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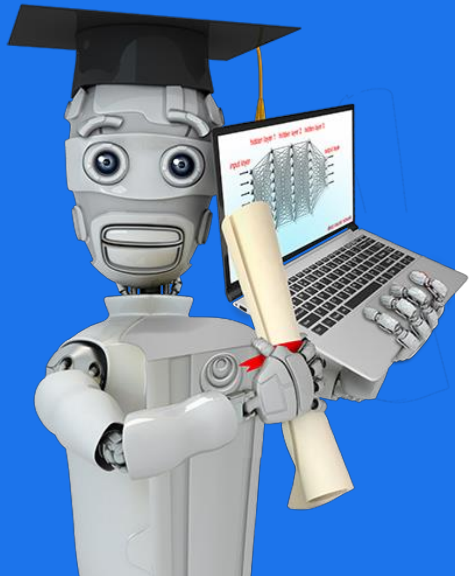
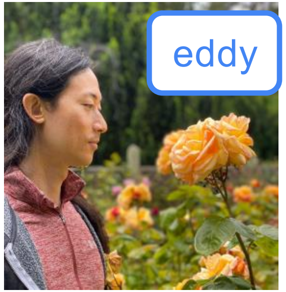


Machine Learning

Welcome!


aarti


geoff


eddy


Ivy

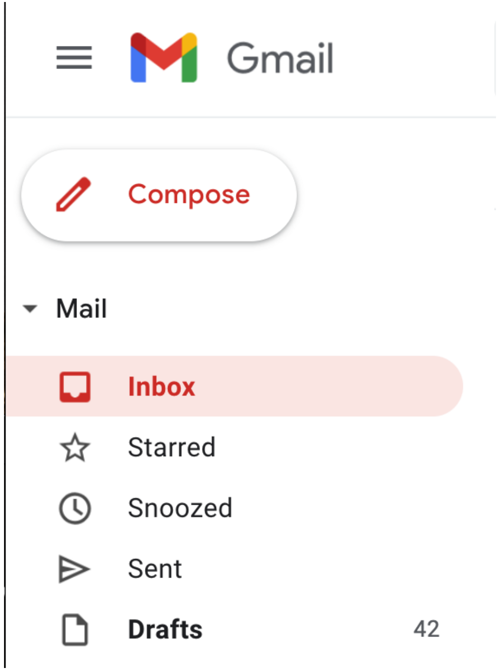

kin


robert

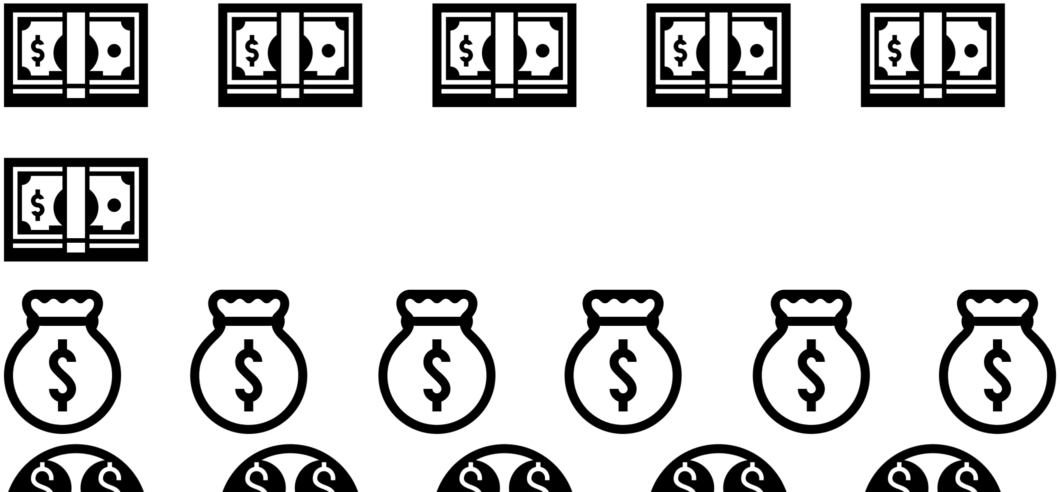

andres


daniel

Re: Urgent Information :) External Spam ×



Congratulations!
You've won
a million dollars!



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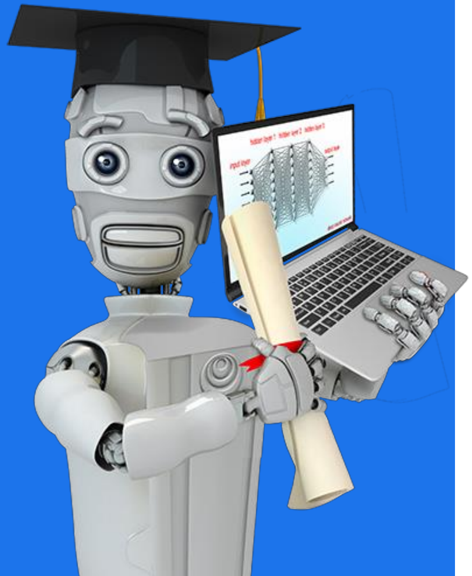

Machine Learning

Applications of Machine Learning

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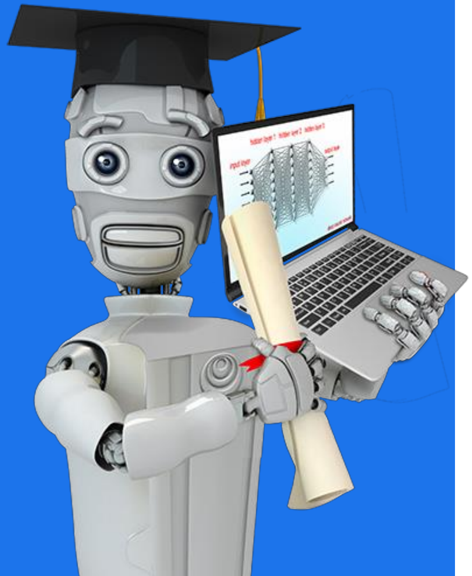


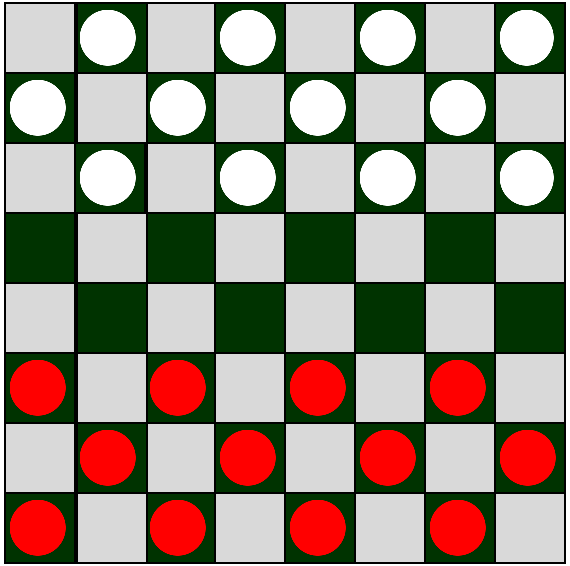
Machine Learning Overview

What is Machine Learning?

Machine learning

"Field of study that gives computers the ability to learn without being explicitly programmed."

Arthur Samuel (1959)



Question

If the checkers program had been allowed to play only ten games (instead of tens of thousands) against itself, a much smaller number of games, how would this have affected its performance?

- ○ Would have made it better
- ○ Would have made it worse

Machine learning algorithms

rapid advancements

used most in real-world applications

- Supervised learning

course 1, 2

- Unsupervised learning
- Recommender systems
- Reinforcement learning

course 3

Practical advice for applying learning algorithms

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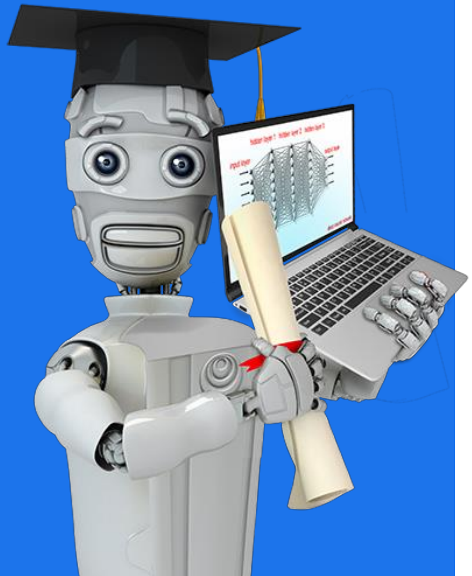


Machine Learning Overview

Supervised Learning
Part 1

Supervised learning

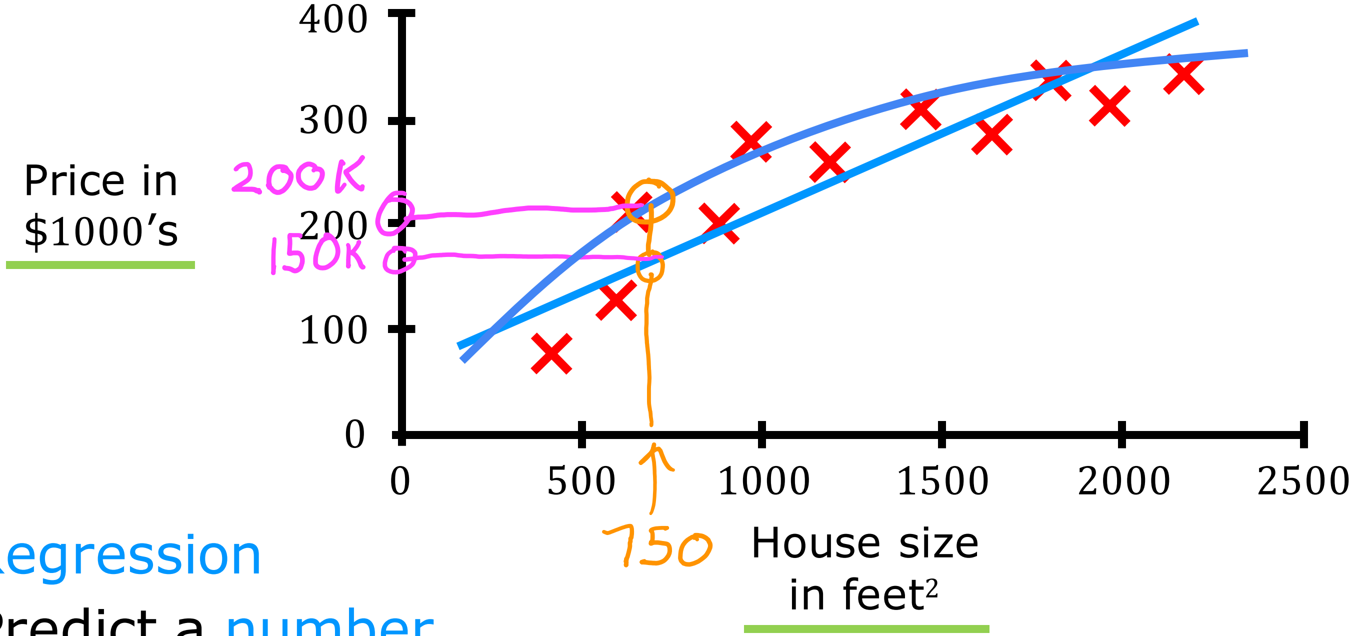
$x \longrightarrow y$

input $\longrightarrow$ output label

Learns from being given "right answers"

Input (X)		Output (Y)	Application
email	→	spam? (0/1)	spam filtering
audio	→	text transcripts	speech recognition
English	→	Spanish	machine translation
ad, user info	→	click? (0/1)	online advertising
image, radar info	→	position of other cars	self-driving car
image of phone	→	defect? (0/1)	visual inspection

Regression: Housing price prediction



150,000
70,000
183,000

Regression
Predict a number
infinitely many possible outputs

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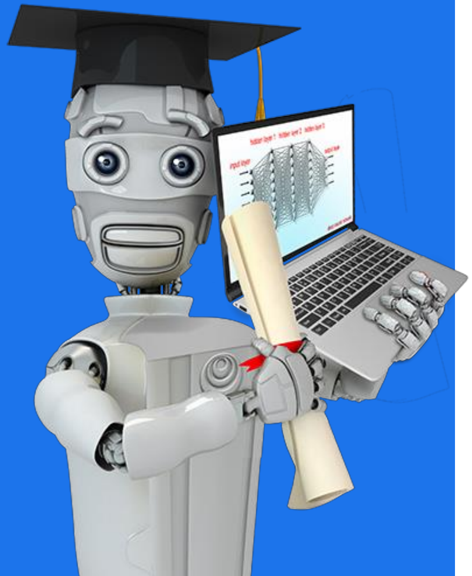
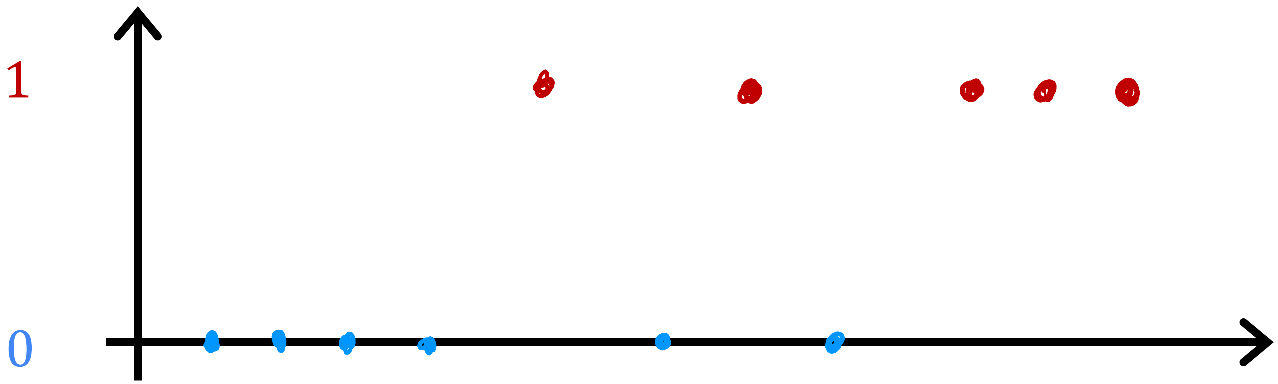


Machine Learning Overview

Supervised Learning Part 2

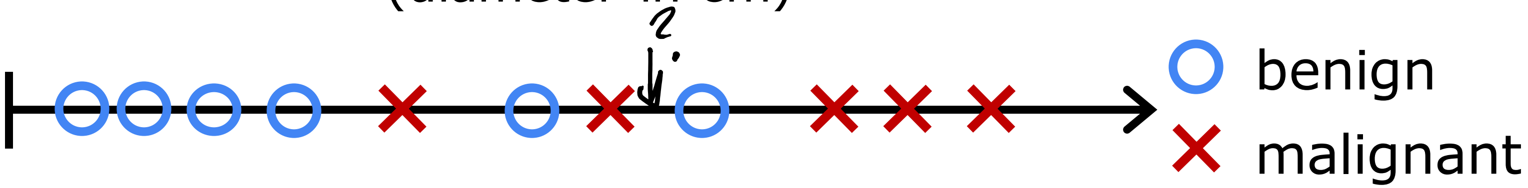
Classification: Breast cancer detection

malignant benign



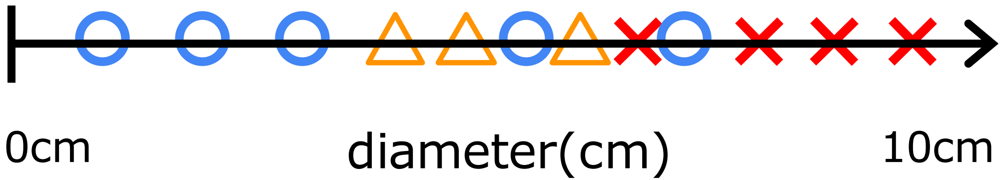
tumor size x
(diameter in cm)

size	diagnosis
2	0
5	1
1	0
7	1
⋮	



Classification: Breast cancer detection

- O benign
- × malignant type1
- △ malignant type 2



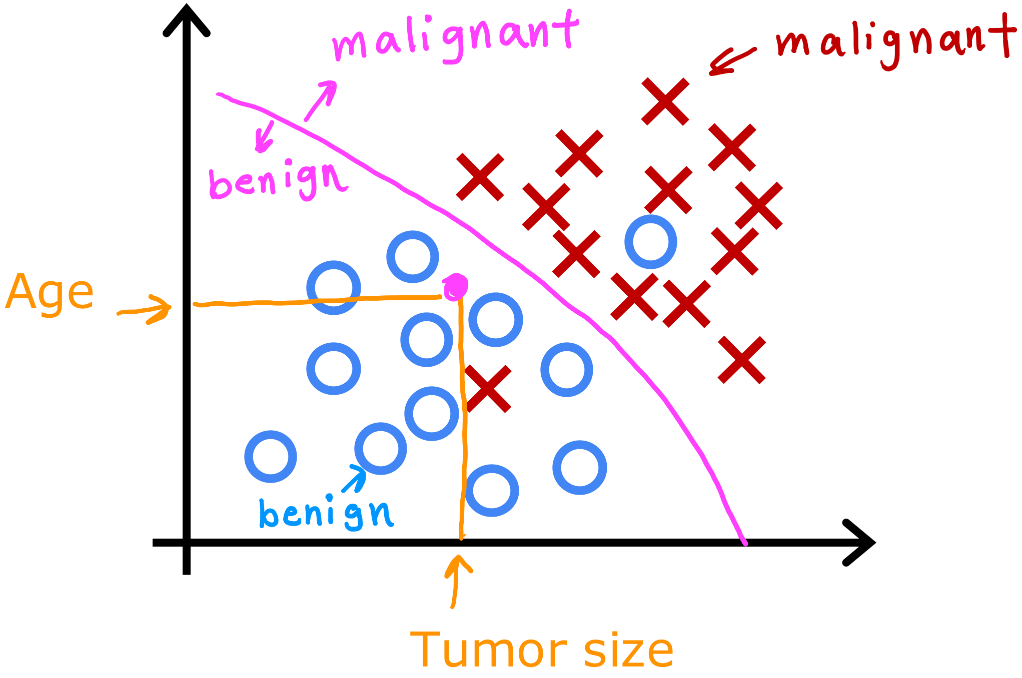
class category

Classification

predict categories cat dog benign malignant 0, 1, 2

small number of possible outputs

Two or more inputs



Supervised learning

Learns from being given "right answers"

Regression	Classification
Predict a number	predict categories
infinitely many possible outputs	small number of possible outputs

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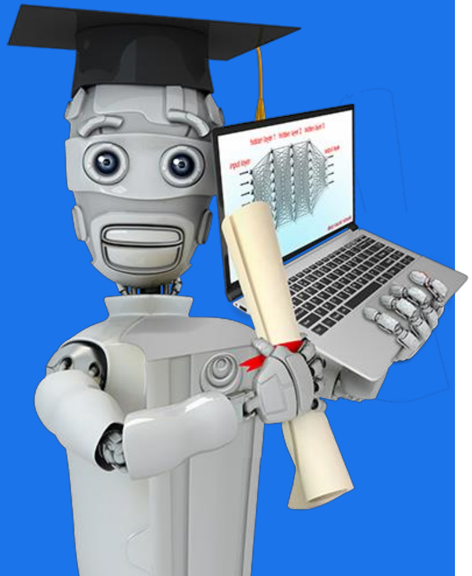
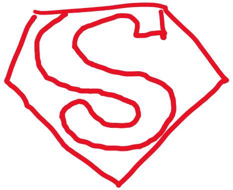


Machine Learning Overview

Unsupervised Learning Part 1

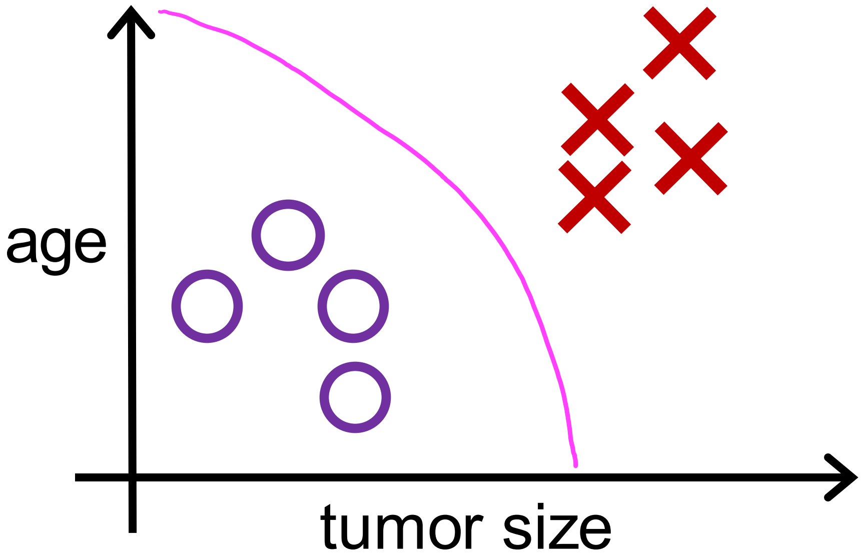
Previous: Supervised learning

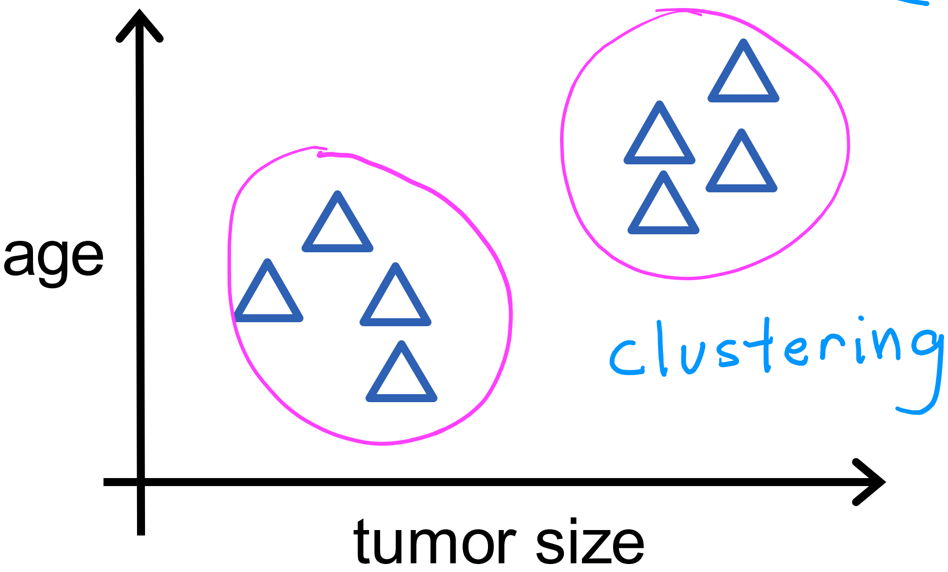
Now: Unsupervised learning



Supervised learning
Learn from data labeled
with the "right answers"

Unsupervised learning
Find something interesting
in unlabeled data.





