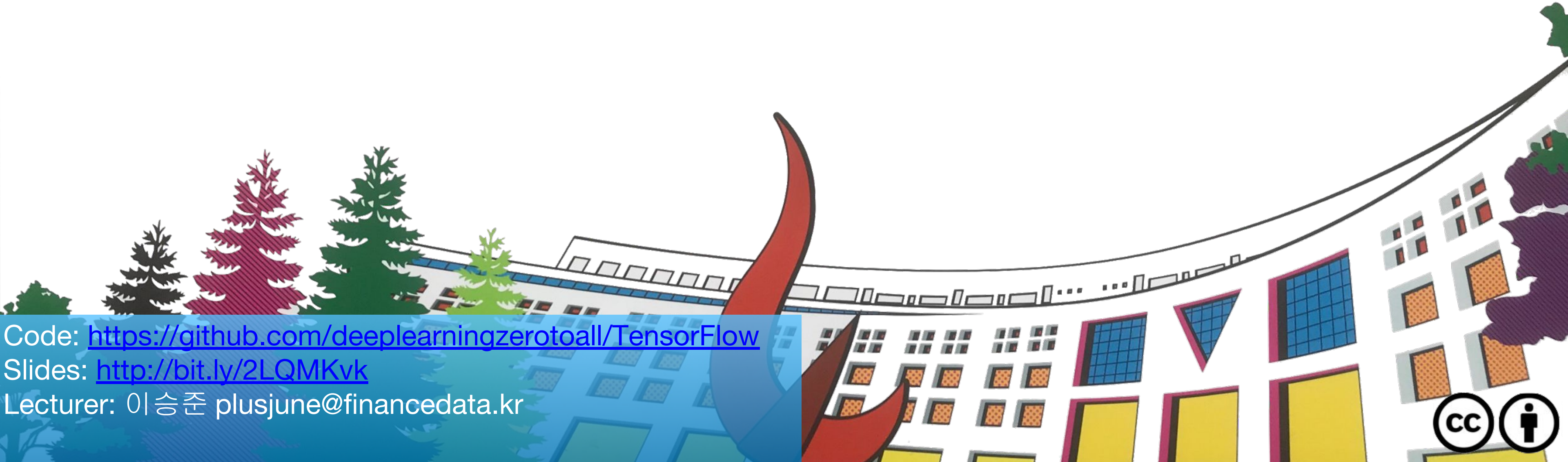
ML/DL for Everyone Season2

with TensorFlow

03 - How to minimize cost



Code: https://github.com/deeplearningzerotoall/TensorFlow
Slides: http://bit.ly/2LQMKvk
Lecturer: 이승준 plusjune@financedata.kr

Hypothesis and Cost

Hypothesis $$H(x) = Wx + b$$

Cost $$cost(W, b) = \frac{1}{m} \sum_{i=1}^{m} \left(H(x_i) - y_i\right)^2$$

Simplified hypothesis

Hypothesis $$H(x) = Wx$$

Cost $$cost(W) = \frac{1}{m} \sum_{i=1}^{m} (Wx_i - y_i)^2$$

What cost(W) looks like?

$$cost(W) = \frac{1}{m} \sum_{i=1}^{m} (Wx_i - y_i)^2$$

- W = 0, cost(W) = ?

x	y
1	1
2	2
3	3

What cost(W) looks like?

$$cost(W) = \frac{1}{m} \sum_{i=1}^{m} (Wx_i - y_i)^2$$

x	y
1	1
2	2
3	3

- W = 0, cost(W) = 4.67

$$\frac{1}{3}((0 * 1 - 1)^2 + (0 * 2 - 2)^2 + (0 * 3 - 3)^2))$$

What cost(W) looks like?

