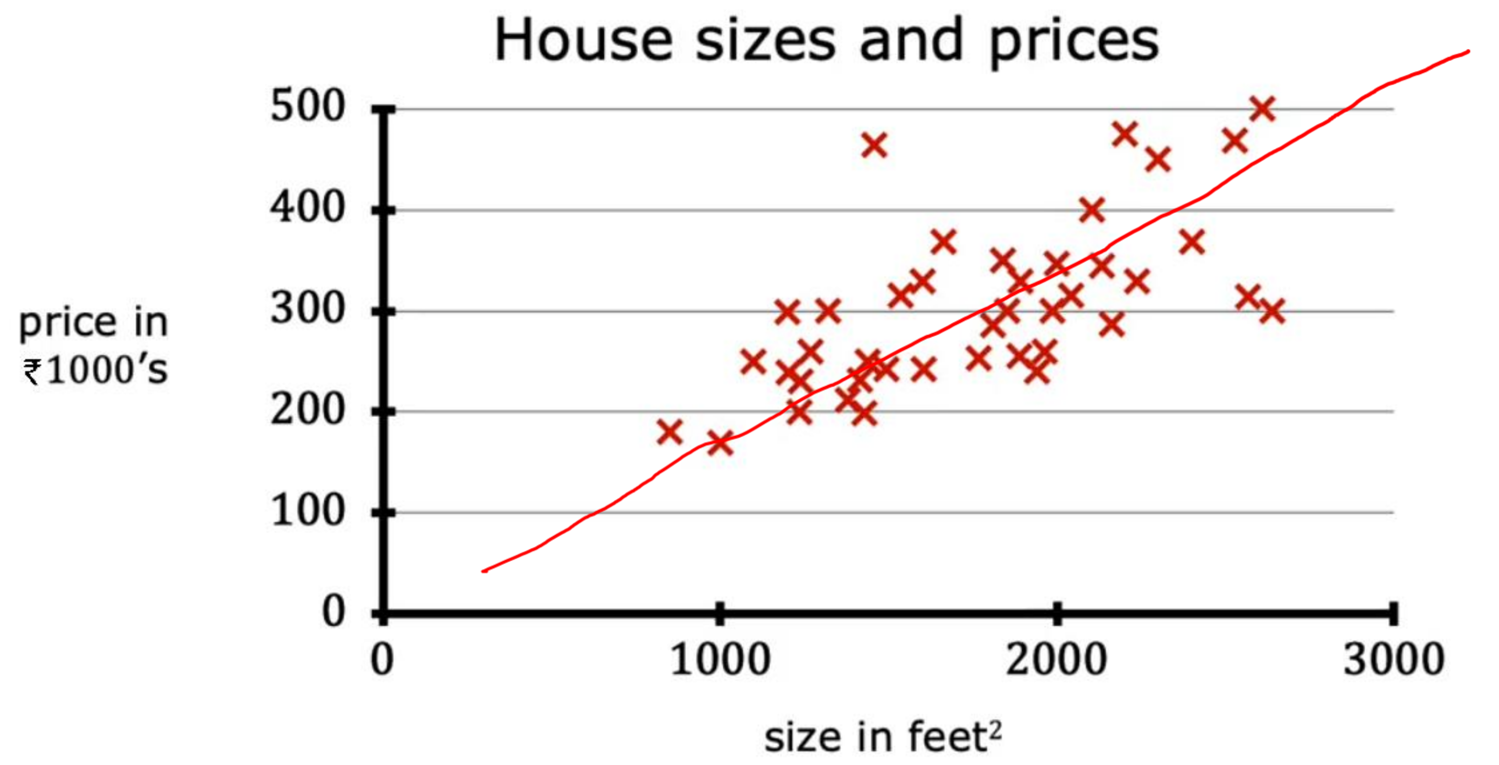
Linear Regression

ONE VARIABLE

Linear Regression: Housing Price prediction

Data table

size in feet^2	price in ₹1000's
2104	400
1416	232
1534	315
852	178
...	...
3210	870