Clustering: Google news

Giant panda gives birth to rare twin cubs at Japan's oldest zoo

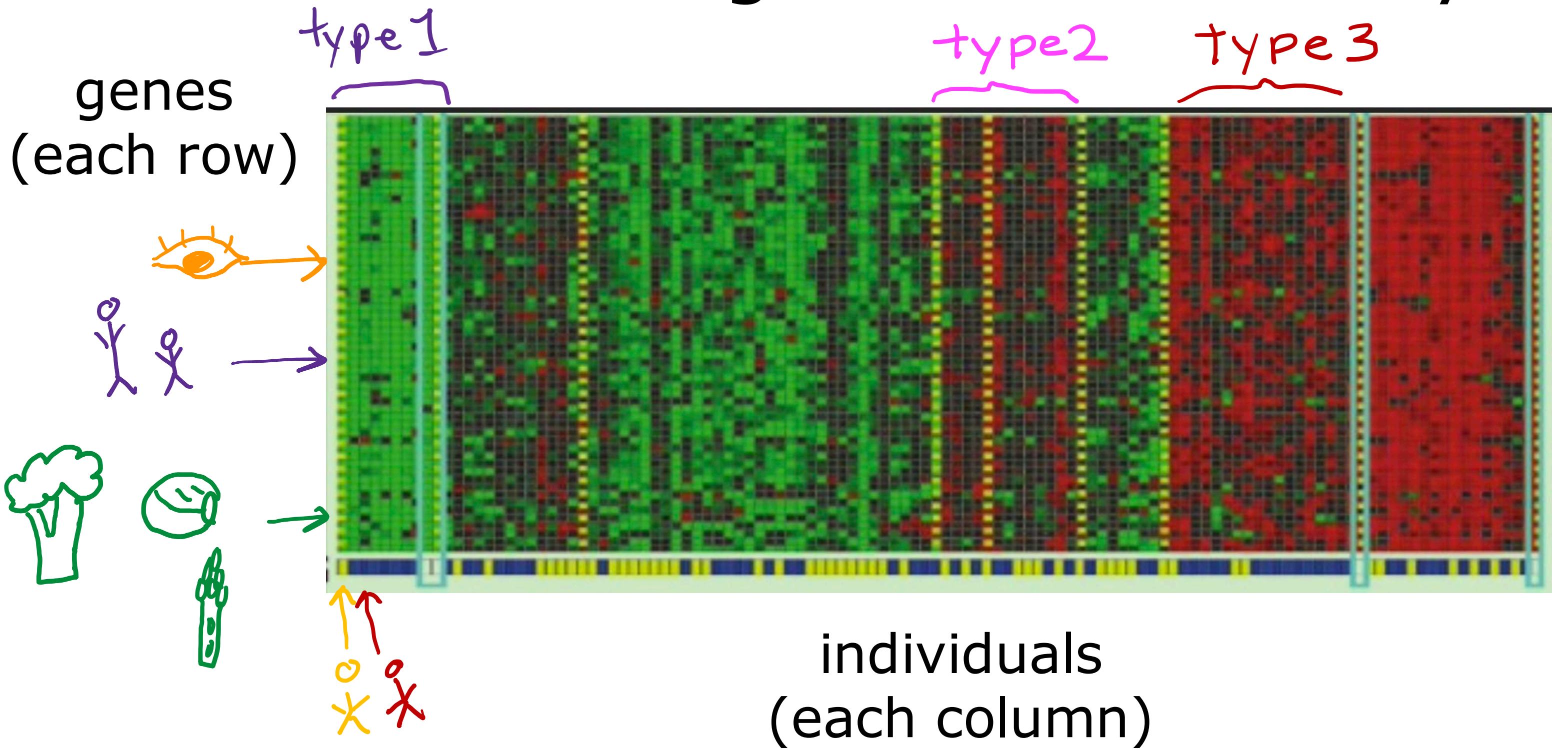
USA TODAY · 6 hours ago

- Giant panda gives birth to twin cubs at Japan's oldest zoo
  CBS News · 7 hours ago
- Giant panda gives birth to twin cubs at Tokyo's Ueno Zoo
  WHBL News · 16 hours ago
- A Joyful Surprise at Japan's Oldest Zoo: The Birth of Twin Pandas
  The New York Times · 1 hour ago
- Twin Panda Cubs Born at Tokyo's Ueno Zoo
  PEOPLE · 6 hours ago

View Full Coverage

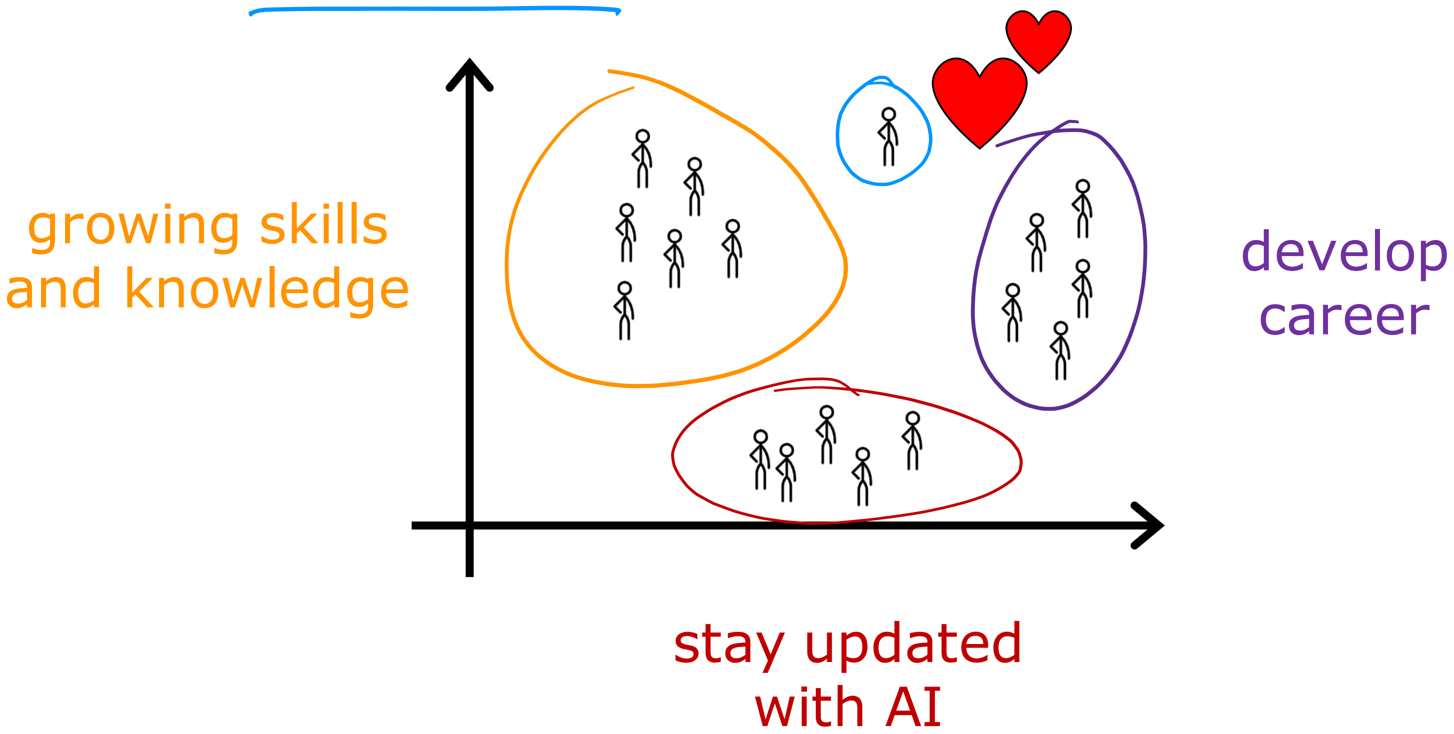
Clustering: DNA microarray

genes
(each row)



individuals
(each column)

Clustering: Grouping customers



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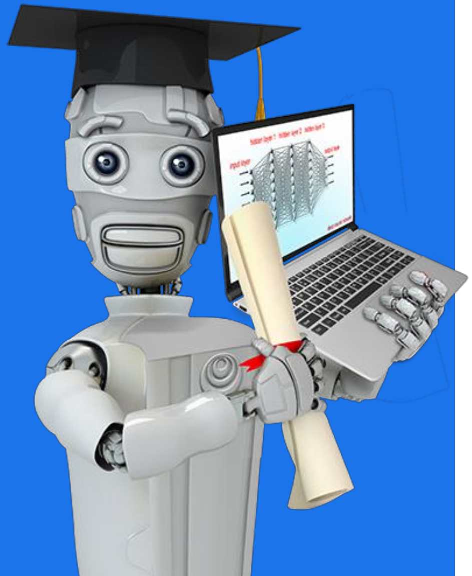

Machine Learning Overview

Unsupervised Learning Part 2

Unsupervised learning

Data only comes with inputs x, but not output labels y.
Algorithm has to find structure in the data.

<u>Clustering</u>
Group similar data points together.

<u>Dimensionality reduction</u>
Compress data using fewer numbers.

<u>Anomaly detection</u>
Find unusual data points.

Question

Of the following examples, which would you address using an unsupervised learning algorithm?

- [ ] Given email labeled as spam/not spam, learn a spam filter.
- [x] Given a set of news articles found on the web, group them into sets of articles about the same story.
- [x] Given a database of customer data, automatically discover market segments and group customers into different market segments.
- [ ] Given a dataset of patients diagnosed as either having diabetes or not, learn to classify new patients as having diabetes or not

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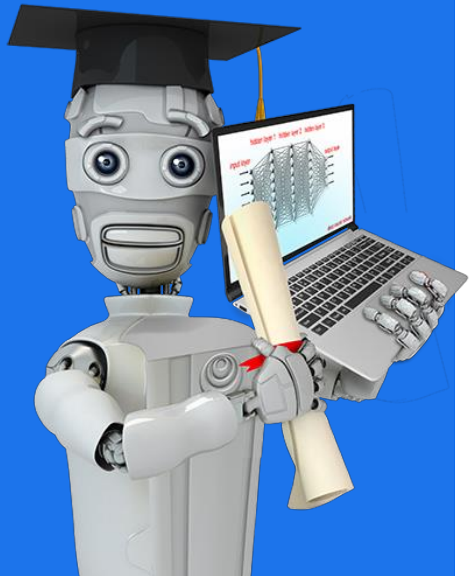

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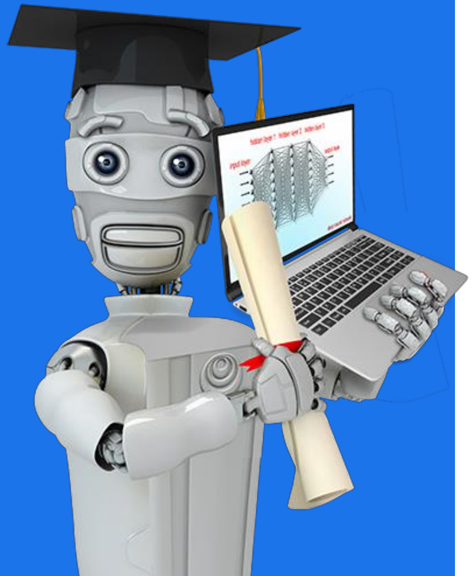
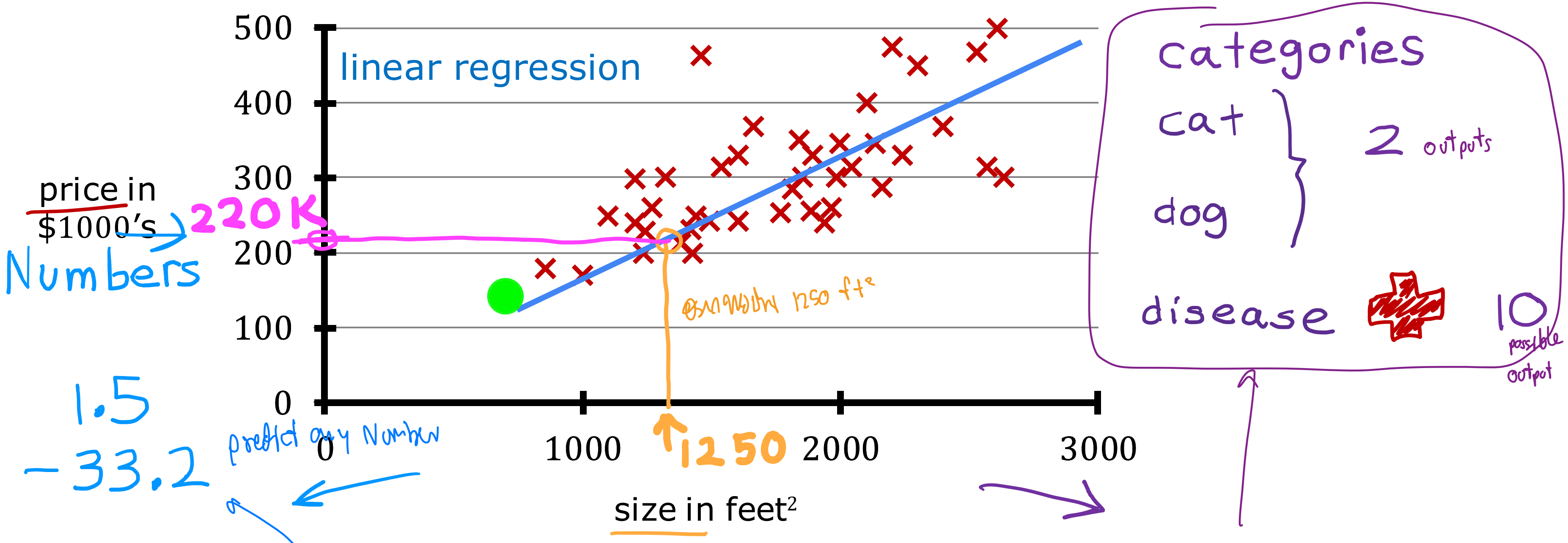


Linear Regression with One Variable

Linear Regression Model Part 1

House sizes and prices

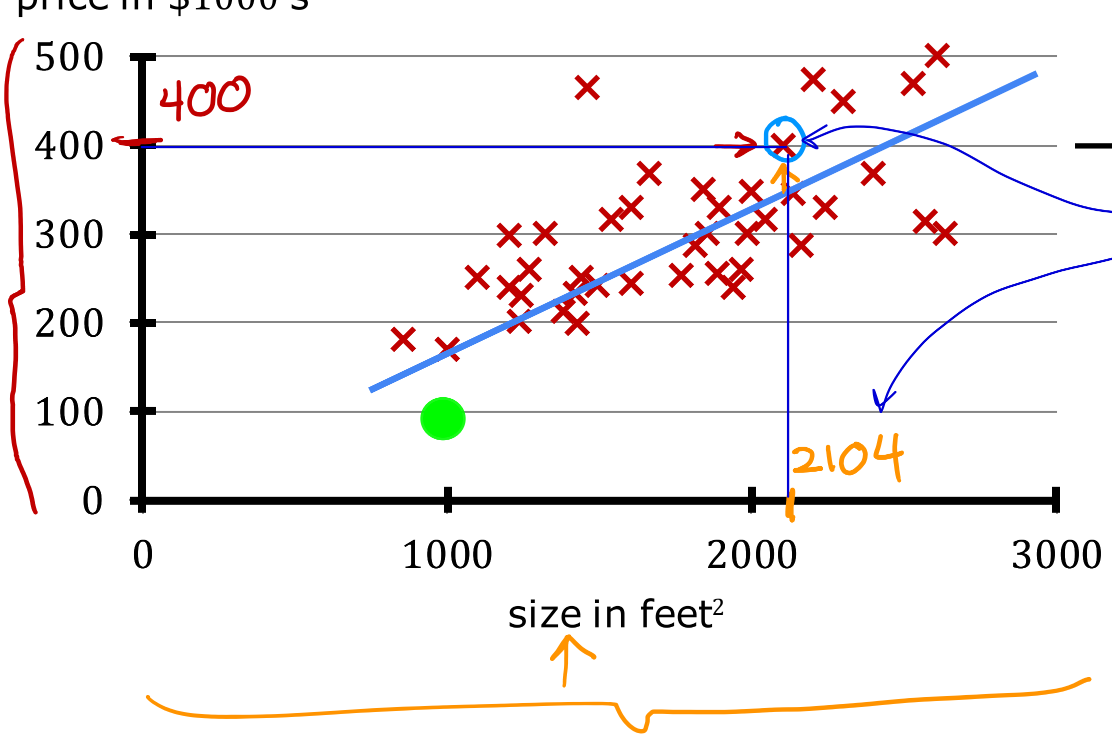


Regression model
Predicts numbers
Infinitely many possible outputs

Supervised learning model
Data has "right answers"

Classification model
Predicts categories
Small number of possible outputs

House sizes and prices



Data table

size in feet²	price in $1000's
2104	400
1416	232
1534	315
852	178
...	...
3210	870

Terminology

Training set: Data used to train the model

	x size in feet^2	y price in \$1000's
(1)	2104	400
(2)	1416	232
(3)	1534	315
(4)	852	178
...	...	...
(47)	3210	870

$m = 47$

$x^{(1)} = 2104$ $\quad y^{(1)} = 400$

$(x^{(1)}, y^{(1)}) = (2104, 400)$

$x^{(2)} = 1416$ $\quad x^{(2)} \neq x^2$ not exponent

Notation:

x = "input" variable
feature (sizes of the house)

y = "output" variable
"target" variable (prices of the house)

m = number of training examples

(x, y) = single training example

$(x^{(i)}, y^{(i)})$

$(x^{(i)}, y^{(i)})$ = i^{th} training example
index $\quad (1^{st}, 2^{nd}, 3^{rd} \ldots)$

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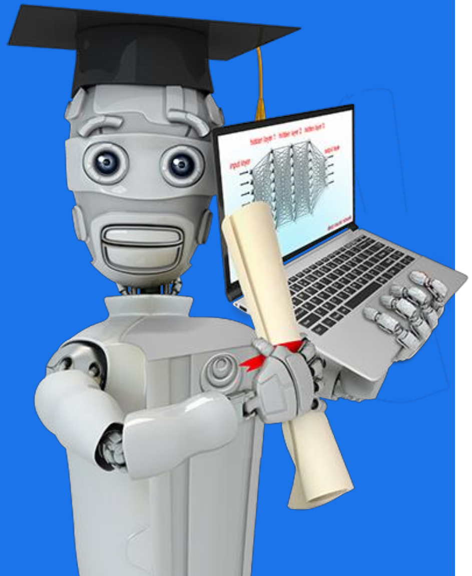


Linear Regression with One Variable

Linear Regression Model Part 2

training set

features
targets

learning algorithm

$x \rightarrow \boxed{f} \rightarrow \hat{y}$

"y-hat" $\hat{y}$

~~hypothesis~~ function

feature model prediction

(estimated y)

target
true value in training set

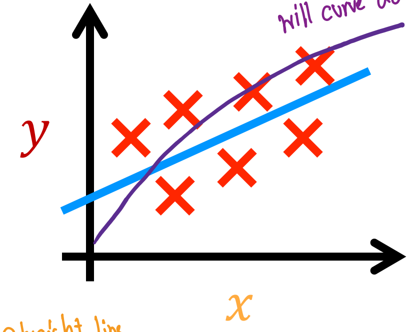
size $\rightarrow \boxed{f} \rightarrow$ price (estimated)

How to represent f?