$$cost(W) = \frac{1}{m} \sum_{i=1}^{m} (Wx_i - y_i)^2$$

x	y
1	1
2	2
3	3

- W = 0, cost(W) = 4.67

  $\frac{1}{3}((0*1-1)^2 + (0*2-2)^2 + (0*3-3)^2))$

- W = 1, cost(W) = 0

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

- W = 2, cost(W) = 4.67

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

- W = 3, cost(W) = 18.67

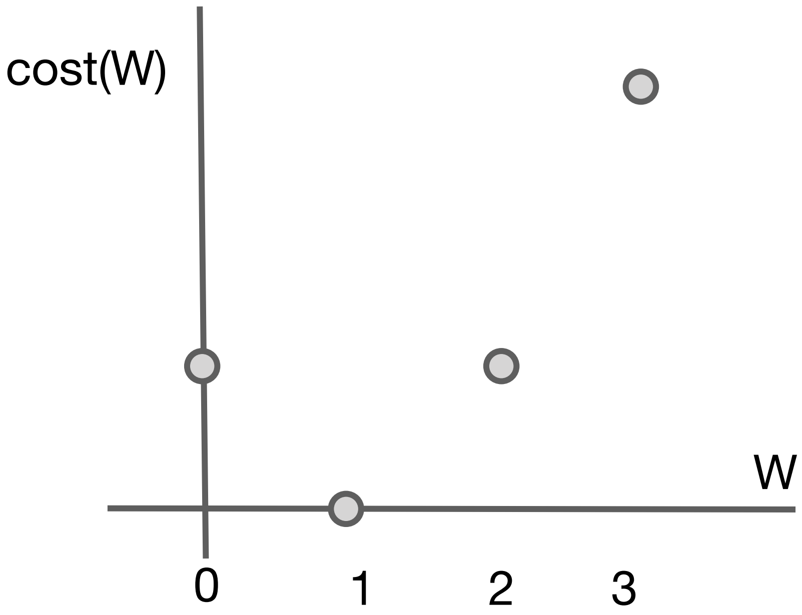
  $\frac{1}{3}((3*1-1)^2 + (3*2-2)^2 + (3*3-3)^2))$

What cost(W) looks like?

- W = 0, cost(W) = 4.67
- W = 1, cost(W) = 0
- W = 2, cost(W) = 4.67
- W = 3, cost(W) = 18.67

What cost(W) looks like?

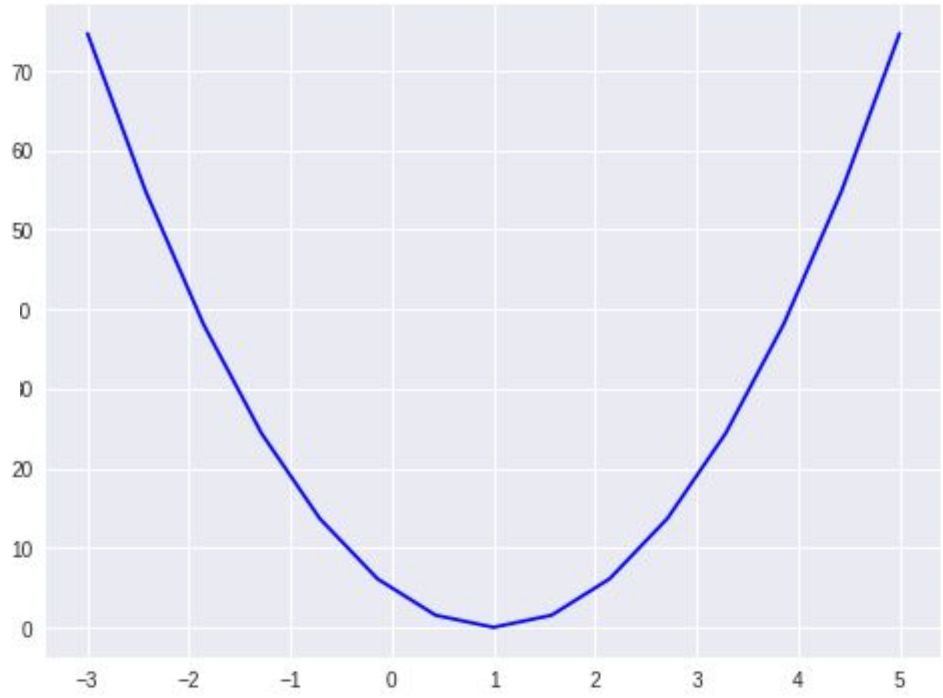
- W = 0, cost(W) = 4.67
- W = 1, cost(W) = 0
- W = 2, cost(W) = 4.67
- W = 3, cost(W) = 18.67



