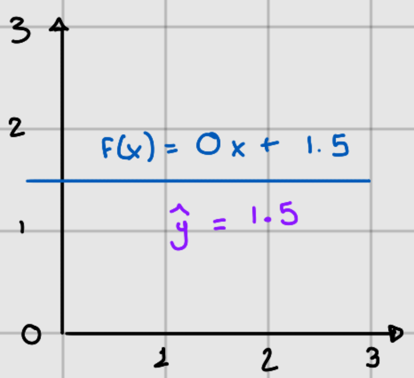
Training set

Features size in feet^2 (x)	targets price \$1000's (y)
2000	400
1000	200
...	...

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

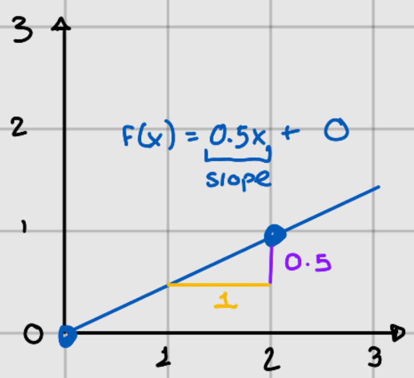
w, b : parameters
- coefficients
- weights

What do w, b do?



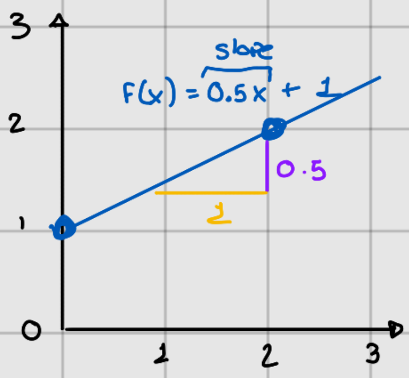
$w = 0$

$b = 1.5$ ← y - intercept



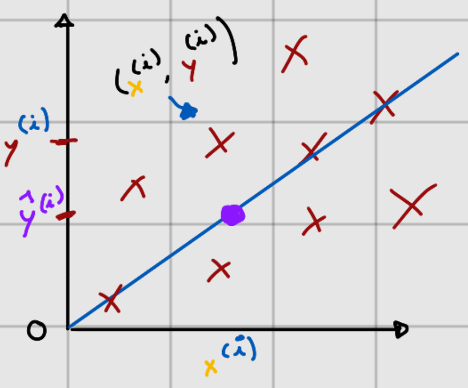
$w = 0.5$

$b = 0$



$w = 0.5$

$b = 1$



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

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

Find w, b

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

Cost Function : Squared error cost function

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

Error

m = number of training examples

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

Cost Function Intuition

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

parameters : w, b

model's predictions — true values

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

goal : we want to $\underset{w,b}{\text{minimize}}$ $J(w,b)$

Simplified

If we get a $f_w(x) = wx$ $\qquad b = \emptyset$

w

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

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

$\boxed{\text{Activity}}$

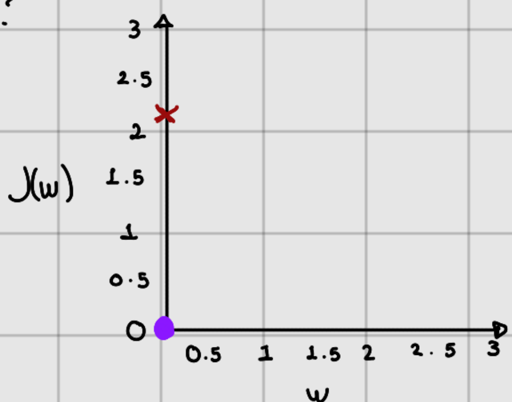
What is the cost function when w is 0 ?

$$J(0) = \frac{1}{2(3)}\left[(\cancel{0}(1) - 1)^2 + (\cancel{0}(2) - 2)^2 + (\cancel{0}(2) - 2)^2\right] =$$

$$(-1)^2 + (-2)^2 + (-3)^2$$

$$1 + 4 + 9$$

$$\frac{1}{2(3)}[14] = \frac{7}{3} = 2.\overline{3}$$



goal of linear regression: $\underset{w}{\text{minimize}}\ J(w)$

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

when the cost is relatively small, it means the model fits the data better compared to other choices for w and b