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

$f(x)$ w,b เดี๋ยวไปเลือก (หาได้ train อ่ะ)

will curve do better? Maybe.



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

$f(x) = wx + b$

linear?

straight line

single feature x

Linear regression with one variable.

size

Univariate linear regression.

one variable

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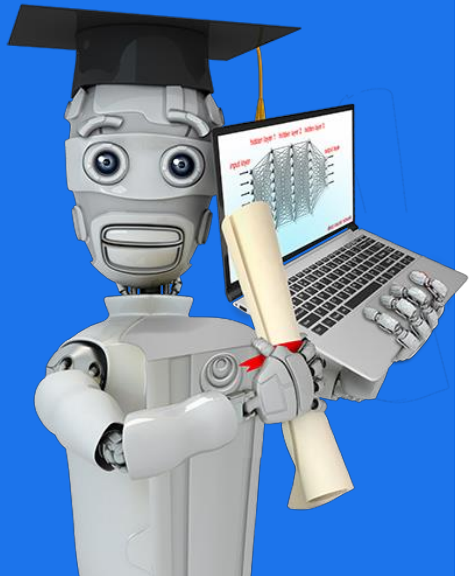


Linear Regression with One Variable

Cost Function

↳ tell us how well the model is doing

Training set

features size in feet^2 (x)	targets price \$1000's (y)
2104	460
1416	232
1534	315
852	178
...	...

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

var. we have to adjust

w, b: parameters

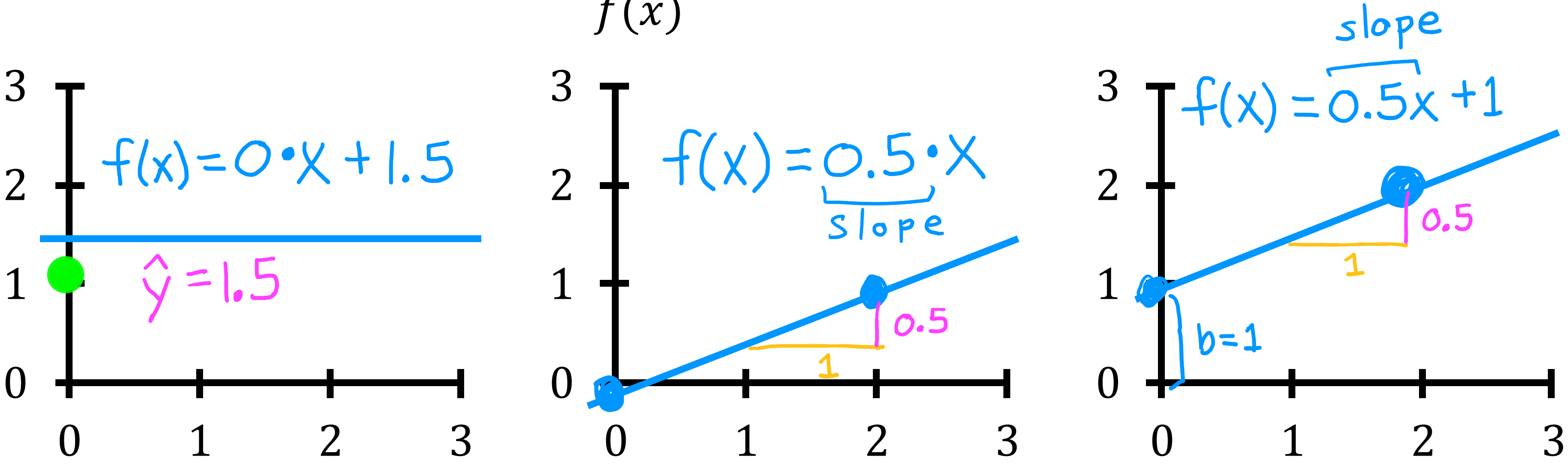
coefficients

weights

What do w, b do?

$$f_{w,b}(x) = wx + b \rightarrow \text{เส้นตรงต่อ}$$

$f(x)$



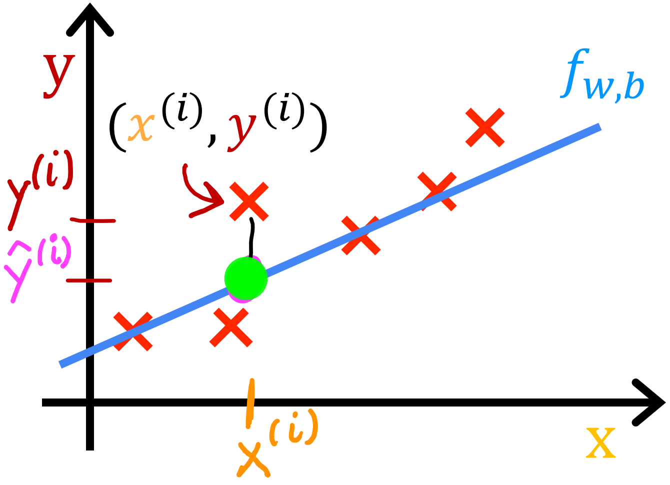
$\rightarrow$ $w = 0$
$\rightarrow$ $b = 1.5$
y-intercept

$\rightarrow$ $w = 0.5$
$\rightarrow$ $\mathrm{b} = 0$

$\rightarrow$ $w = 0.5$
$\rightarrow$ $b = 1$

Cost function: Squared error cost function

(Good for linear regression)



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

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

cost function

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

error

ใส่/ไม่ใส่ก็ได้ แต่ใส่ neat กว่า

m = number of training examples

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

intuition (next!)

Find w, b:

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

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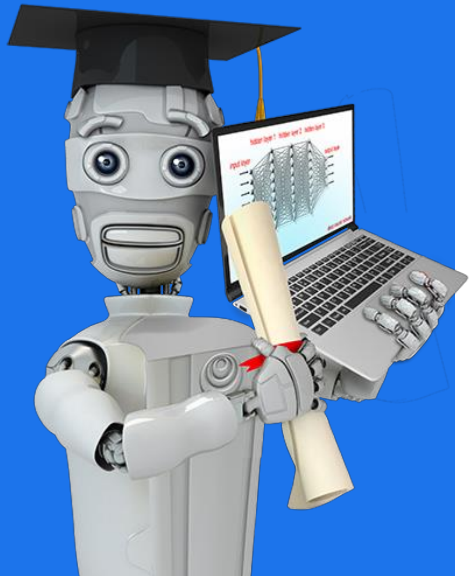
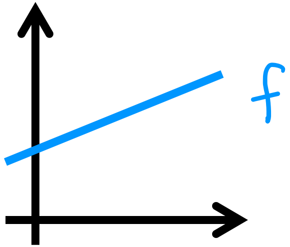


Linear Regression with One Variable

Cost Function Intuition

model:

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



parameters:

$$w, b$$

cost function:

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

goal:

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

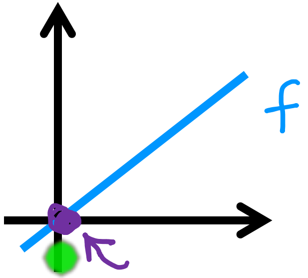
simplified

$$f_w(x) = wx$$

0 0

b = 0

w



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

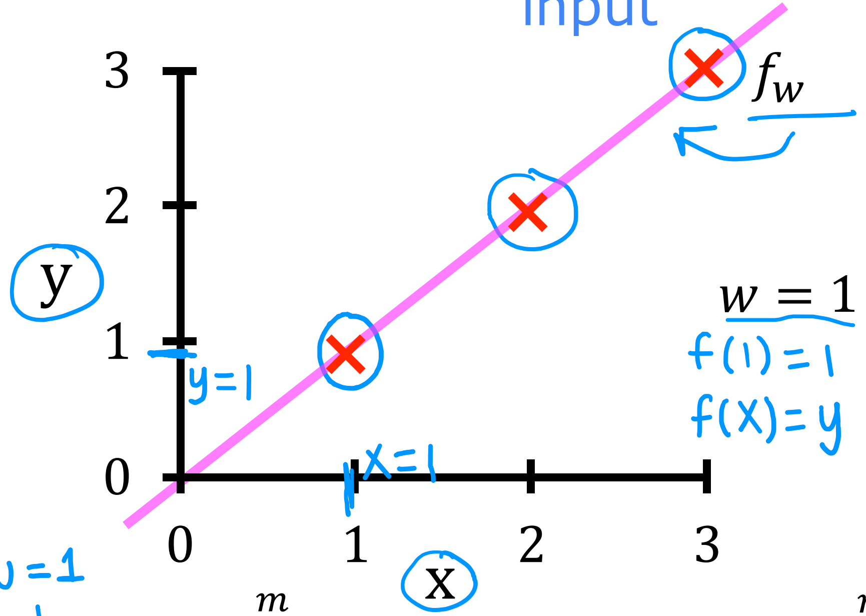
$wx^{(i)}$

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

$f_w(x)$

(for fixed w, function of x)

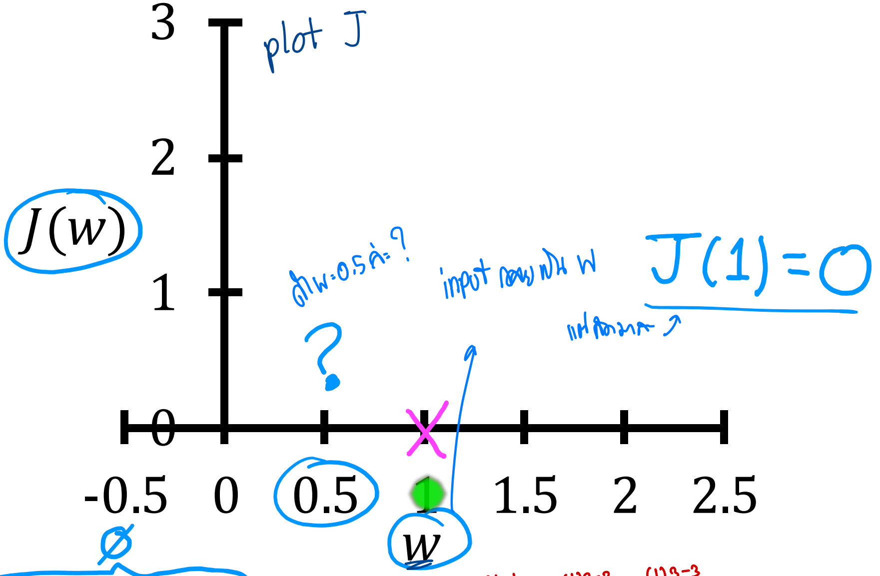
input



$J(w)$

(function of w)

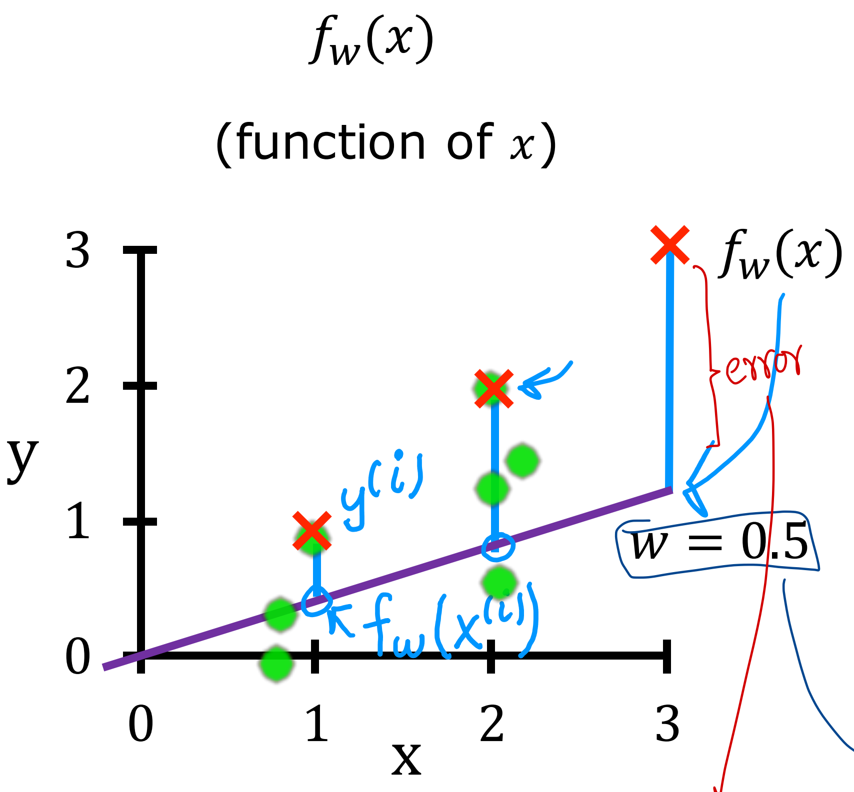
parameter

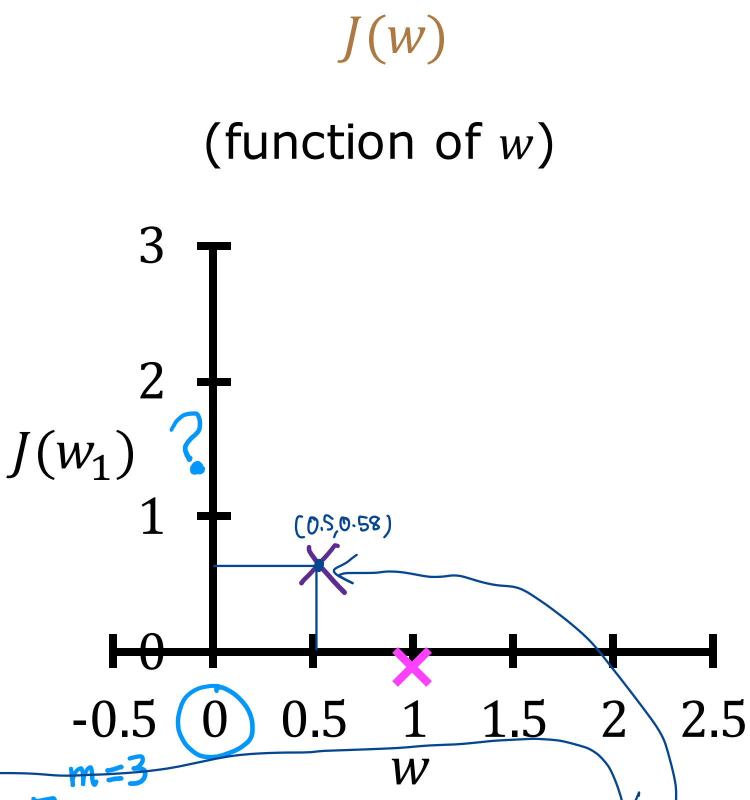


$$\underset{\uparrow\, w=1}{J(w)} = \frac{1}{2m}\sum_{i=1}^{m}(\underbrace{f_w(x^{(i)})}_{wx^{(i)}} - y^{(i)})^2 = \frac{1}{2m}\sum_{i=1}^{m}(\overbrace{\cancel{w}x^{(i)} - y^{(i)}}^{0})^2 = \frac{1}{2m}(0^2 + 0^2 + 0^2) = 0$$

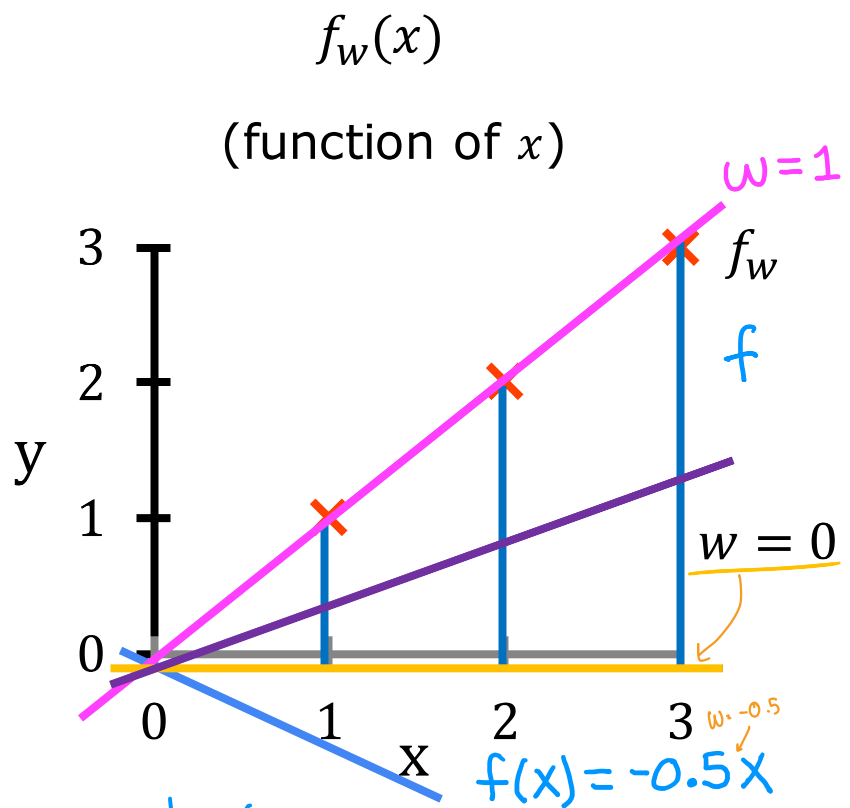
and $x^i = y^i$ so all 0

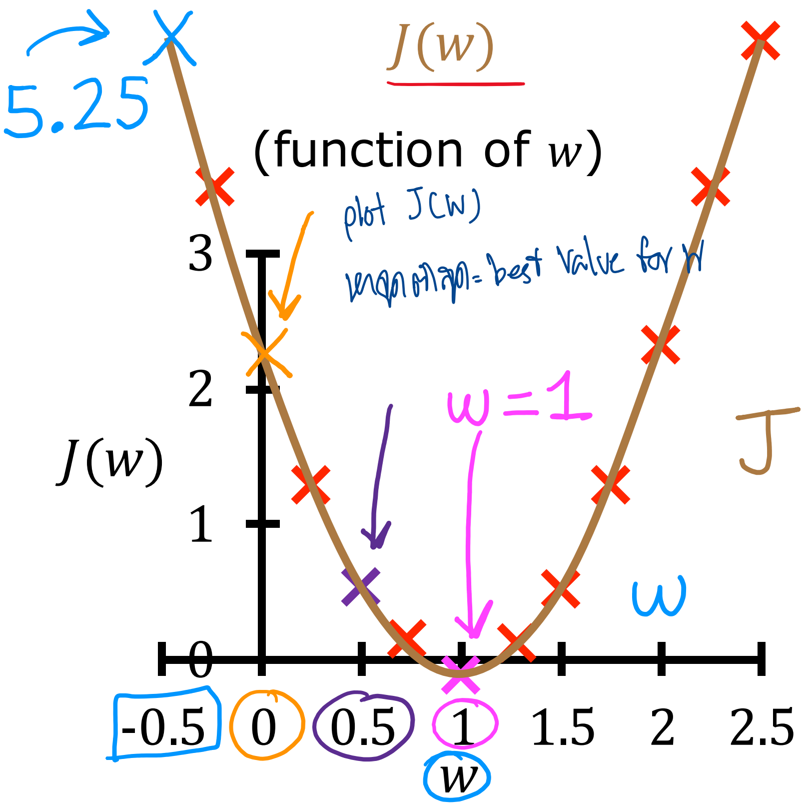
(1)1-1 (1)2-2 (1)3-3





$$J(0.5) = \frac{1}{2m}\left[(0.5-1)^2+(1-2)^2+(1.5-3)^2\right] = \frac{1}{2\times 3}[3.5] = \frac{3.5}{6} \approx 0.58$$





$$J(0) = \frac{1}{2m}\left(1^2 + 2^2 + 3^2\right) = \frac{1}{6}[14] \approx 2.3$$