What cost(W) looks like?

$$cost(W) = \frac{1}{m} \sum_{i=1}^{m} (Wx_i - y_i)^2$$

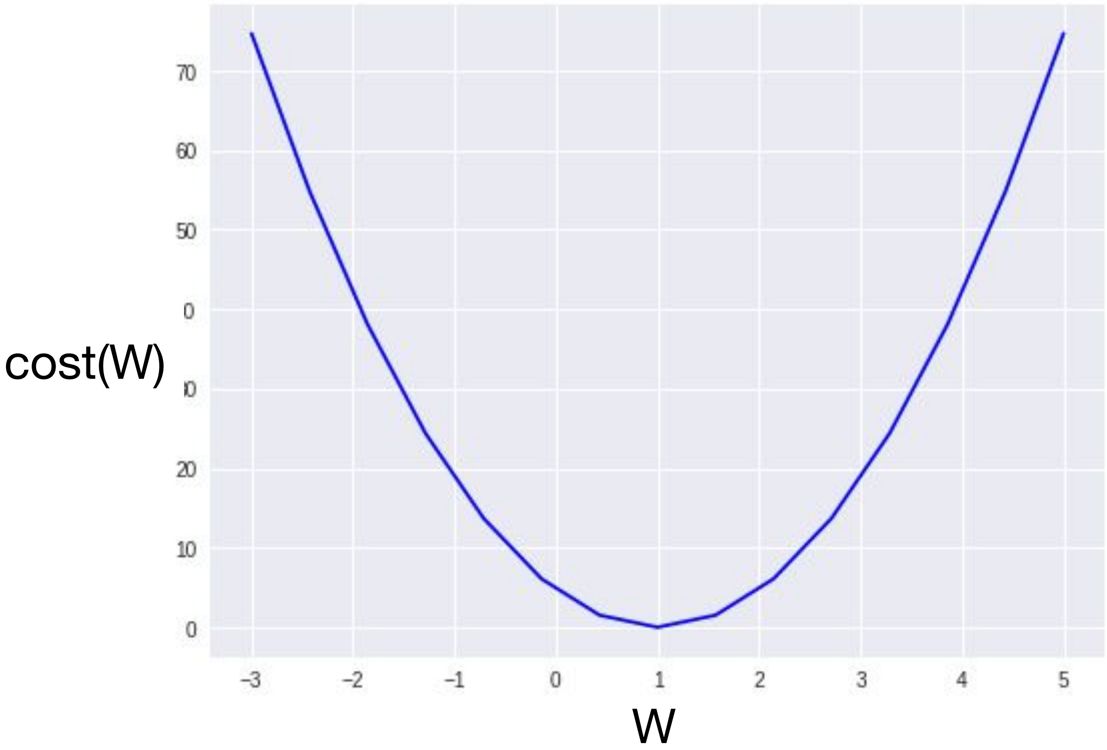
cost(W)



W

How to minimize cost?