Basic Terminology

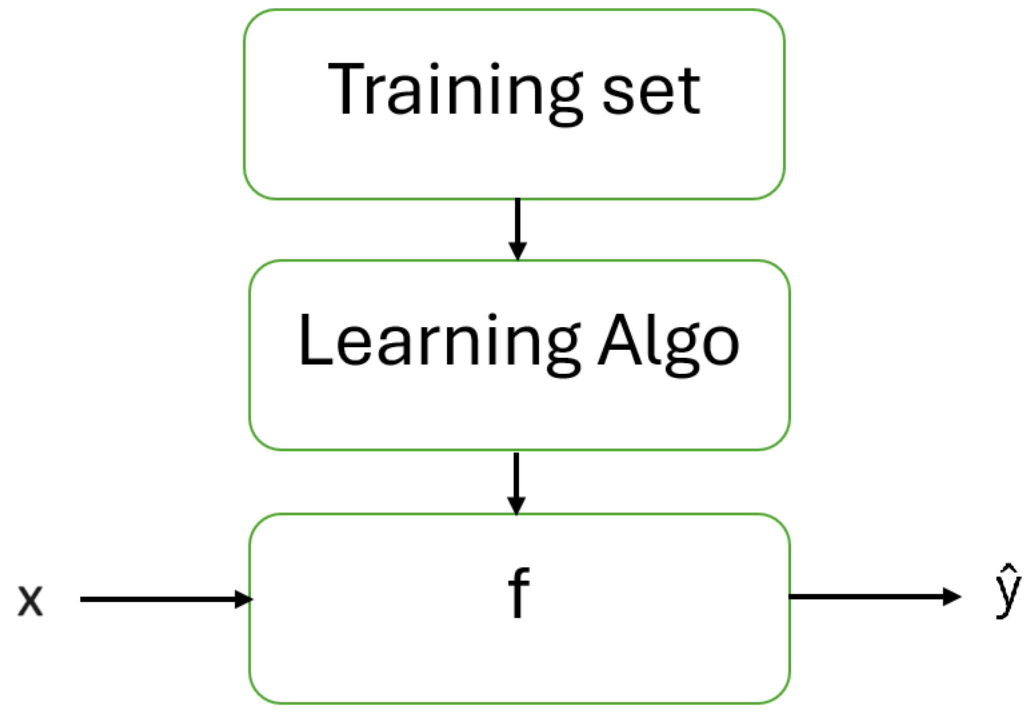
- Training set
- x = Input variable or input feature
- y = Output variable or target variable
- m = number of training examples
- (x, y) = single training example
- $(x^{(i)}, y^{(i)})$ = i^{th} training example

Data table

size in feet^2	price in ₹1000's
2104	400
1416	232
1534	315
852	178
...	...
3210	870

Supervised learning

- x feature (input variable)
- y-hat prediction (estimated y)
- f function (model)