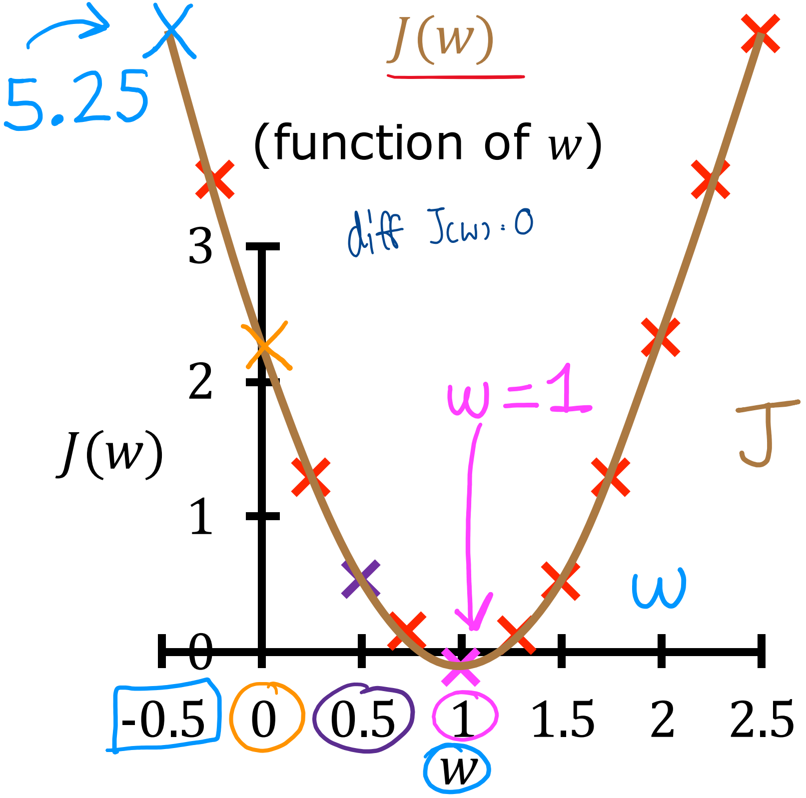
how to choose w?

goal of linear regression:

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

general case:

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



choose w to minimize J(w)

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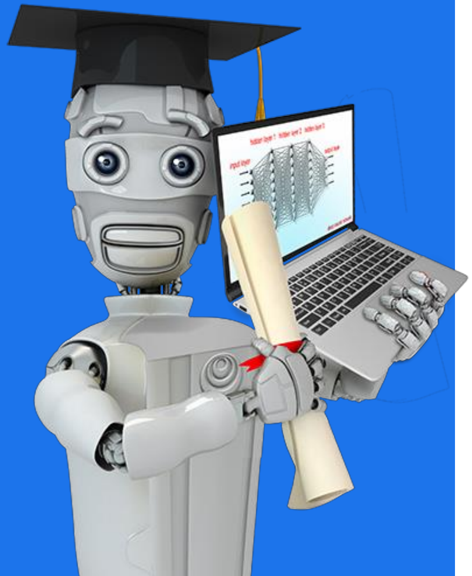


Linear Regression with One Variable

Visualizing the Cost Function

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

Parameters w, b

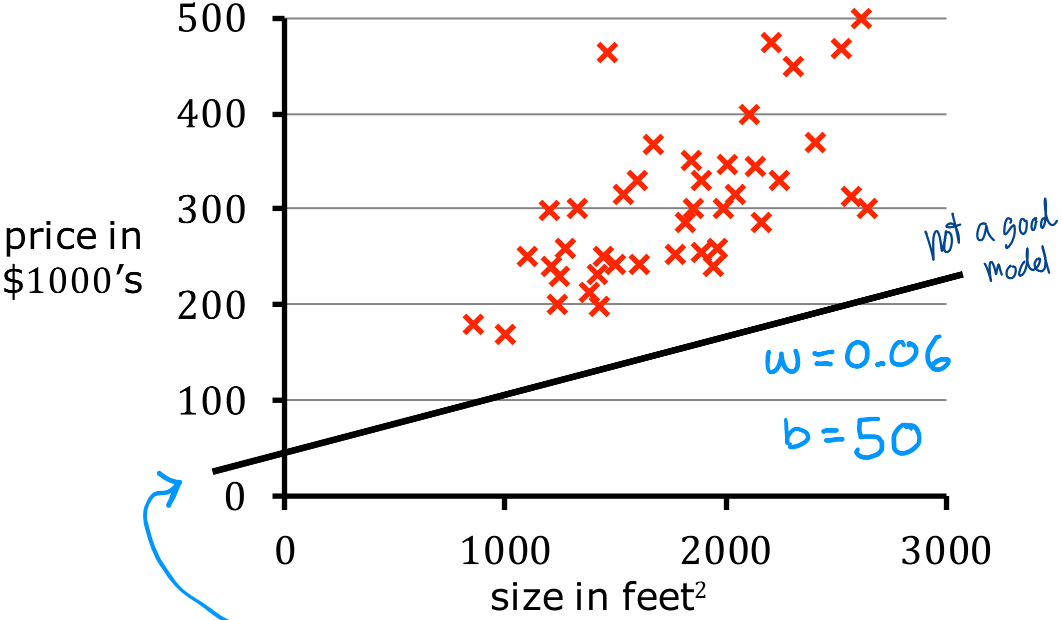
~~before: b=0~~

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

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

$f_{w,b}$

(function of x)

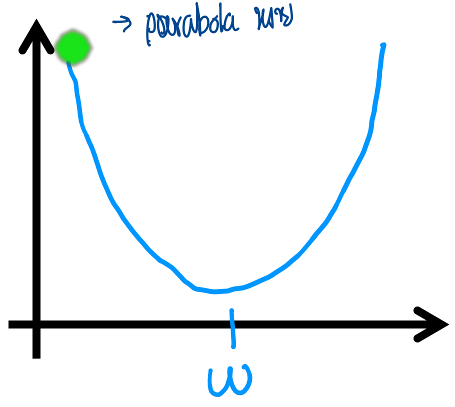


$$\boxed{f_{w,b}(x) = 0.06x + 50}$$

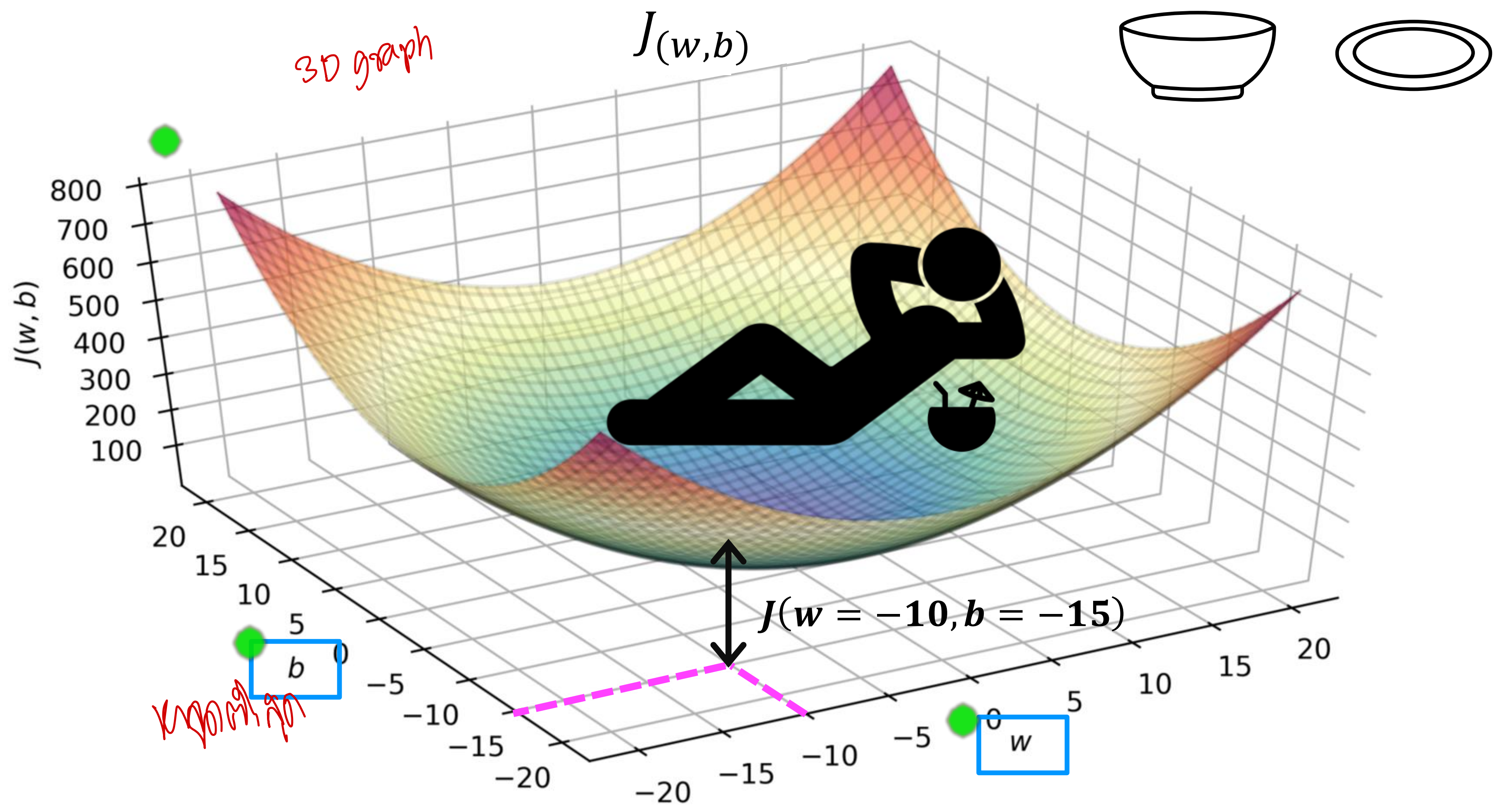
J

(function of w, b)

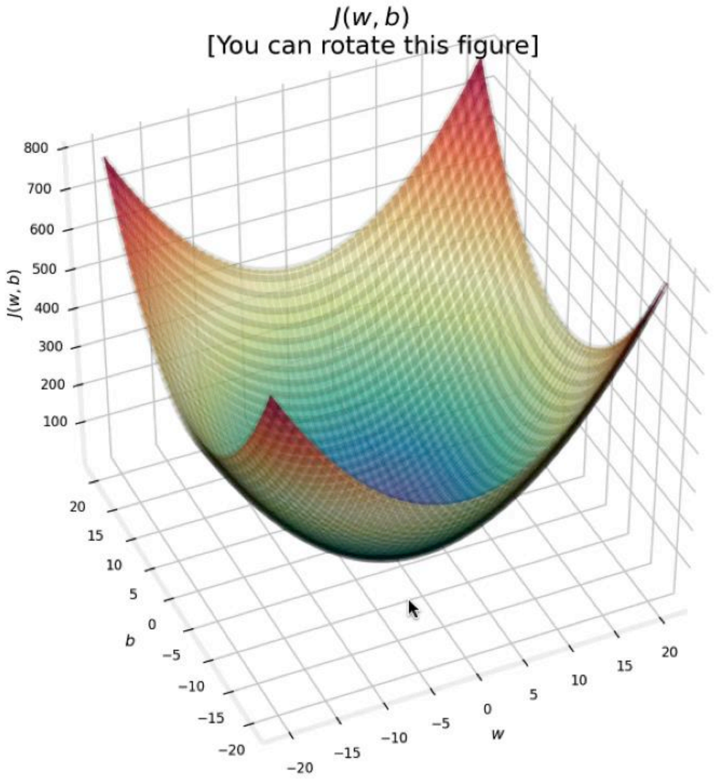
what of J(w) will look like



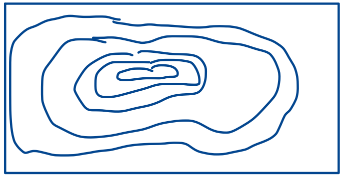
$$\boxed{w, b}$$

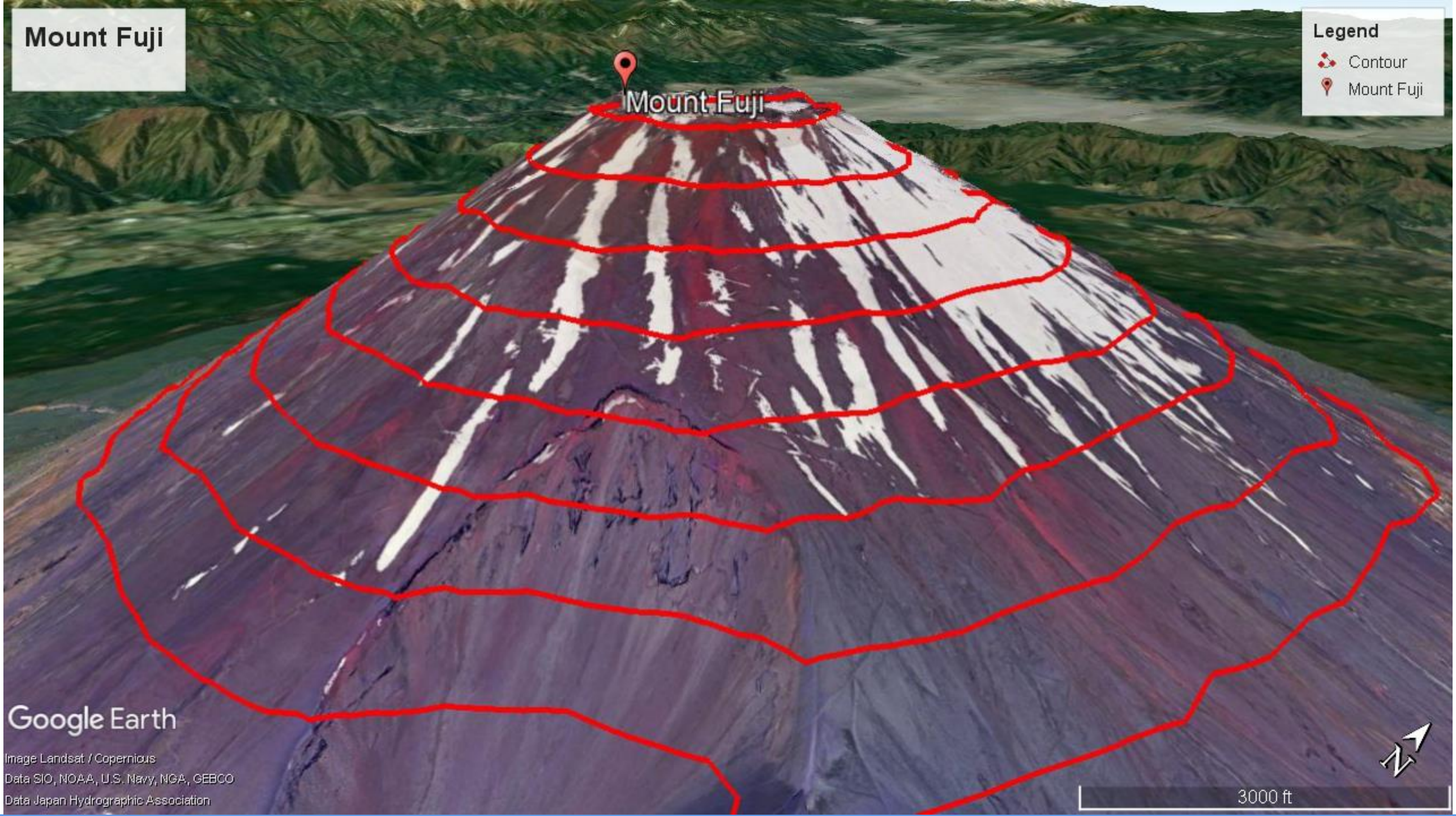

3D graph
$J(w,b)$
800
700
600
500
400
300
200
100
$J(w,b)$
20
15
10
5
0
−5
−10
−15
−20
b
$J(w = -10, b = -15)$
−20
−15
−10
−5
0
5
10
15
20
w

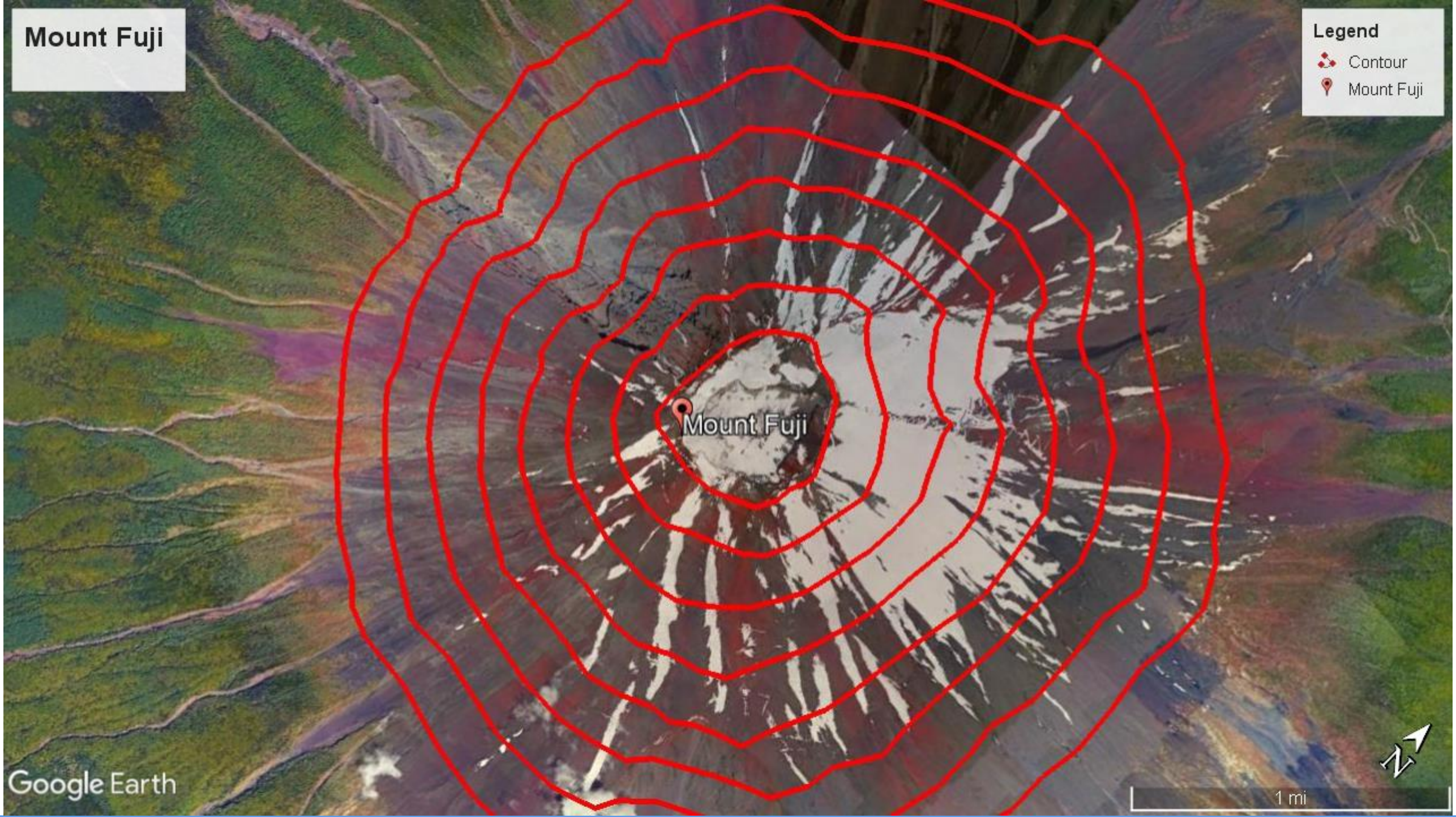
3D surface plot

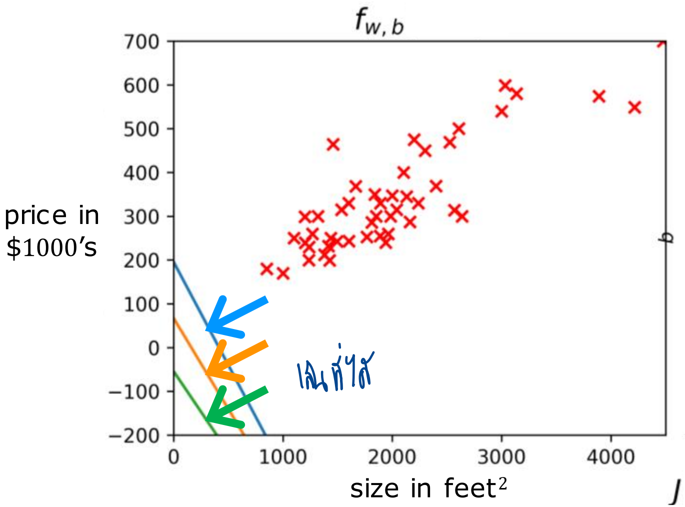


Alternative
contour plot

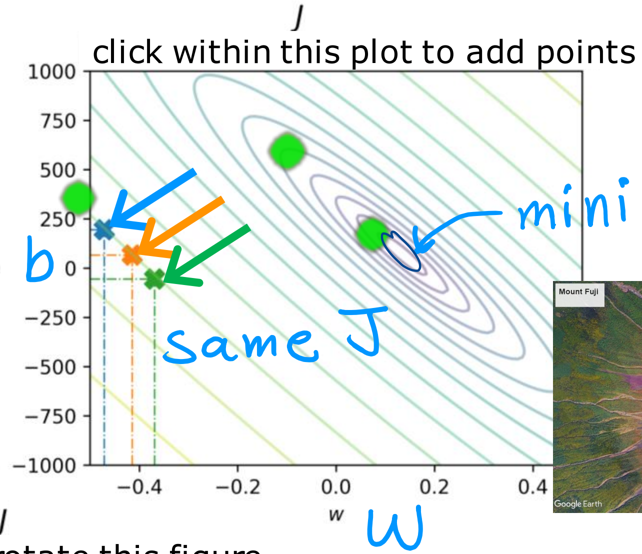



Mount Fuji
Legend
Contour
Mount Fuji
Mount Fuji
Google Earth
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data Japan Hydrographic Association
3000 ft

