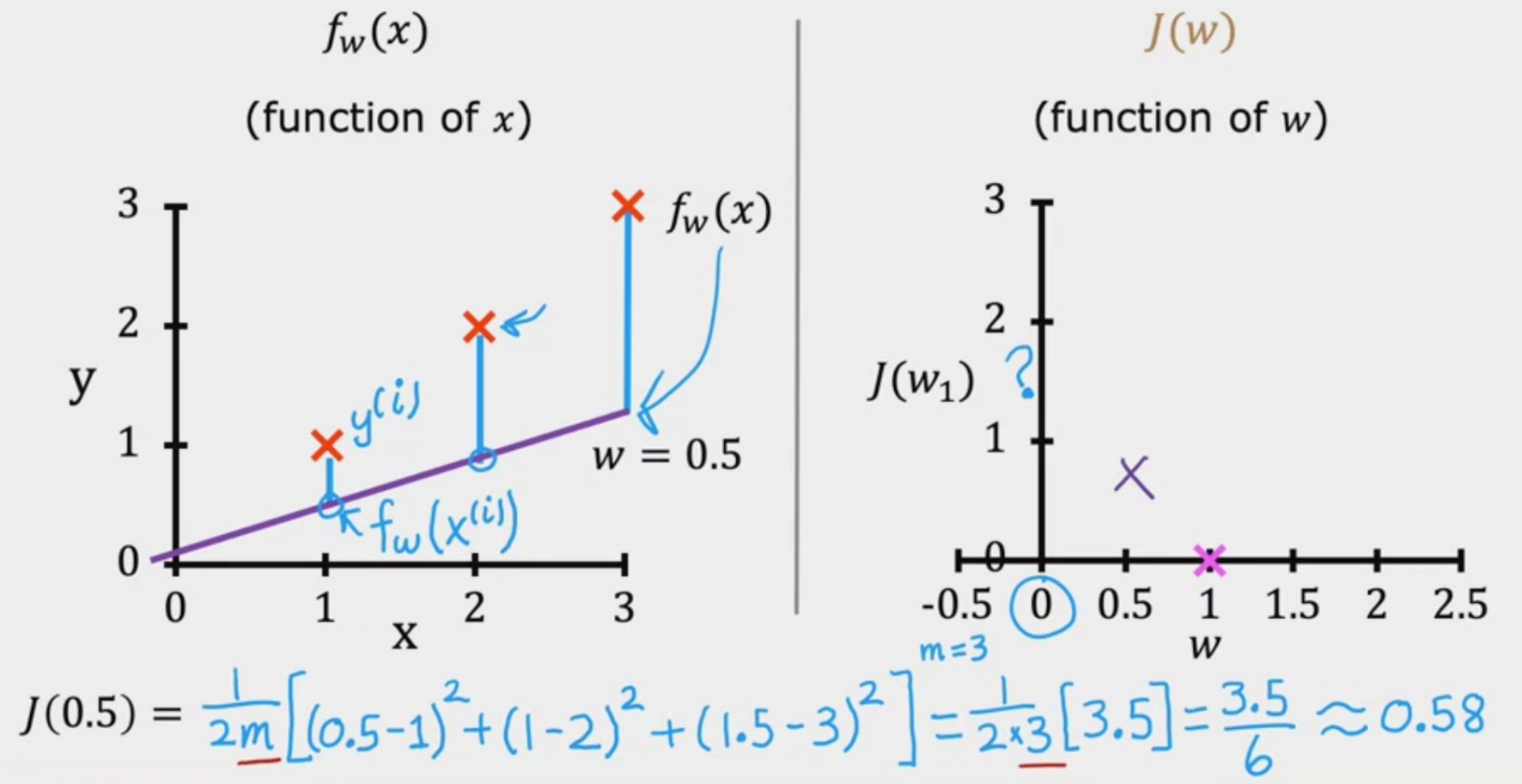
Cost Function



Cost Function



Cost Function



Visualizing the Cost Function

Model	$f_{w,b}(x) = wx + b$
Parameters	w, b
Cost Function	$J(w,b) = \frac{1}{2m}\sum_{i=1}^{m}(f_{w,b}(x^{(i)}) - y^{(i)})^2$
Objective	$\underset{w,b}{\text{minimize}}\, J(w,b)$