$$cost(W) = \frac{1}{m} \sum_{i=1}^{m} (Wx_i - y_i)^2$$

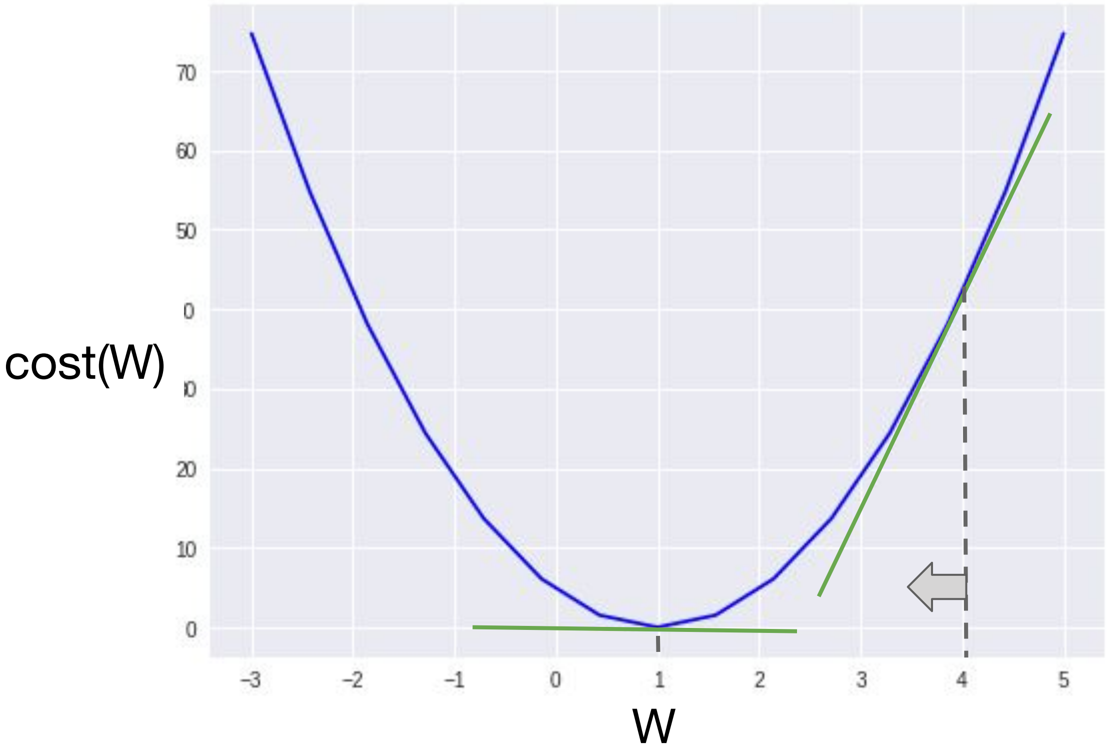


Gradient descent algorithm

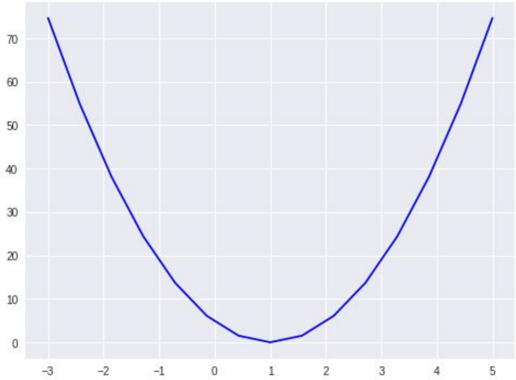
- Minimize cost function
- Gradient descent is used many minimization problems
- For a given cost function, cost (W, b), it will find W, b to minimize cost
- It can be applied to more general function: *cost (w1, w2, ...)*

How it works?

How would you find the lowest point?