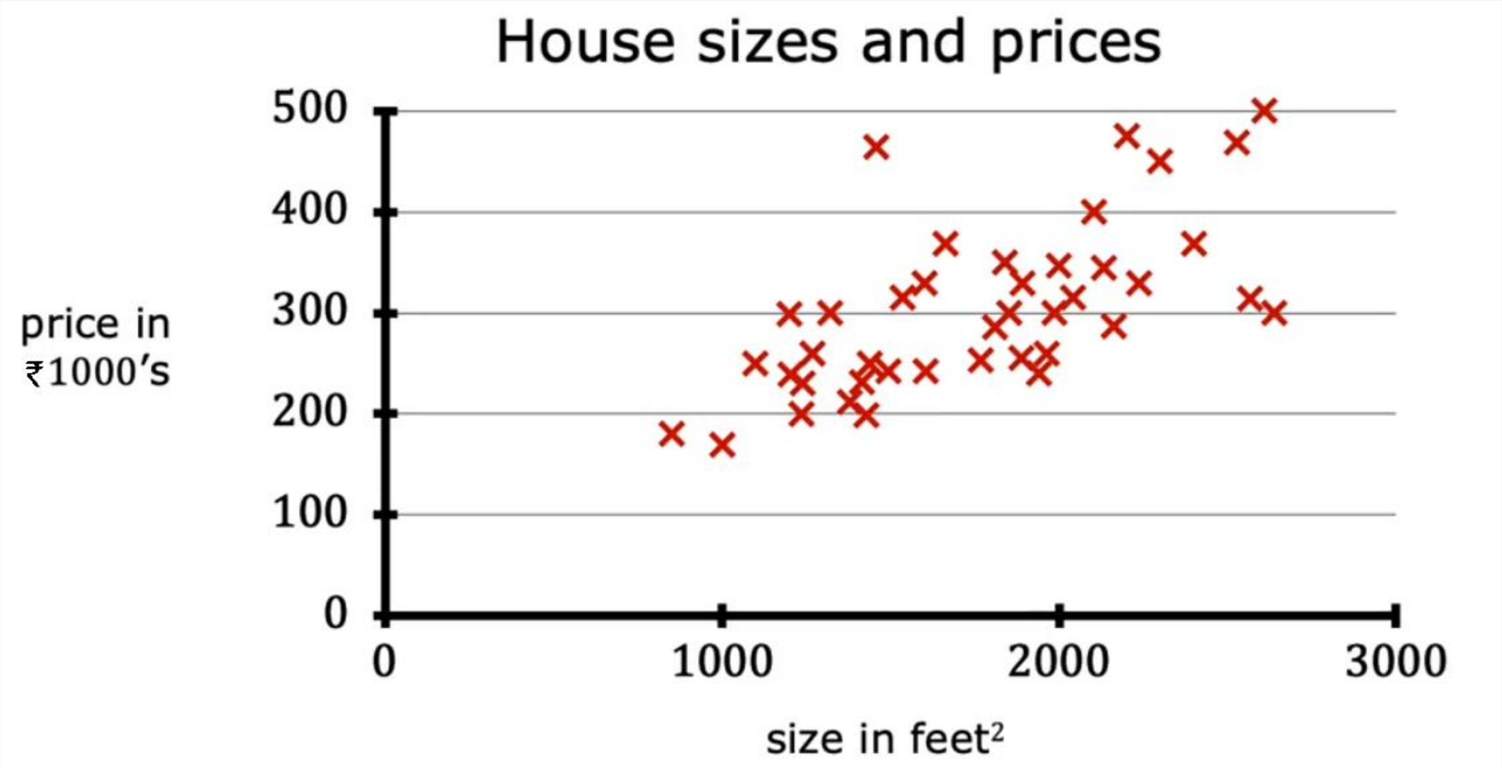


Linear Regression (One variable) | Univariate linear Regression

Straight line equation

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

w & b: parameters/ coefficients/ weights

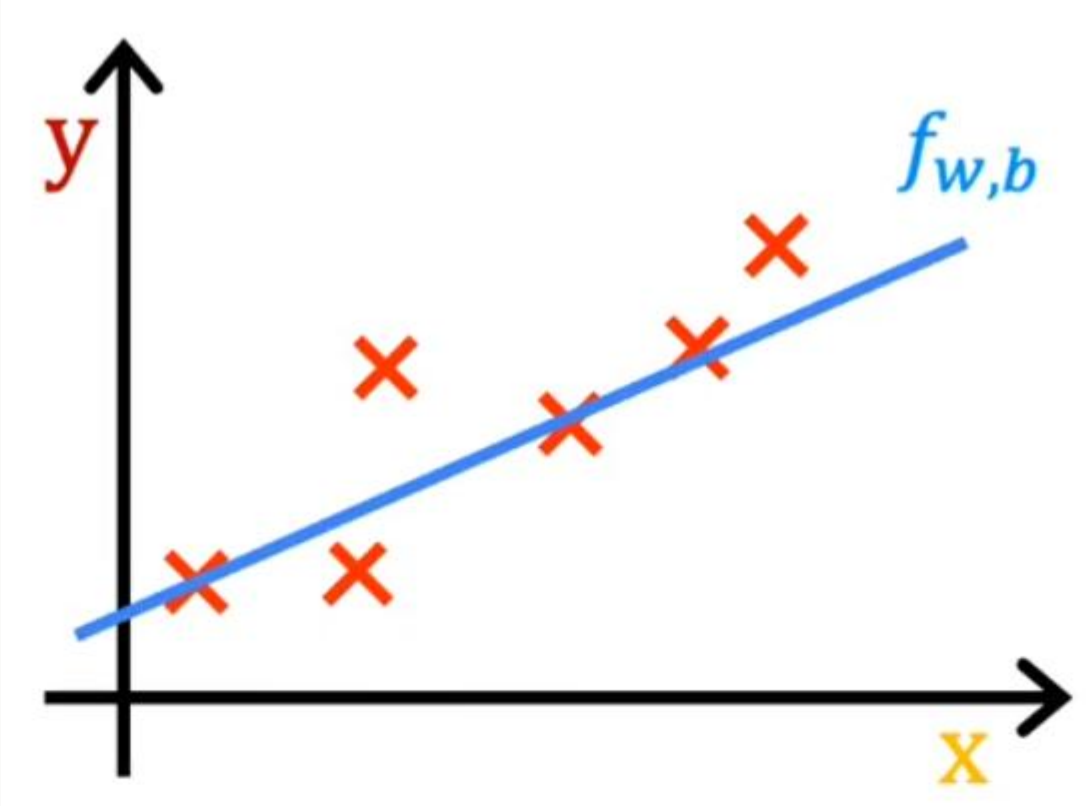


Cost function

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

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

Find values of w & b so that y-hat$^{(i)}$ is close to $y^{(i)}$ for all $(x^{(i)}, y^{(i)})$



Cost function

Squared error cost function J(w,b)