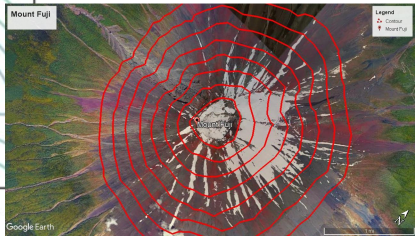

Mount Fuji
Legend
Contour
Mount Fuji
Mount Fuji
Google Earth
1 mi



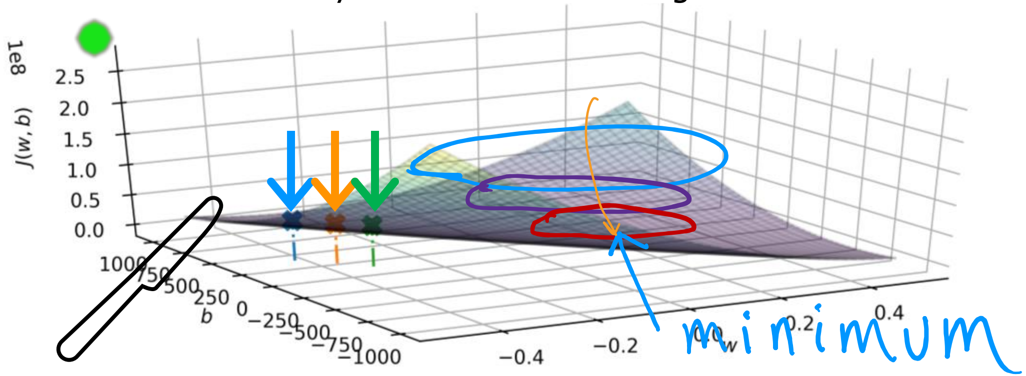
$f_{w,b}$
price in $1000's
size in feet^2



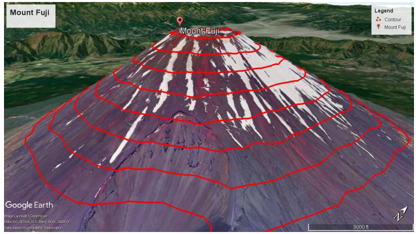
J
click within this plot to add points
b
w
minimum
same J



Mount Fuji
Google Earth



J
you can rotate this figure
1e8
J(w, b)
b
w
minimum



Mount Fuji
Google Earth

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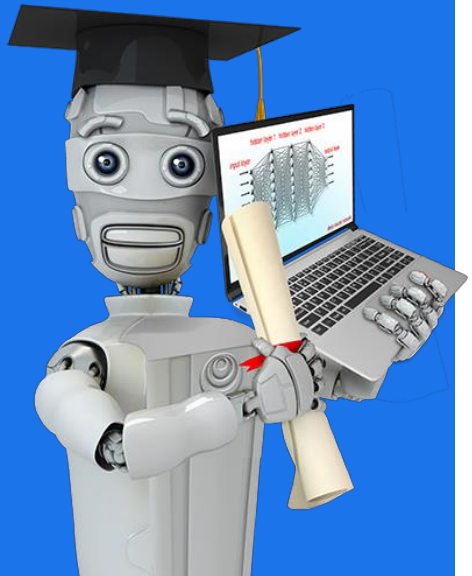
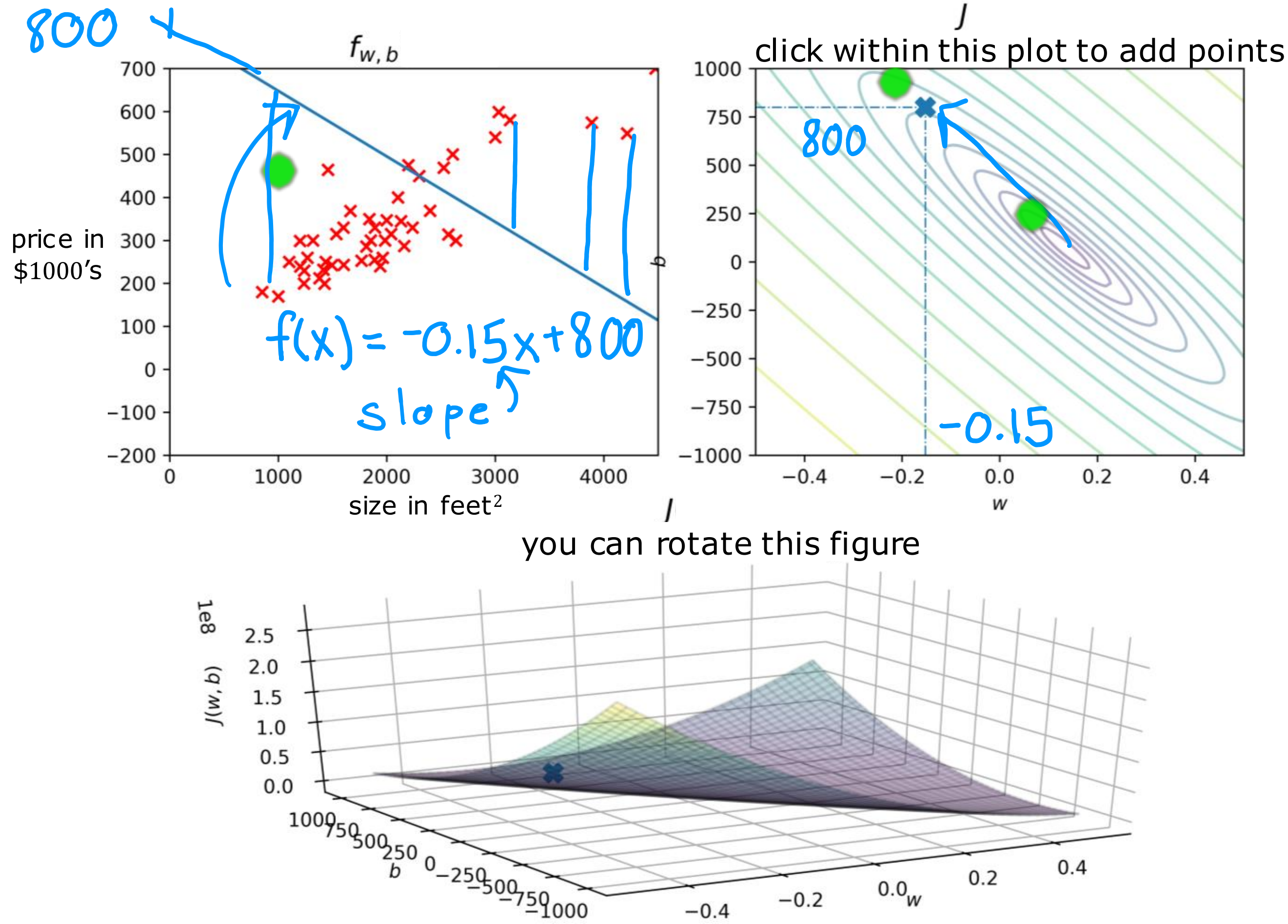
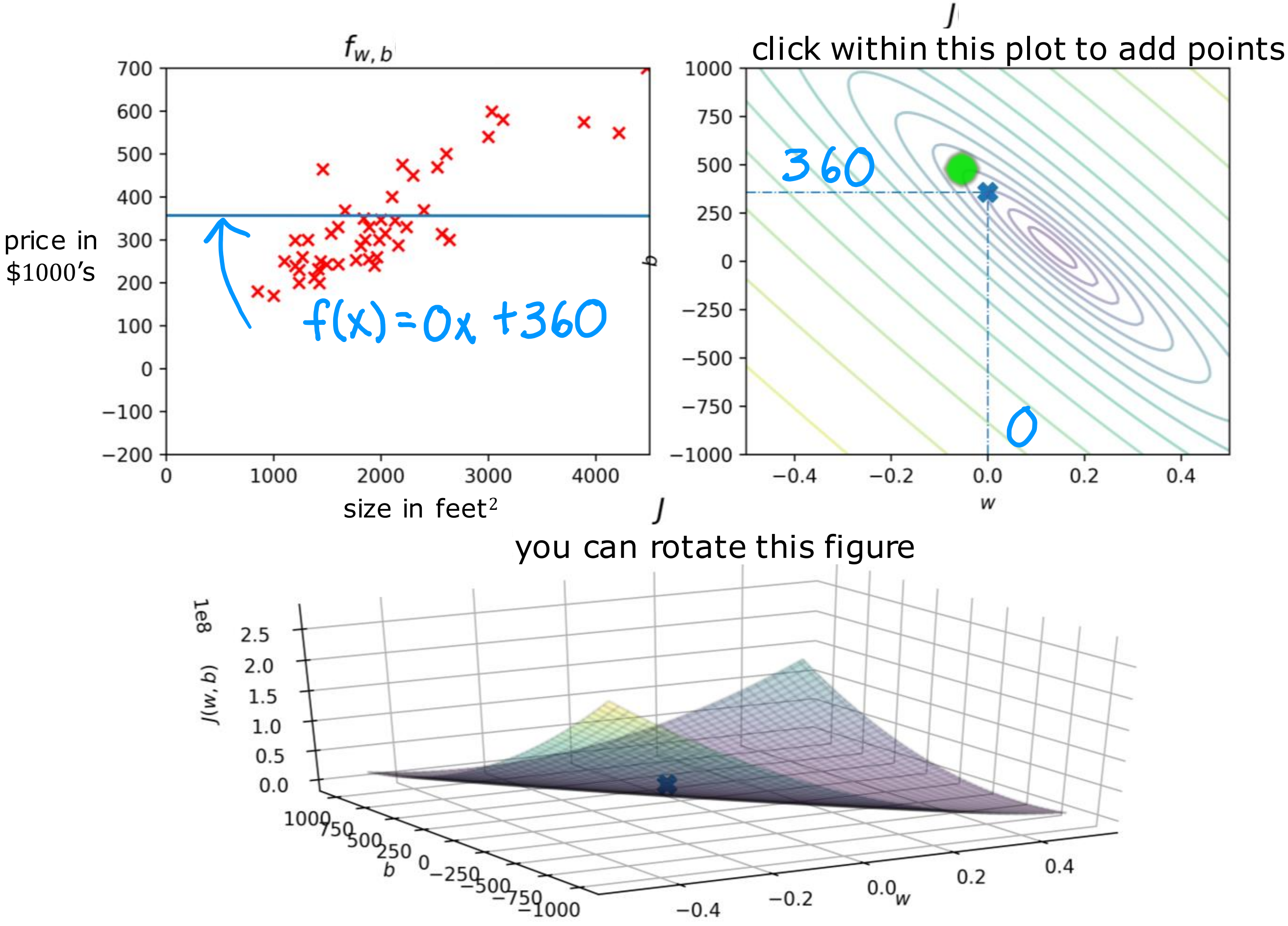


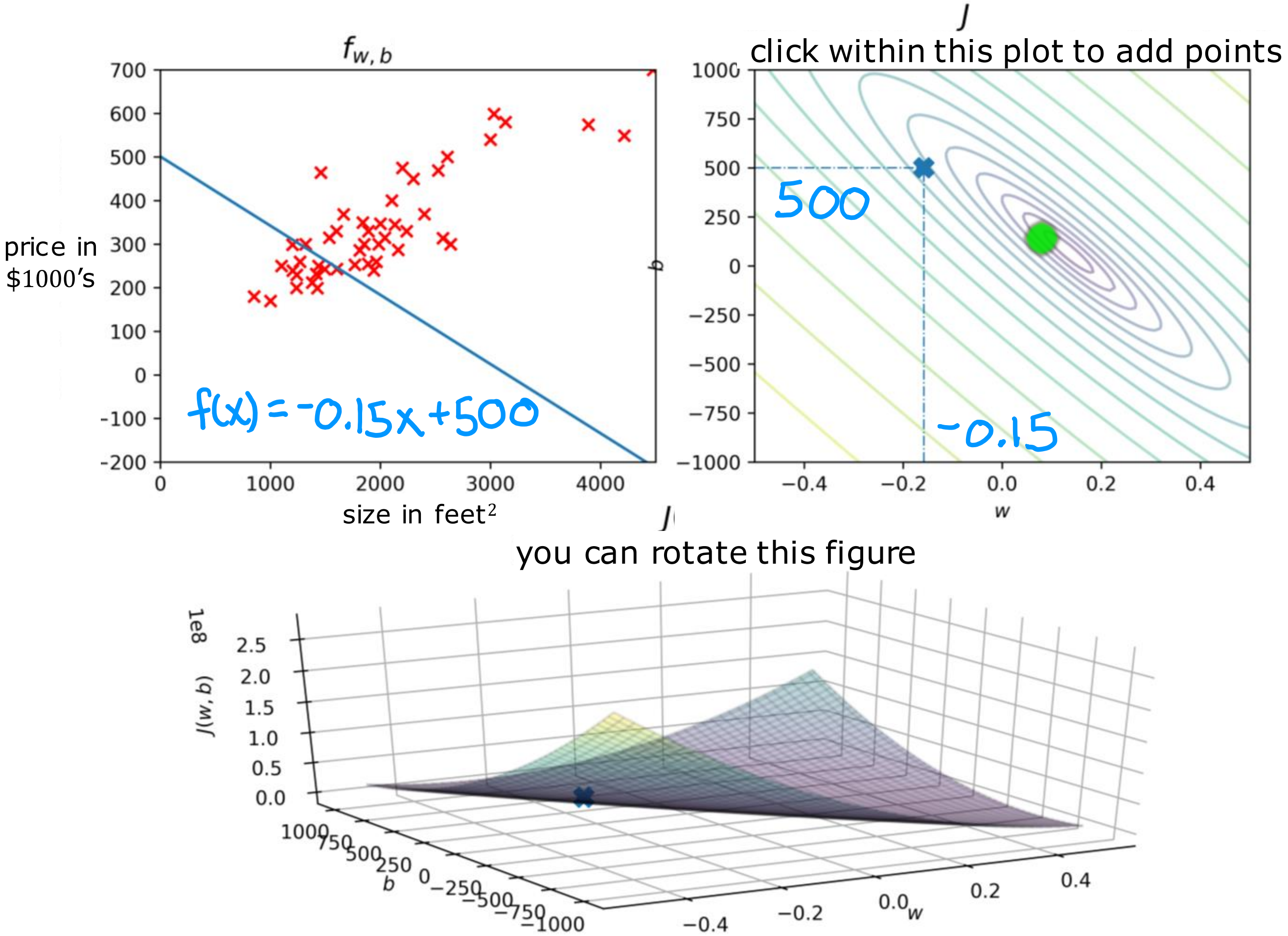
Linear Regression with One Variable

Visualization examples

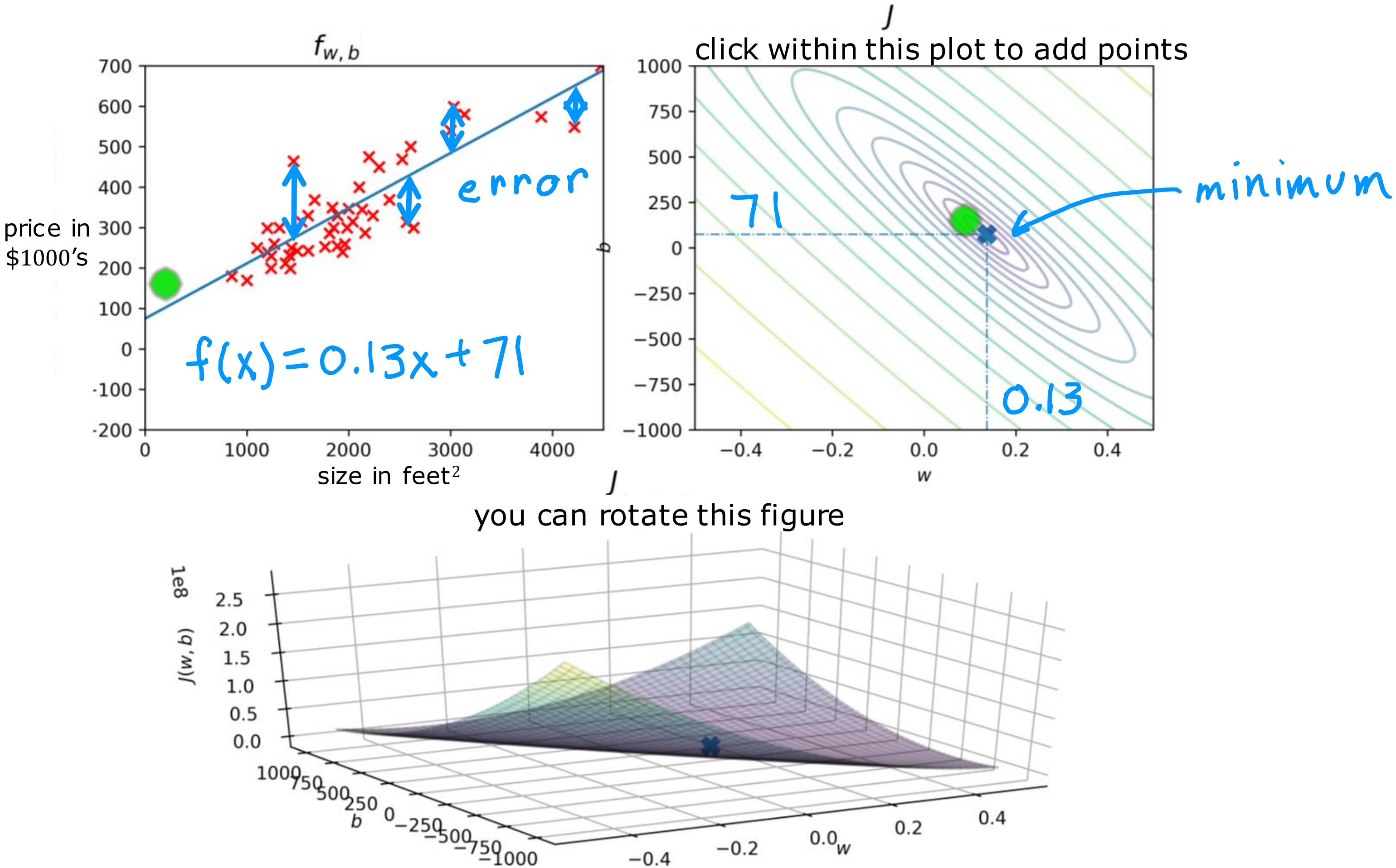

800
$f_{w,b}$
price in $1000's
size in feet²
f(x) = -0.15x+800
slope
J
click within this plot to add points
800
-0.15
b
w
J
you can rotate this figure
1e8
J(w, b)
b
w