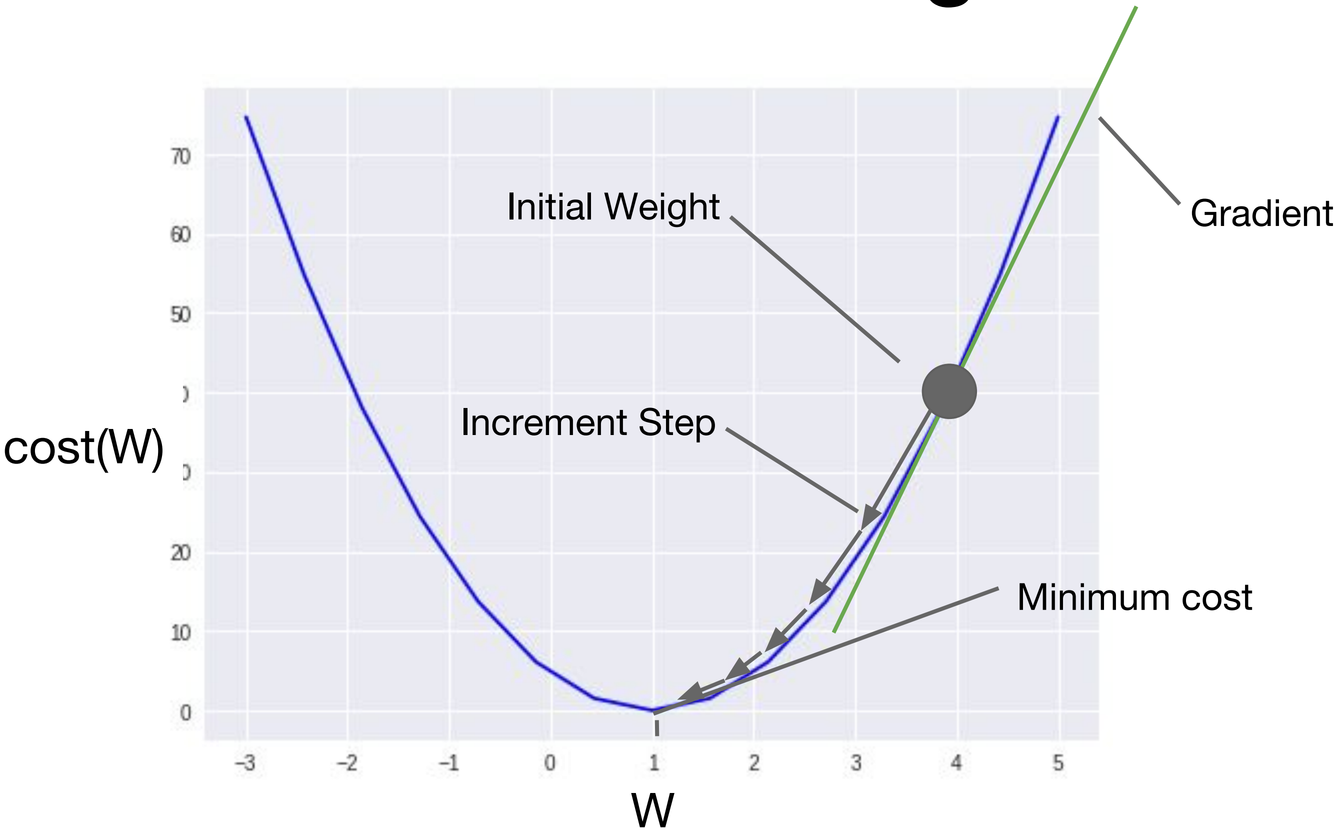
How it works?



- Start with initial guesses
  - Start at 0,0 (or any other value)
  - Keeping changing W and b a little bit to try and reduce <u>cost(W, b)</u>
- Each time you change the parameters, you select the gradient which reduces cost(W, b) the most possible
- Repeat
- Do so until you converge to a local minimum
- Has an interesting property
  - Where you start can determine which minimum you end up

http://www.holehouse.org/mlclass/01_02_Introduction_regression_analysis_and_gr.html

Gradient descent algorithm



Formal definition

$$cost(W, b) = \frac{1}{m} \sum_{i=1}^{m} \left(H(x_i) - y_i\right)^2$$

$$cost(W, b) = \frac{1}{2m} \sum_{i=1}^{m} \left(H(x_i) - y_i\right)^2$$

Formal definition

$$W := W - \alpha \frac{\partial}{\partial W} \frac{1}{2m} \sum_{i=1}^{m} (W(x_i) - y_i)^2$$