$$\frac{1}{2m}\sum_{i=1}^{m}(\hat{y}^{(i)} - y^{(i)})^2$$

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

Linear Regression (One variable) | Univariate linear Regression

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

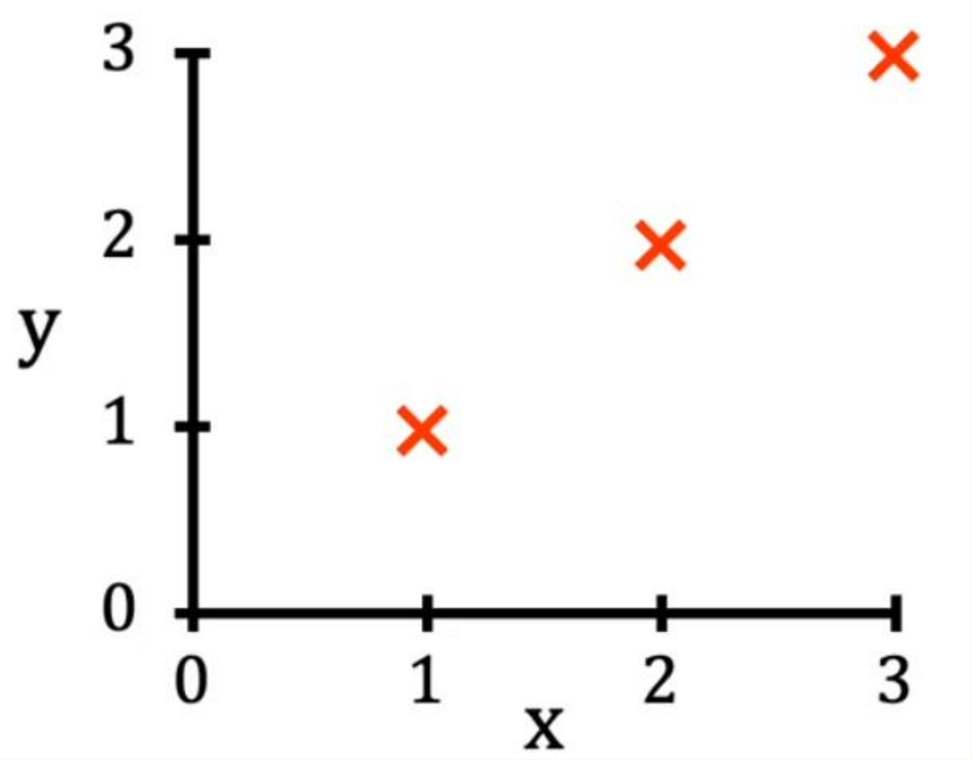
Simplified Cost function

$f_w(x) = wx$