$f_{w,b}$
price in $1000's
size in feet^2
f(x)=0x +360
J
click within this plot to add points
360
0
b
w
J
you can rotate this figure
1e8
J(w, b)
b
w



$f_{w,b}$
price in $1000's
size in feet^2
f(x) = -0.15x+500
J
click within this plot to add points
500
-0.15
w
b
you can rotate this figure
1e8
J(w, b)



$f_{w,b}$
price in $1000's
size in feet²
error
f(x)=0.13x+71
J
click within this plot to add points
71
minimum
0.13
b
w
J
you can rotate this figure
J(w, b)
1e8
b
w

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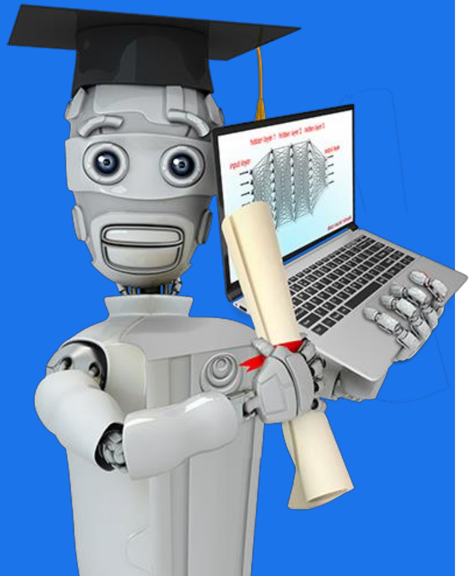


Training Linear Regression

Gradient Descent

Alg to find minimum $J(w,b)$

Have some function $J(w, b)$ for linear regression or any function

Want $\min_{w,b} J(w, b)$ $\qquad \min_{w_1,\ldots,w_n,b} J(w_1, w_2, \ldots, w_n, b)$

ใช้ได้สำหรับหลาย features เหมือนกัน

Outline:

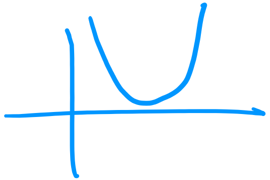
Start with some w, b (set $w=0, b=0$)

Keep changing w, b to reduce $J(w, b)$

Until we settle at or near a minimum

may have >1 minimum

J not always



gradient descent

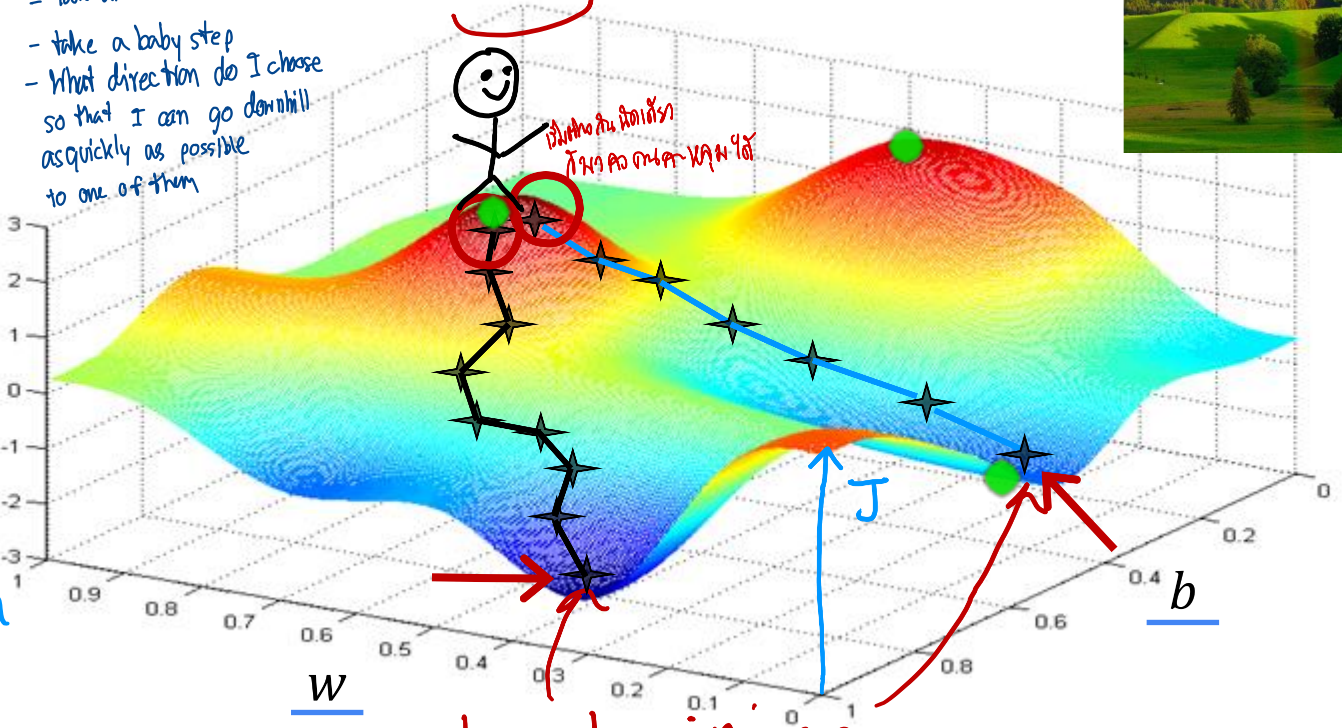
- choose random place
- look around
- take a baby step
- What direction do I choose so that I can go downhill as quickly as possible to one of them

เริ่มต่างกันนิดเดียว
ก็มาคนละหลุมได้

$J(w,b)$

not squared error cost

not linear regression



w

b

local minima

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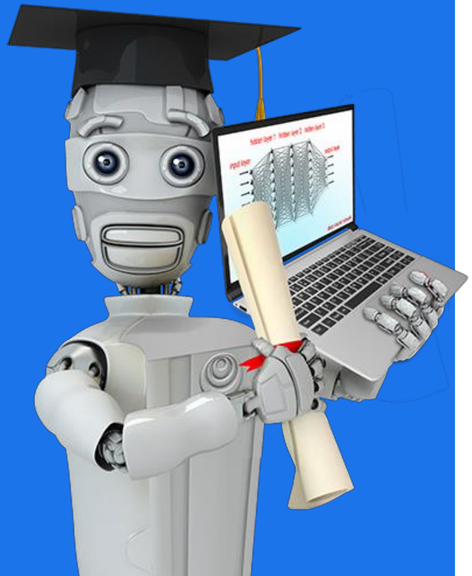

Training Linear Regression

Implementing Gradient Descent

Gradient descent algorithm

Repeat until convergence

assignment coding terms.

$$w = w - \alpha \boxed{\frac{\partial}{\partial w} J(w,b)}$$

$$b = b - \alpha \frac{\partial}{\partial b} J(w,b)$$

how big the step we take

big step made us miss lowest point

Learning rate (0-1)

Derivative

Simultaneously update w and b

update both w and b at the same time

Assignment

$a = c$

$a = a + 1$

Code

Truth assertion

$a = c$

$\cancel{a = a + 1}$

Math

a==c

Correct: Simultaneous update

$$tmp\_w = w - \alpha \frac{\partial}{\partial w} J(w,b)$$

$$tmp\_b = b - \alpha \frac{\partial}{\partial b} J(w,b)$$

$$w = tmp\_w$$

$$b = tmp\_b$$

Incorrect

$$tmp\_w = w - \alpha \frac{\partial}{\partial w} J(w,b)$$

$$w = tmp\_w$$

$$tmp\_b = b - \alpha \frac{\partial}{\partial b} J(w,b)$$

$$b = tmp\_b$$

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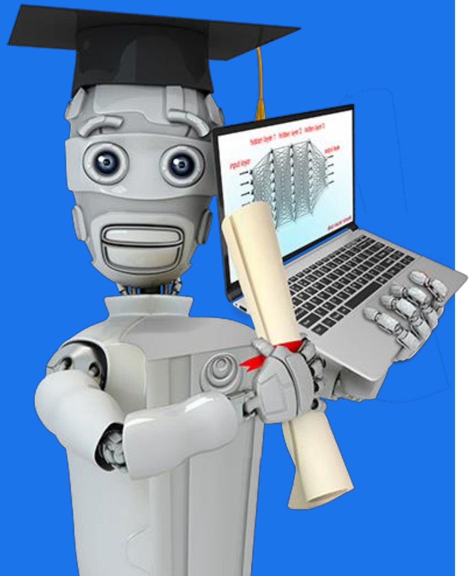


Training Linear Regression

Gradient Descent Intuition

Gradient descent algorithm

minimize just one parameter

repeat until convergence {

learning rate

derivative

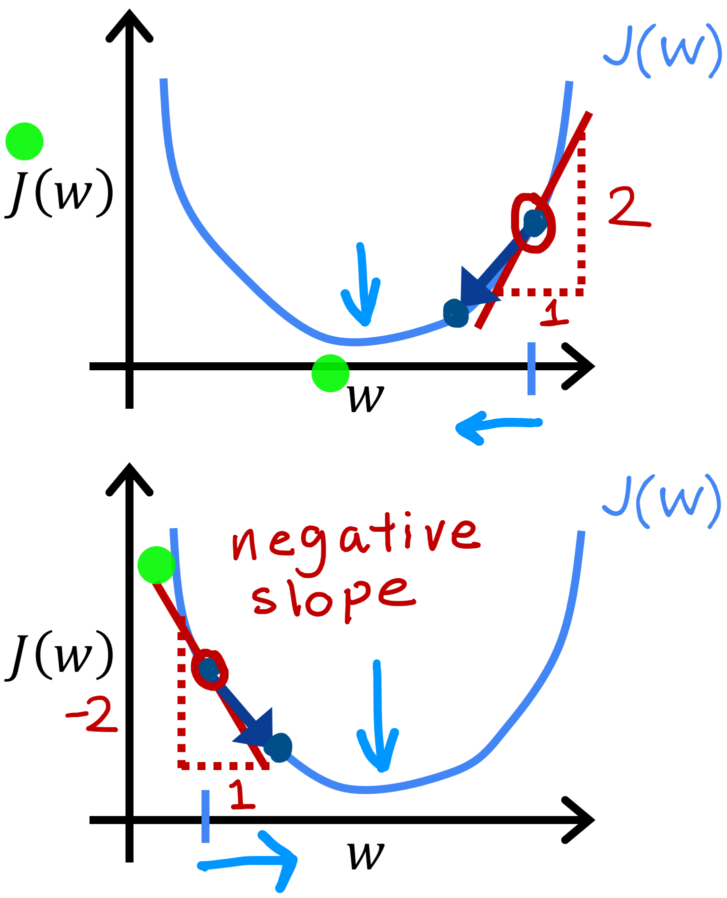
$$w = w - \alpha \boxed{\frac{\partial}{\partial w} J(w,b)}$$

$$b = b - \alpha \frac{\partial}{\partial b} J(w,b)$$

$J(w)$

$$w = w - \alpha \frac{\partial}{\partial w} J(w)$$

$$\min_{w} J(w)$$



$$w = w - \alpha \underbrace{\boxed{\frac{d}{dw}J(w)}}_{>0}$$

$$w = w - \alpha \cdot (\text{positive number})$$ → w will be smaller

$$\underbrace{\frac{d}{dw}J(w)}\ <0$$

$$w = w - \alpha \cdot (\text{negative number})$$ → W will be bigger

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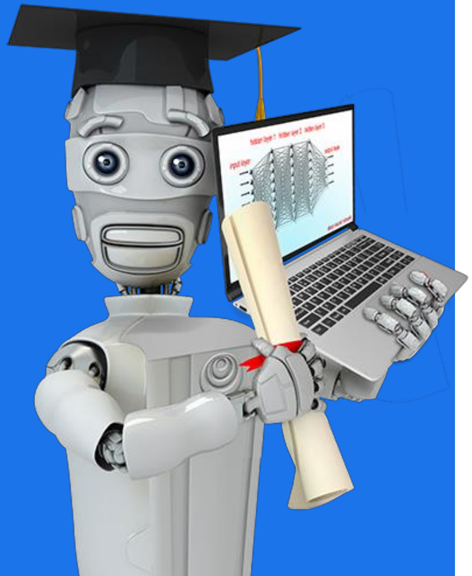


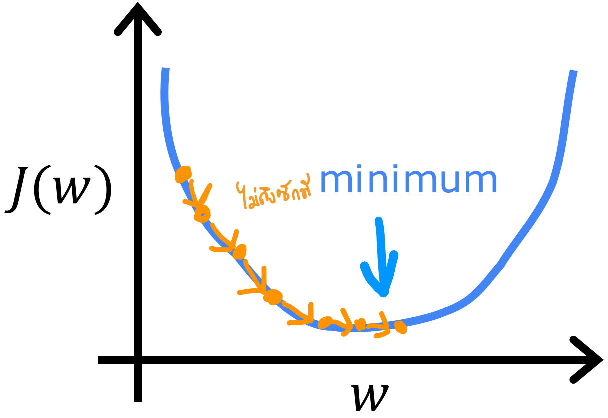
Training Linear Regression

Learning Rate

$$w = w - \alpha \frac{d}{dw} J(w)$$

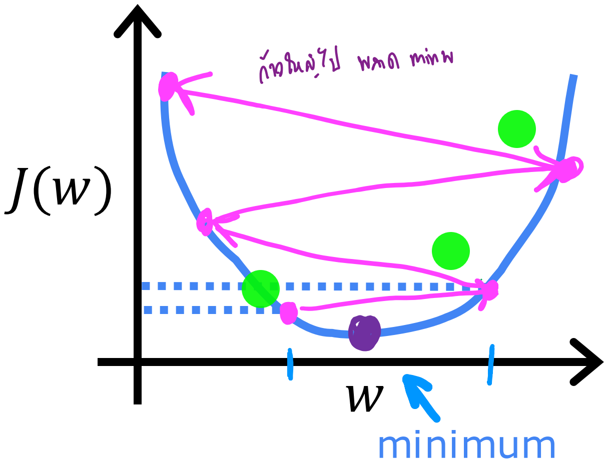
If α is too small...

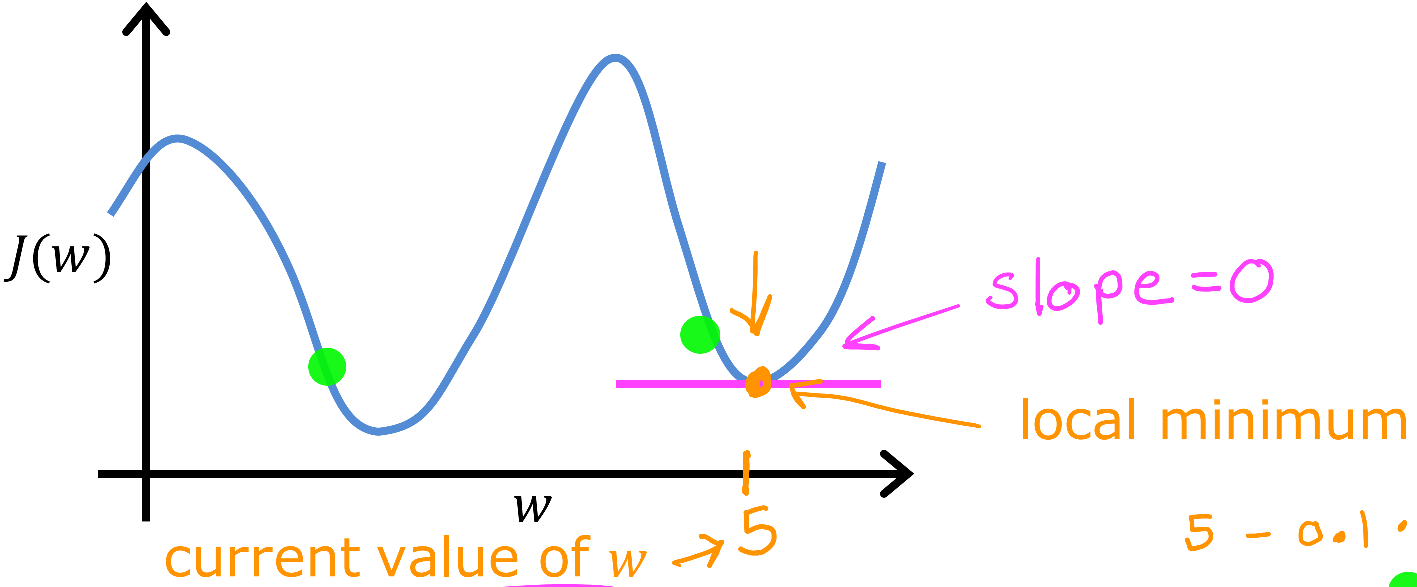
Gradient descent may be slow.



If α is too large...

Gradient descent may:
- Overshoot, never reach minimum
- Fail to converge, diverge





$5 - 0.1 \cdot 0 = 5$ เท่าเดิม

$$w = w - \underset{0.1}{\alpha} \underbrace{\boxed{\frac{d}{dw}J(w)}}_{=0}$$

w will stay the same ☆

$$w = w - \alpha \cdot 0$$

$$\underset{5}{w} = \underset{5}{w}$$

Can reach local minimum with fixed learning rate

α

$$w = w - \underbrace{\boxed{\overset{\text{smaller}}{\overbrace{\overset{\text{not as large}}{\overbrace{\alpha \frac{d}{dw} J(w)}}}}}}_{}$$

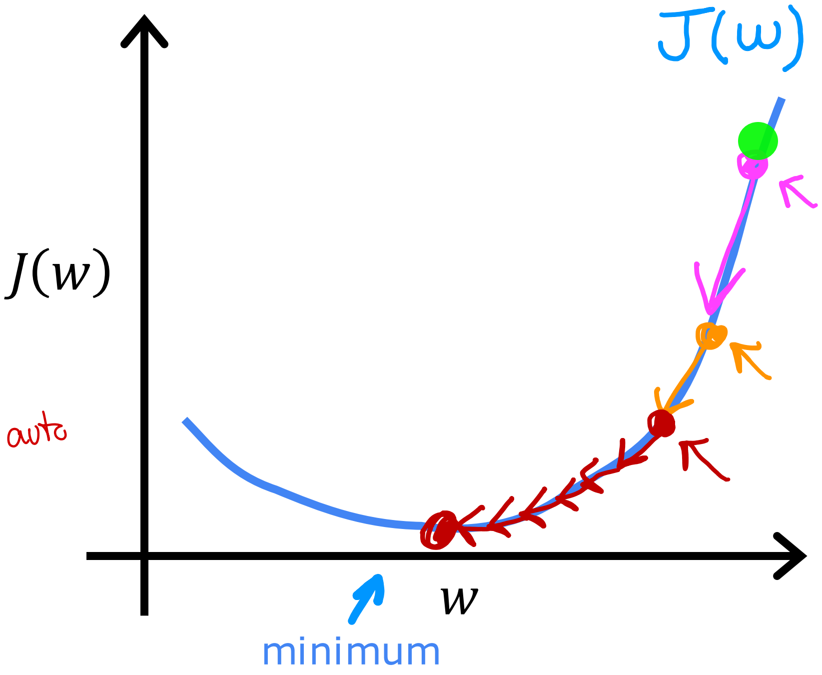
large

พอใกล้จุดต่ำสุด ที่ใช้
ค.ชัน ทดแทนมันน้อย : ต้องคูณ α น้อยลง
เดี๋ยวก้าวมันก็เล็กลง auto
ยกเว้นว่าจะก้าวใหญ่ เกินไปแต่แรก

Near a local minimum,
- Derivative becomes smaller
- Update steps become smaller

ก้าวเล็กลง auto

Can reach minimum without decreasing learning rate α



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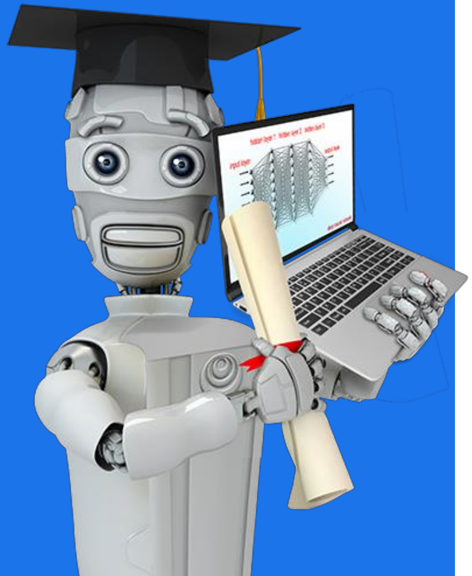


Training Linear Regression

Gradient Descent for Linear Regression

Linear regression model

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

Cost function

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

Gradient descent algorithm

repeat until convergence {

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

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

}

next slide
is optional!