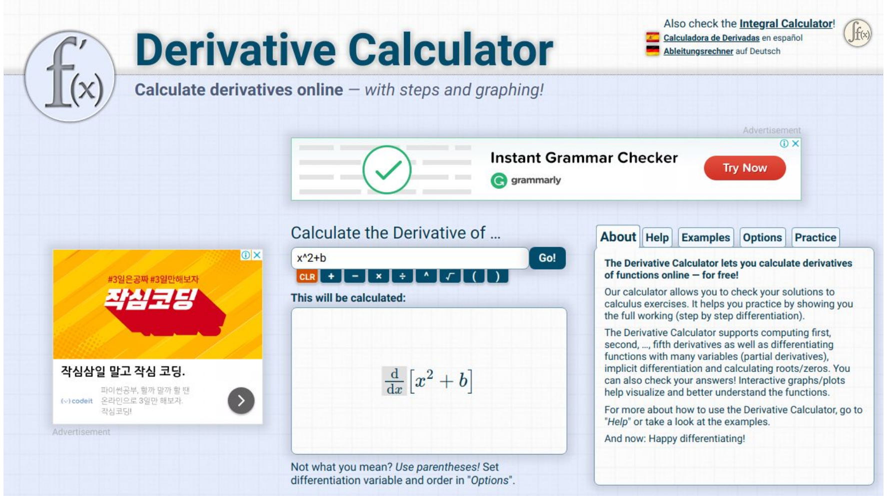
$$W := W - \alpha \frac{1}{2m} \sum_{i=1}^{m} 2(W(x_i) - y_i)x_i$$

$$W := W - \alpha \frac{1}{m} \sum_{i=1}^{m} (W(x_i) - y_i)x_i$$

Formal definition

$$cost(W, b) = \frac{1}{2m} \sum_{i=1}^{m} \left(H(x_i) - y_i \right)^2$$

$$W := W - \alpha \frac{\partial}{\partial W} cost(W)$$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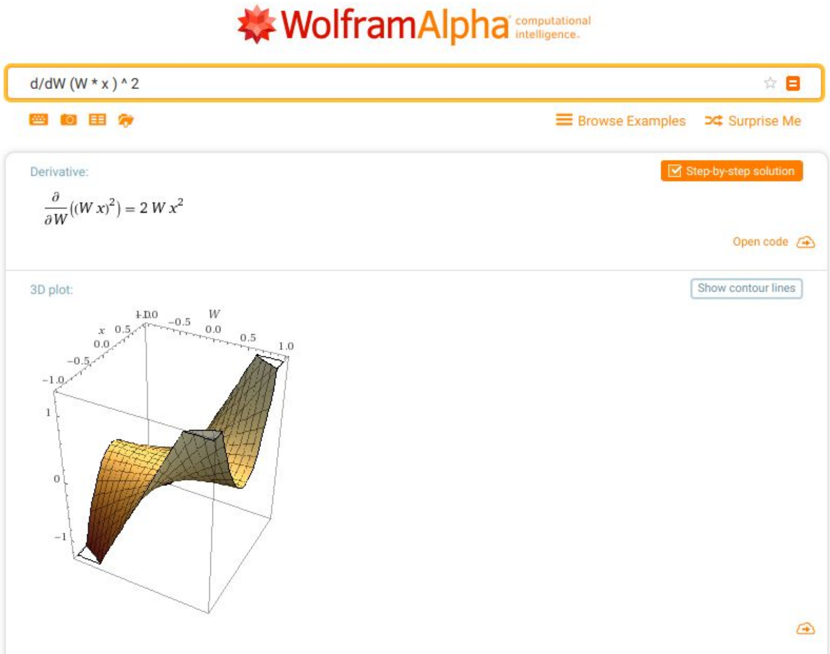
For more about how to use the Derivative Calculator, go to "Help" or take a look at the examples.
And now: Happy differentiating!