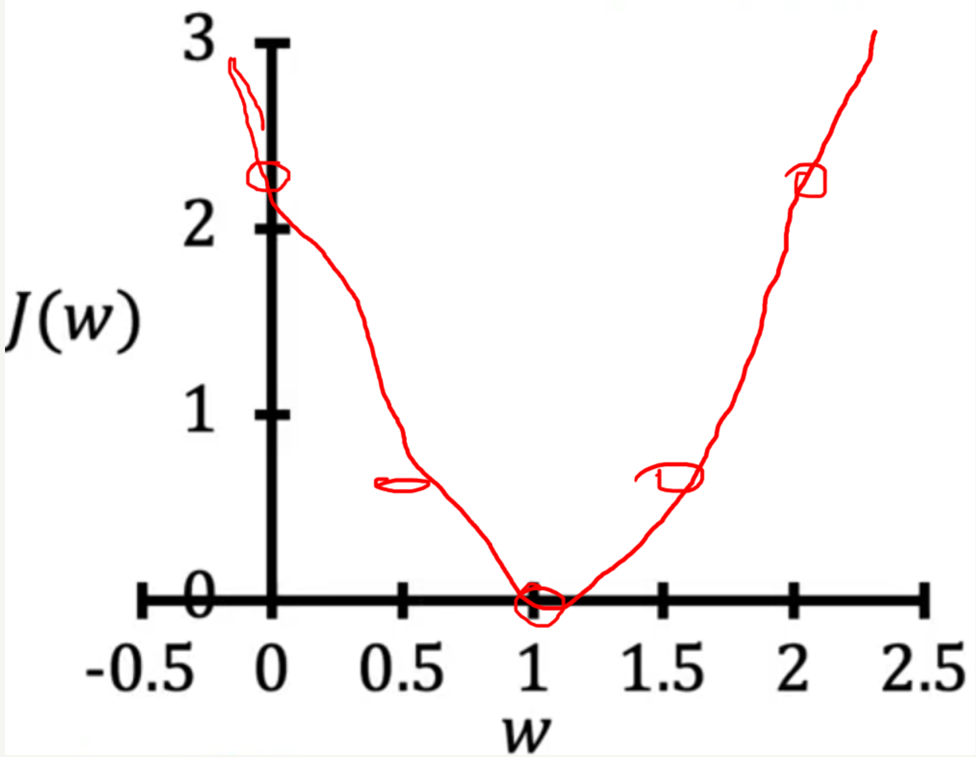
$$J(w) = \frac{1}{2m}\sum_{i=1}^{m}(f_w(x^{(i)}) - y^{(i)})^2$$

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

$f_w(x) = wx$
for fixed w, model is a function of x (input feature)



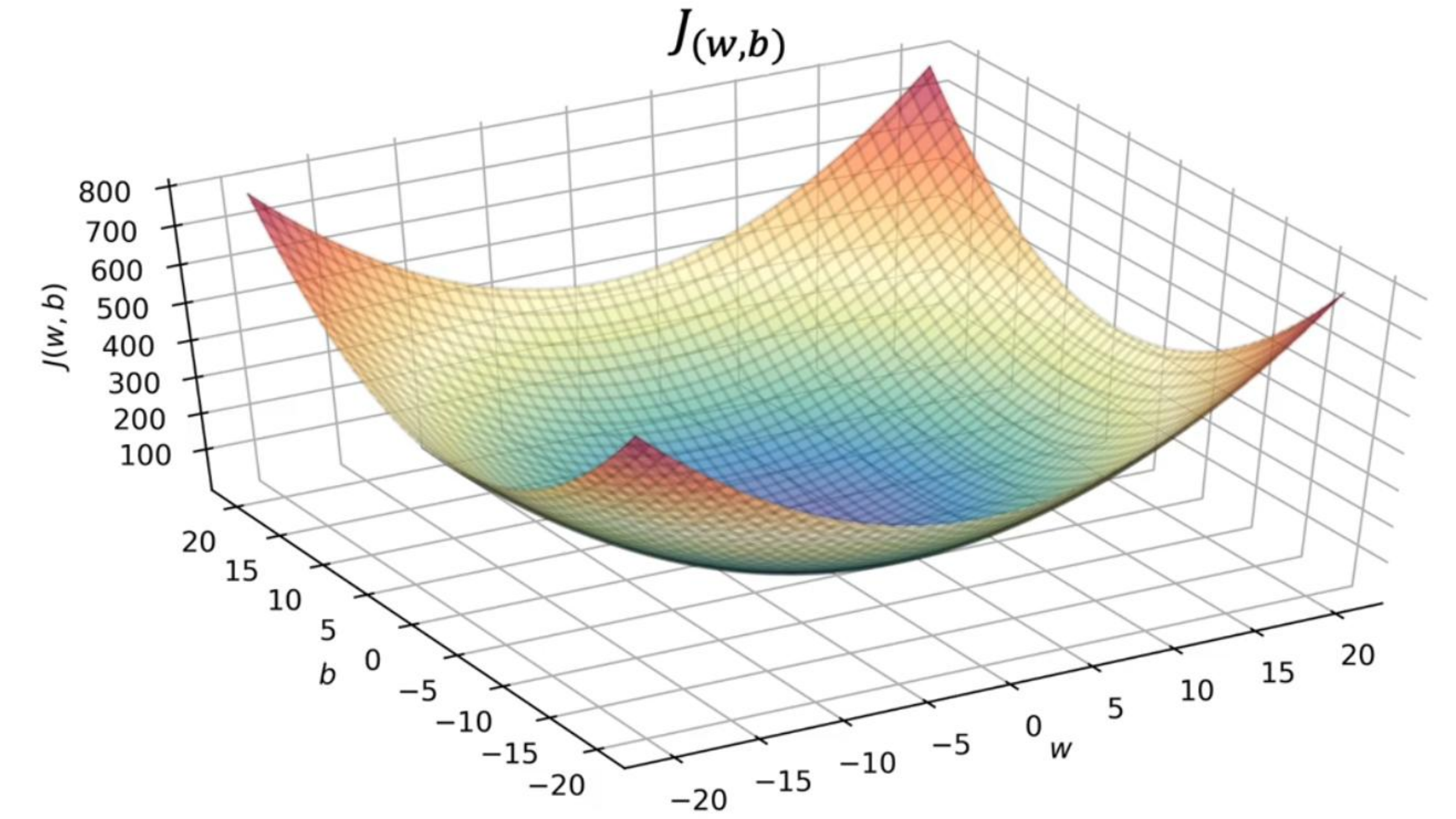
J(w) is a function of w (parameter)