(Optional)

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

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

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

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

no $x^{(i)}$

Gradient descent algorithm

$\frac{\partial}{\partial w} J(w,b)$

repeat until convergence {

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

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

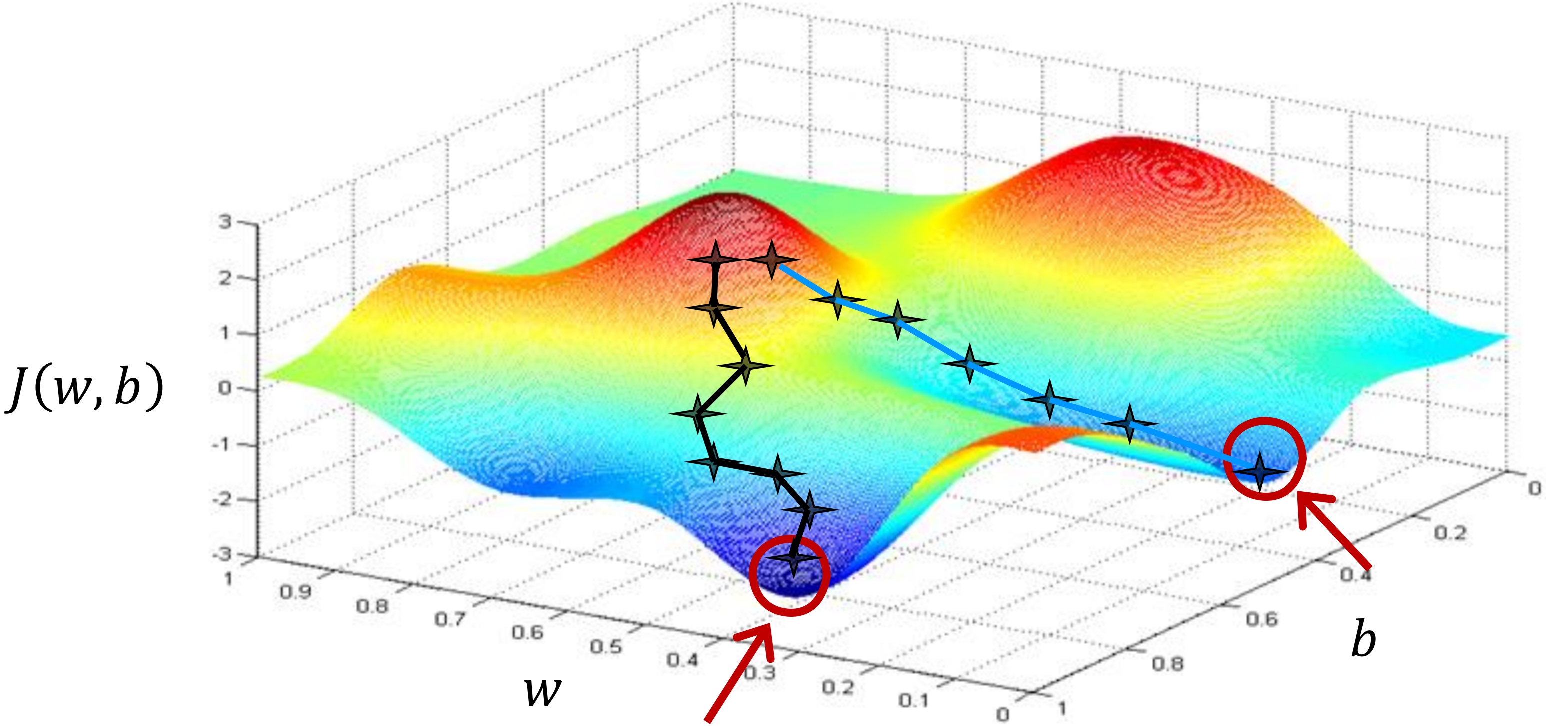
}

$\frac{\partial}{\partial b} J(w,b)$

Update w and b simultaneously

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

More than one local minimum



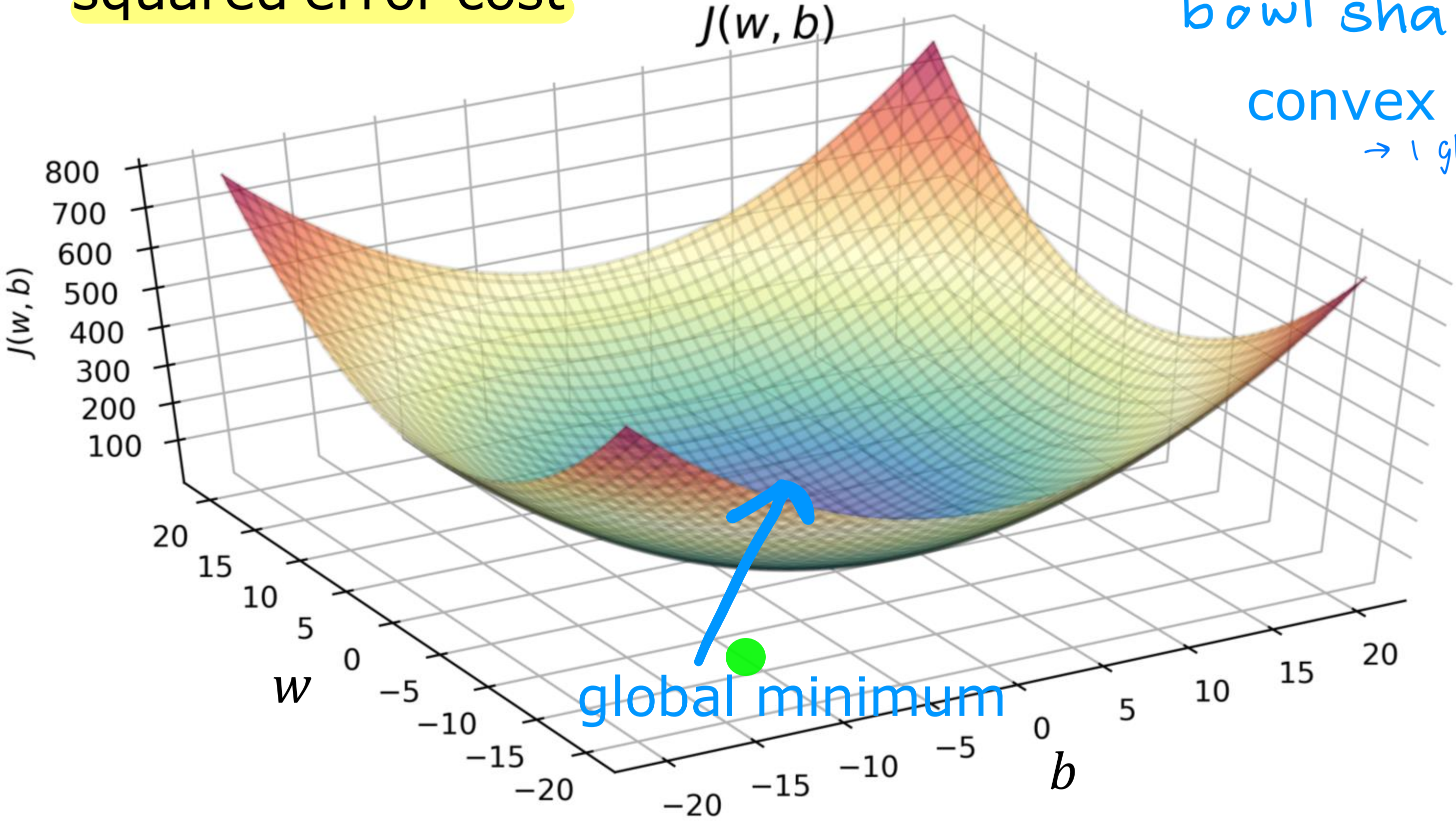
$\nexists$ 1 local minimum

squared error cost

bowl shape

convex function

→ 1 global minimum



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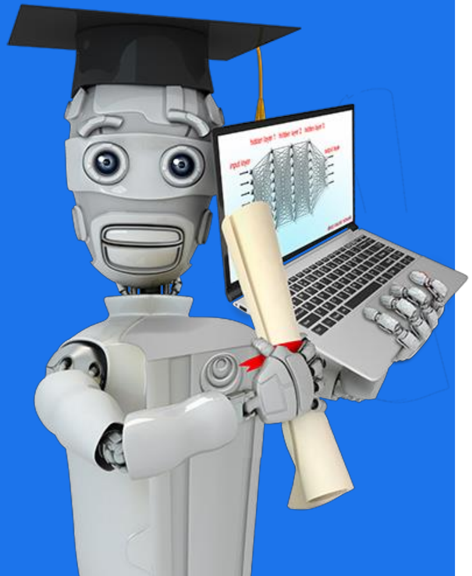


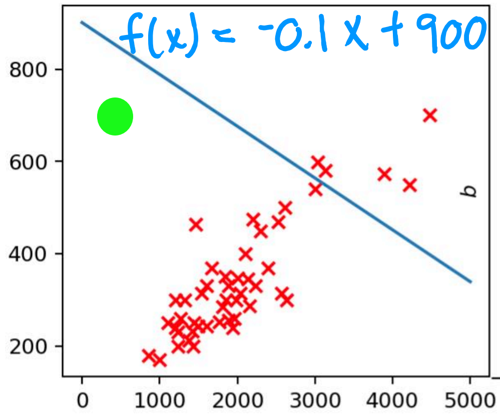
Training Linear Regression

Running Gradient Descent

price in
$1000’s

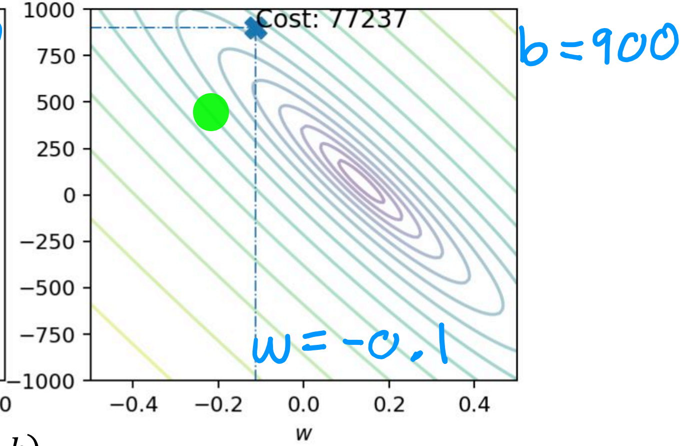
ปกติจะเริ่มที่ $w=b=0$

$f_{w,b}(size)$

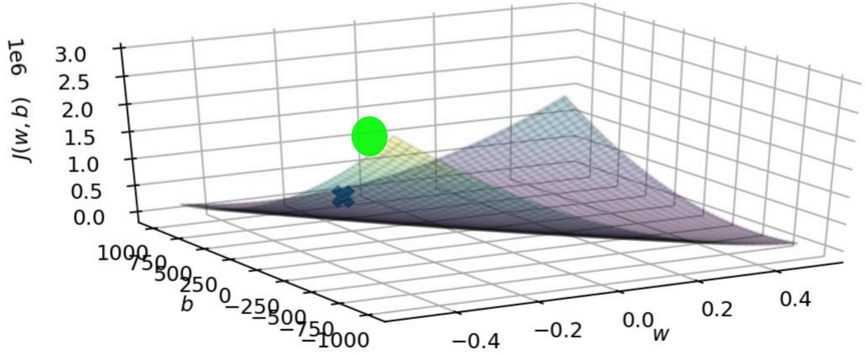


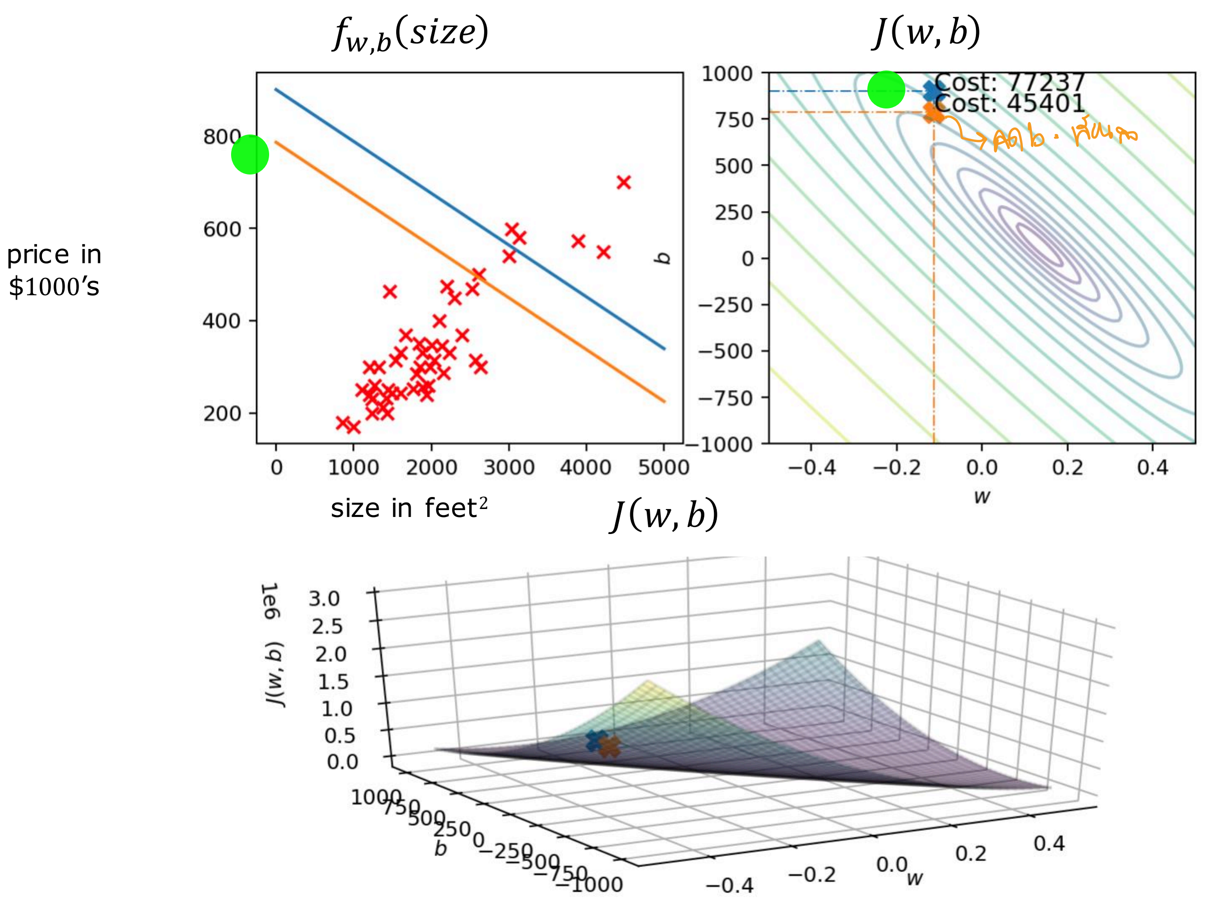
size in feet^2

$J(w,b)$

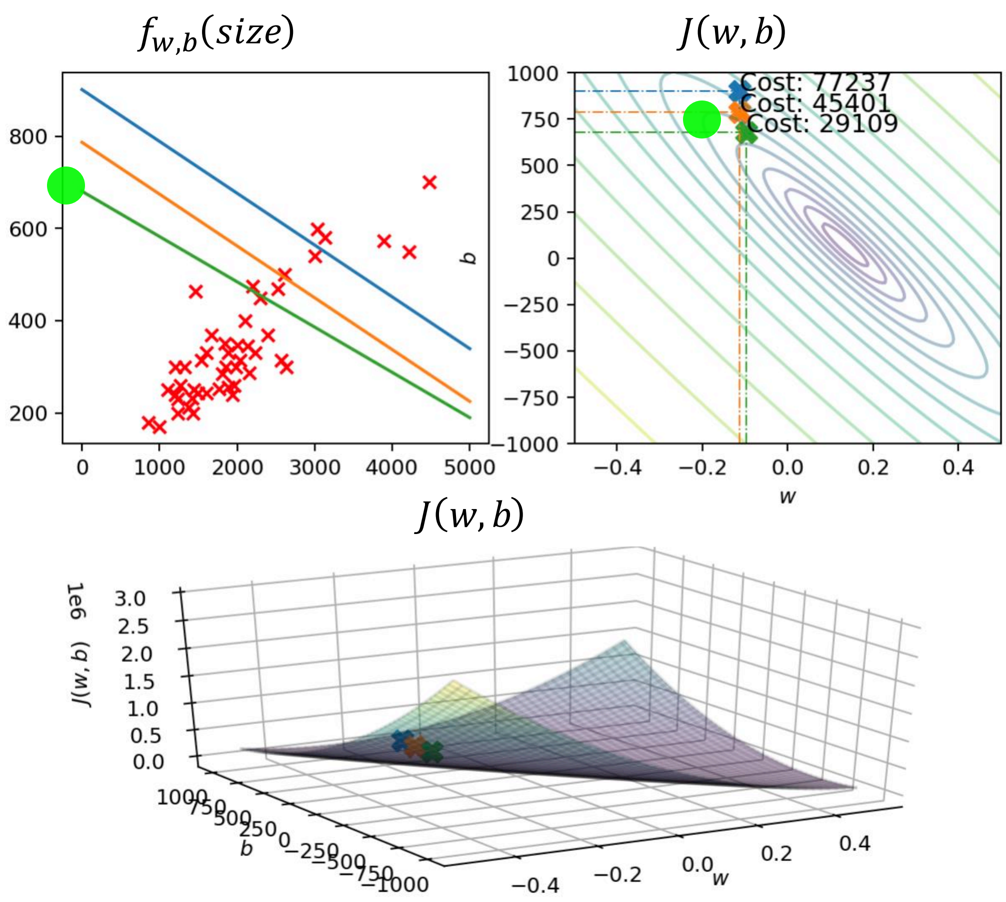


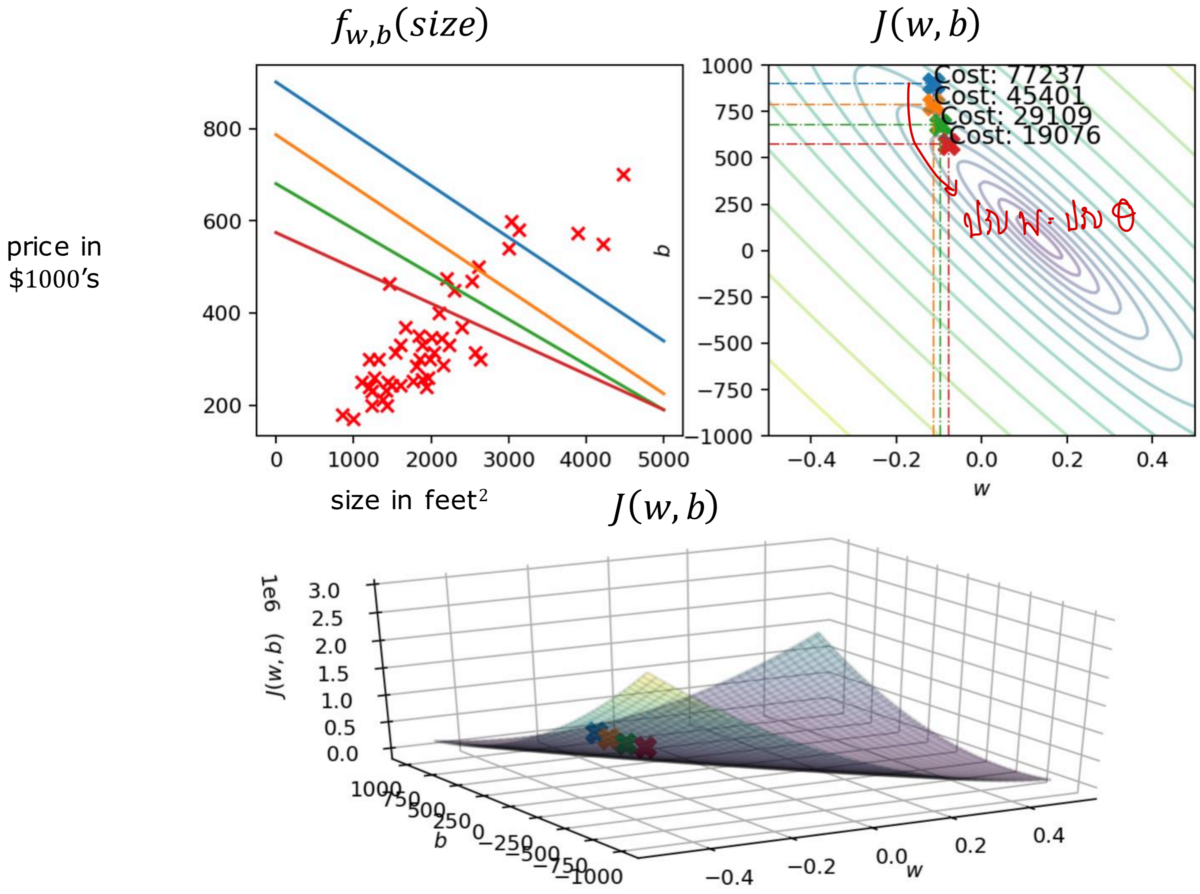
$J(w,b)$

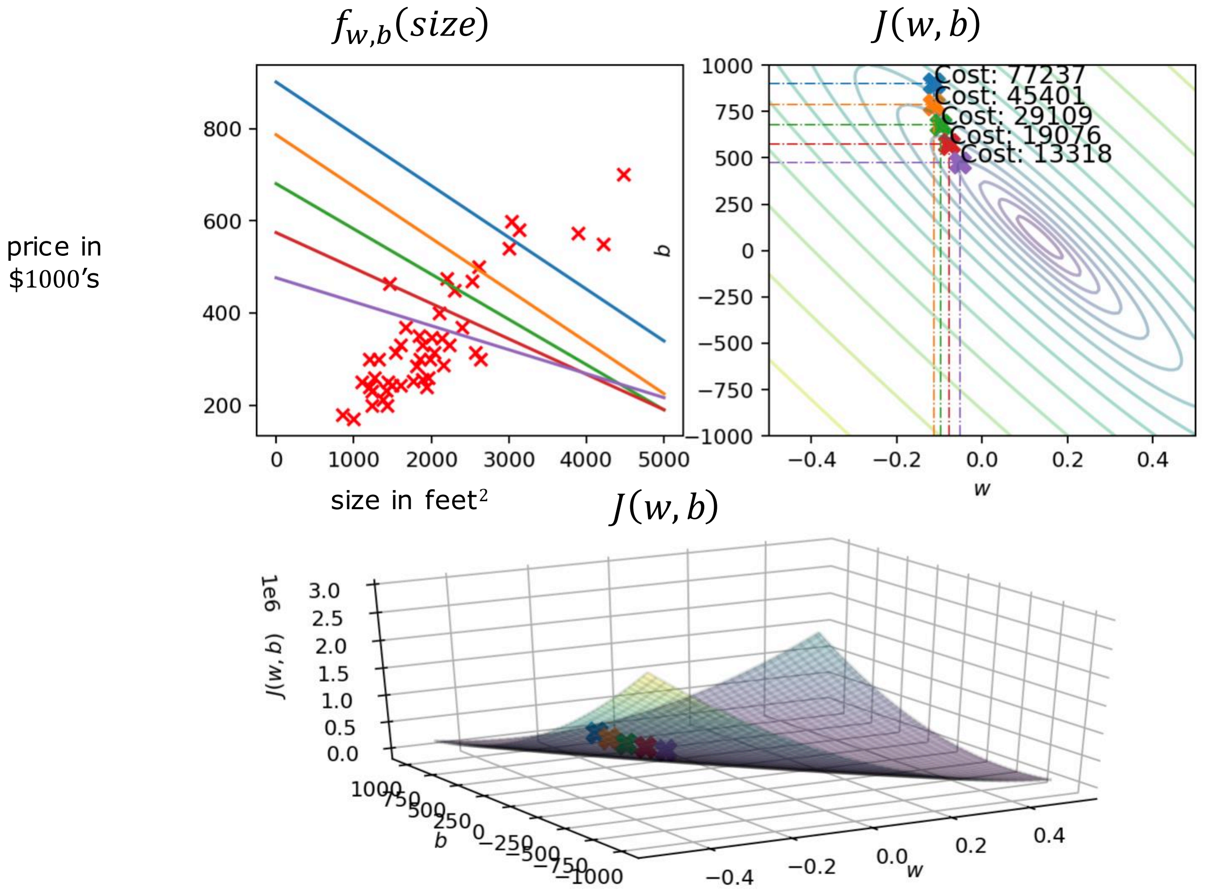




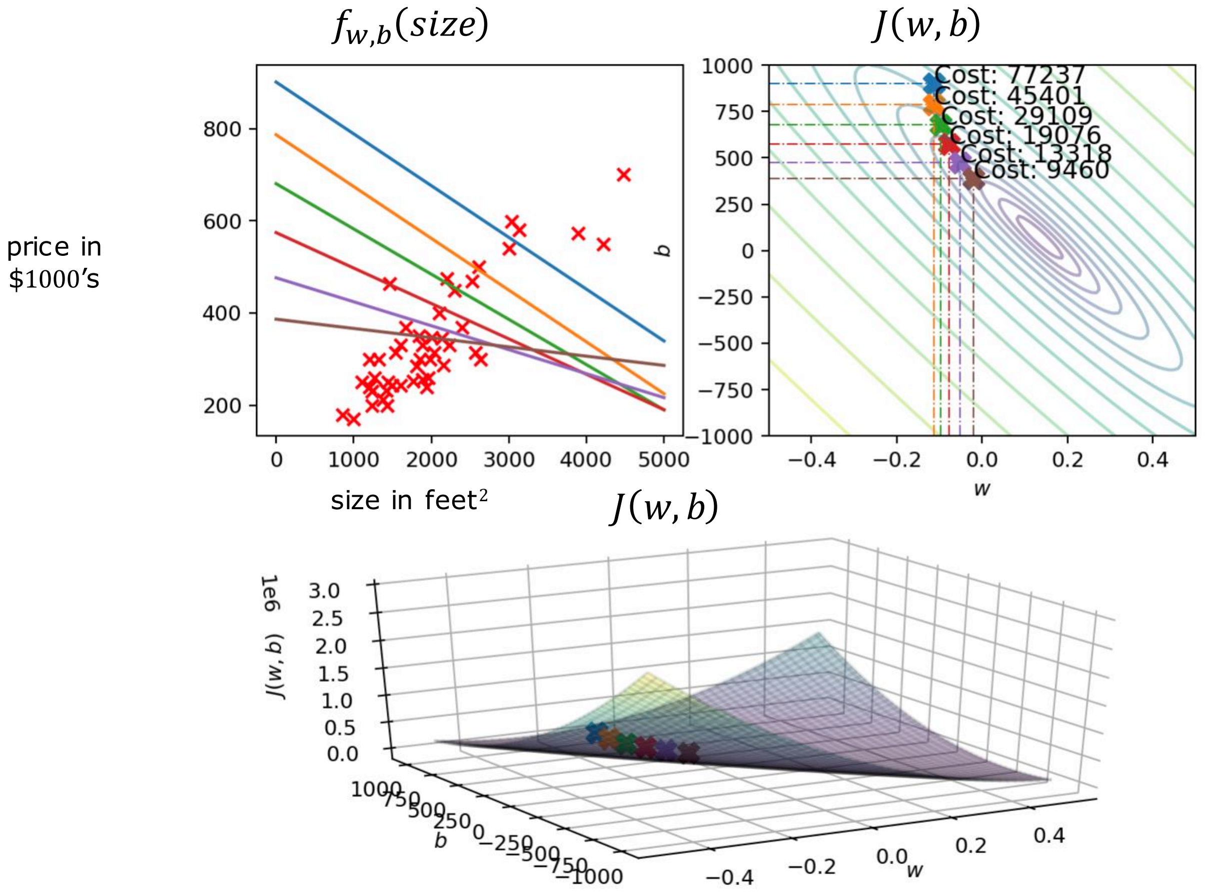
$f_{w,b}(size)$
price in $1000's
size in feet^2
$J(w,b)$
Cost: 77237
Cost: 45401
ลด b . เส้นลด
b
w
$J(w,b)$
1e6
$J(w, b)$
b
w


$f_{w,b}(size)$
$J(w,b)$
Cost: 77237
Cost: 45401
Cost: 29109
b
w
$J(w,b)$
1e6
J(w, b)
b
w

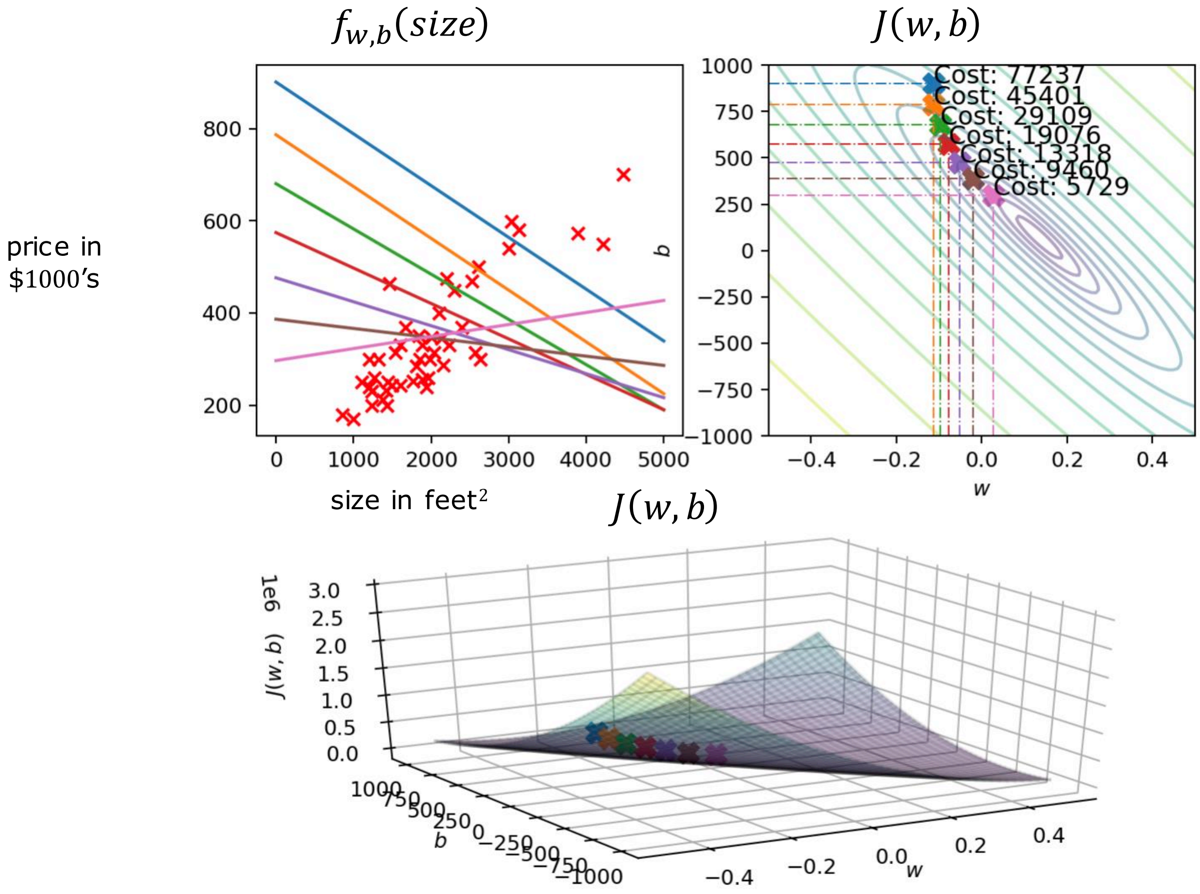

$f_{w,b}(size)$
$J(w, b)$
price in $1000's
size in feet^2
Cost: 77237
Cost: 45401
Cost: 29109
Cost: 19076
ปรับ w : ปรับ θ
b
w
$J(w, b)$
1e6
$J(w, b)$
b
w

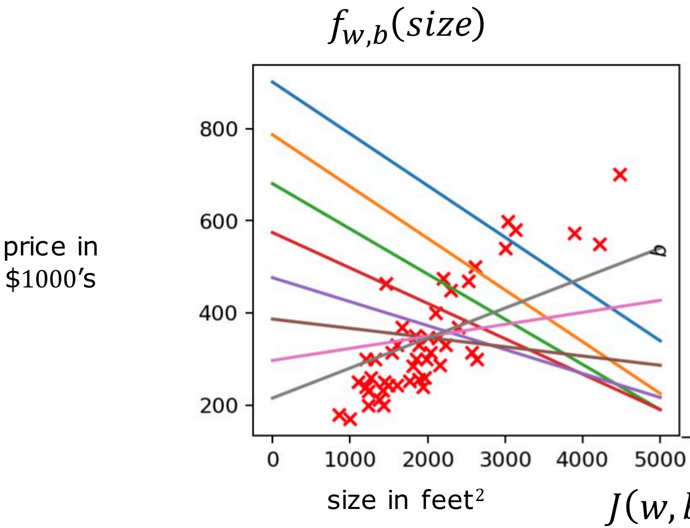


$f_{w,b}(size)$
price in
$1000's
size in feet²
800
600
400
200
0
1000
2000
3000
4000
5000
$J(w,b)$
Cost: 77237
Cost: 45401
Cost: 29109
Cost: 19076
Cost: 13318
1000
750
500
250
0
−250
−500
−750
−1000
b
−0.4
−0.2
0.0
0.2
0.4
w
$J(w,b)$
1e6
3.0
2.5
2.0
1.5
1.0
0.5
0.0
J(w, b)
b
w

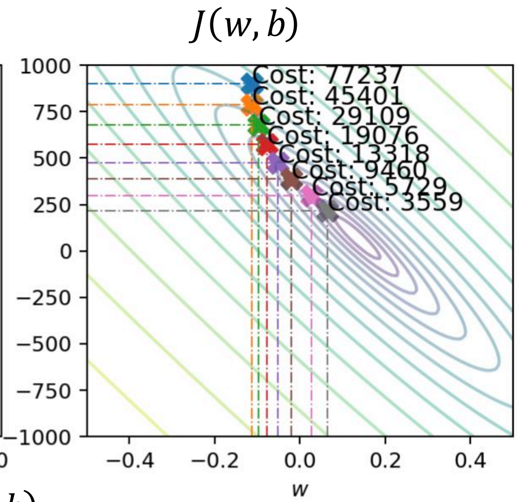


$f_{w,b}(size)$
$J(w,b)$
price in $1000's
size in feet^2
Cost: 77237
Cost: 45401
Cost: 29109
Cost: 19076
Cost: 13318
Cost: 9460
b
w
$J(w,b)$
1e6
J(w, b)

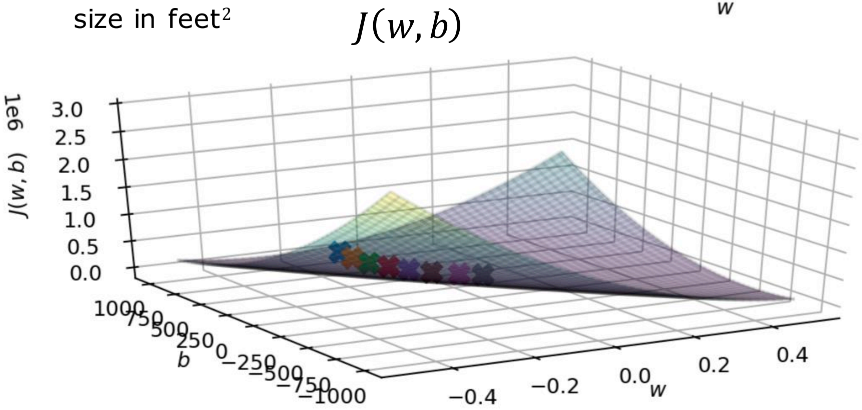

$f_{w,b}(size)$
price in
$1000's
size in feet^2
$J(w,b)$
Cost: 77237
Cost: 45401
Cost: 29109
Cost: 19076
Cost: 13318
Cost: 9460
Cost: 5729
$J(w,b)$
1e6
$J(w,b)$



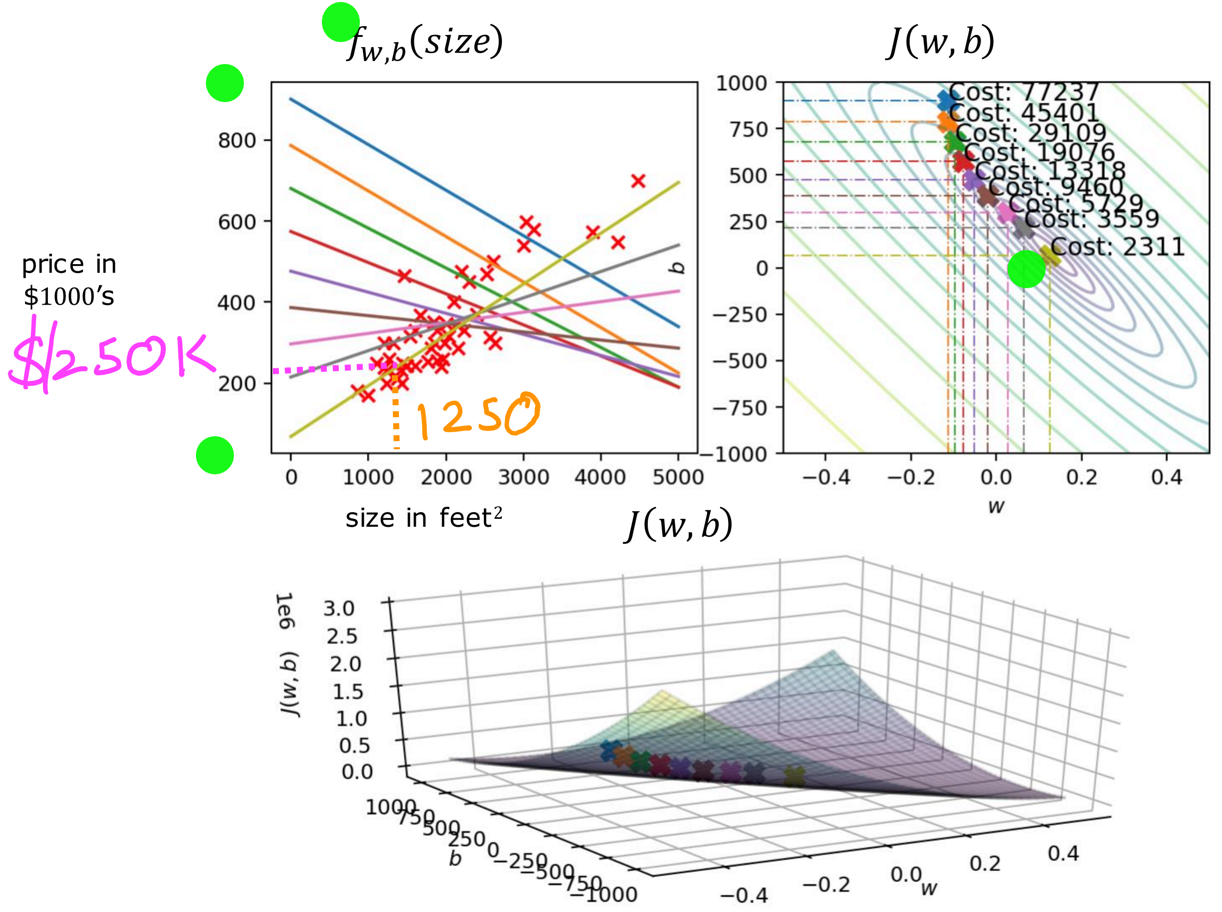
$f_{w,b}(size)$
price in $1000's
size in feet^2
800
600
400
200
0
1000
2000
3000
4000
5000



$J(w,b)$
Cost: 77237
Cost: 45401
Cost: 29109
Cost: 19076
Cost: 13318
Cost: 9460
Cost: 5729
Cost: 3559
1000
750
500
250
0
−250
−500
−750
−1000
−0.4
−0.2
0.0
0.2
0.4
w
b



$J(w,b)$
1e6
J(w, b)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
b
w
−0.4
−0.2
0.0
0.2
0.4



$f_{w,b}(size)$
$J(w,b)$
price in $1000's
$250K
1250
800
600
400
200
0
1000
2000
3000
4000
5000
size in feet²
Cost: 77237
Cost: 45401
Cost: 29109
Cost: 19076
Cost: 13318
Cost: 9460
Cost: 5729
Cost: 3559
Cost: 2311
b
w
1e6
J(w, b)

"Batch" gradient descent

DeepLearning.AI
THE BATCH

other gradient descent: subsets

"Batch": Each step of gradient descent uses all the training examples.

	x size in feet²	y price in $1000's
(1)	2104	400
(2)	1416	232
(3)	1534	315
(4)	852	178
…	…	…
(47)	3210	870

m = 47

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

เอา sum ลงหมดเลย