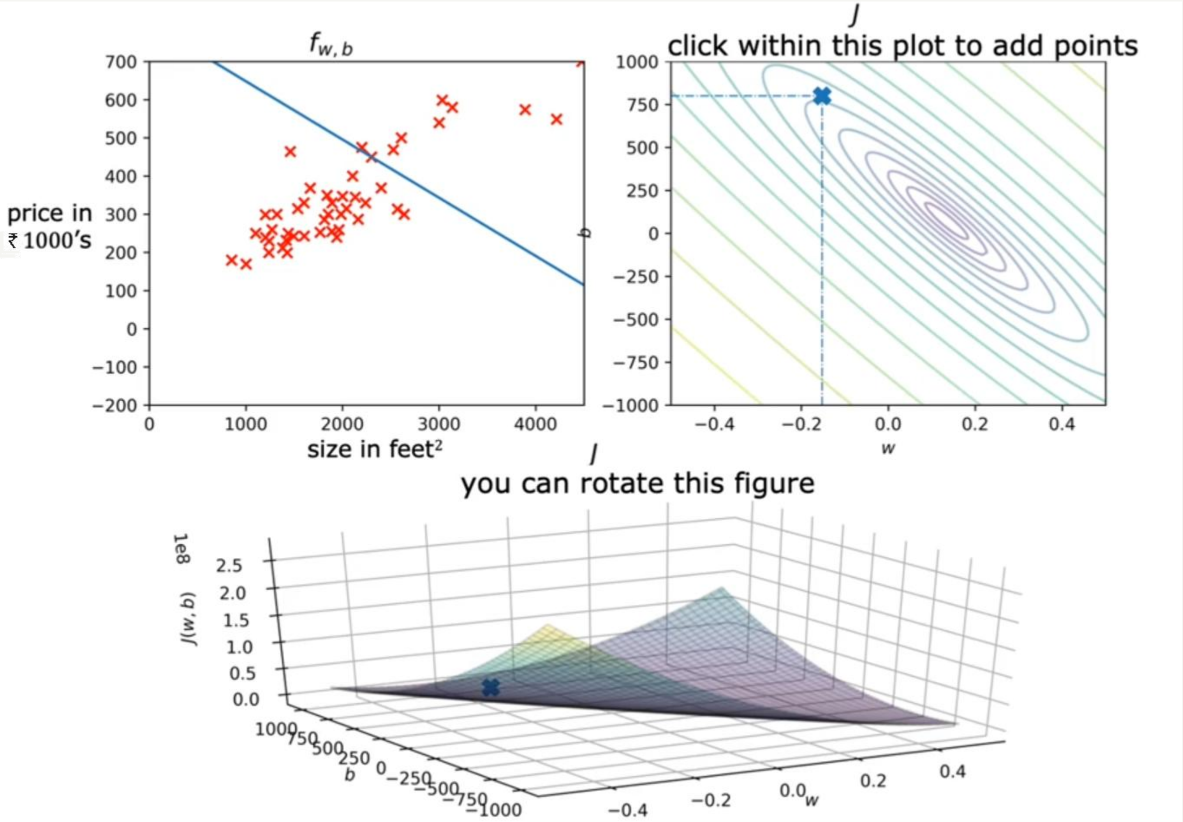
General Cost function

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

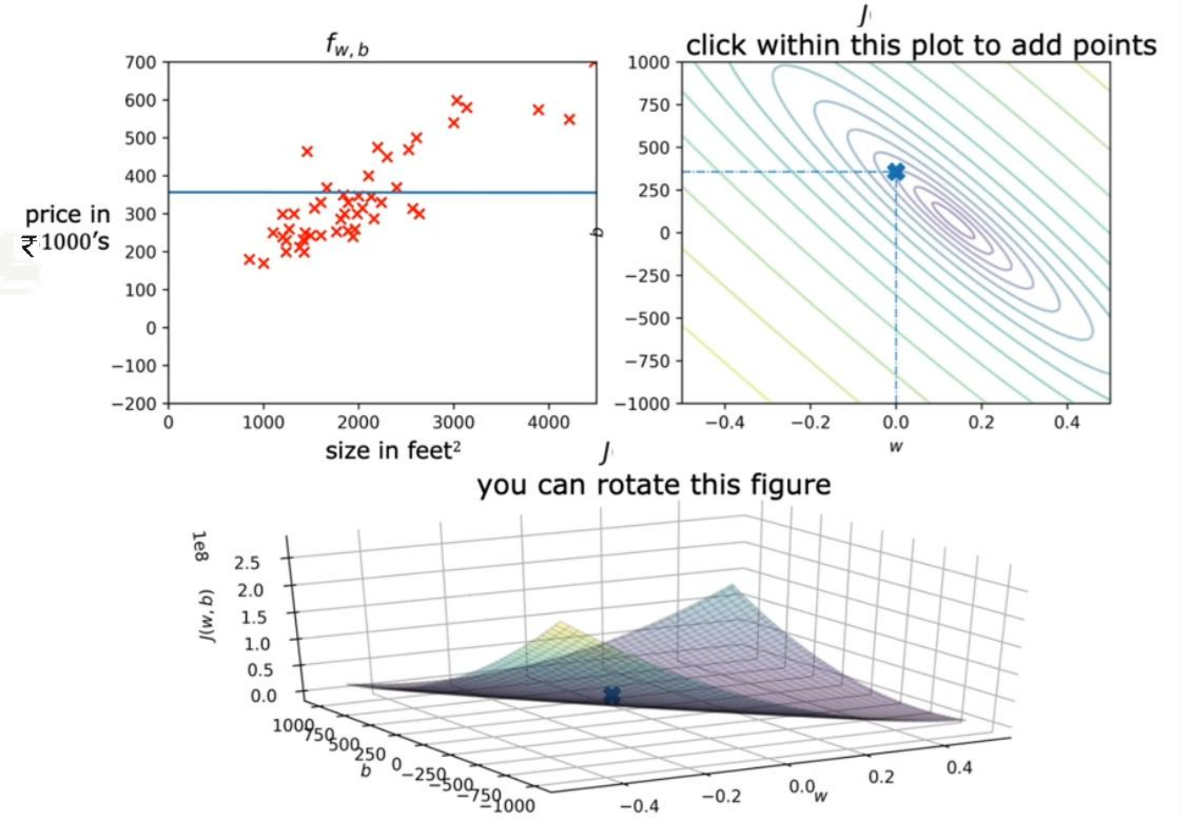
General Cost function



General Cost function visualization



General Cost function visualization



General Cost function visualization