WolframAlpha computational intelligence.
d/dW (W * x) ^ 2
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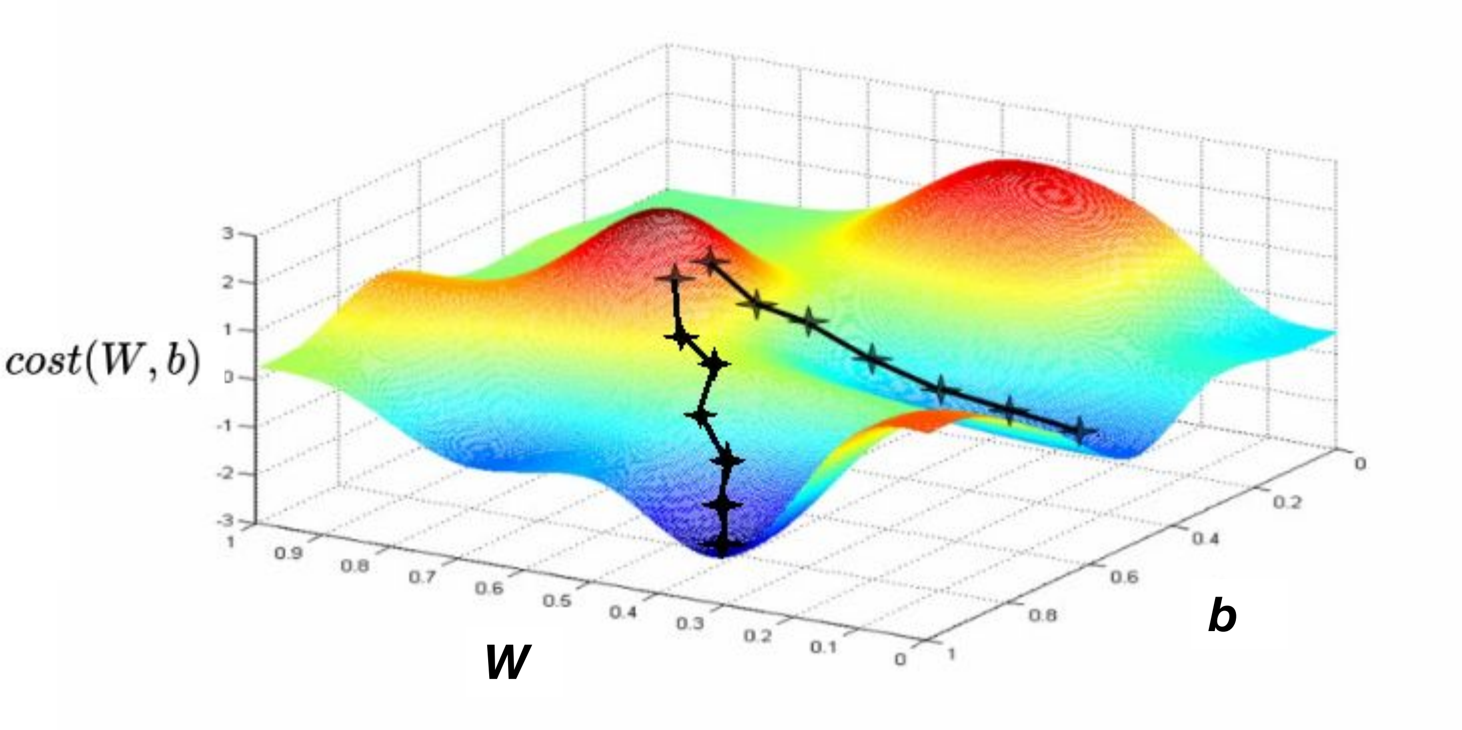
Derivative:
Step-by-step solution
$\frac{\partial}{\partial W}((W\,x)^2) = 2\,W\,x^2$
Open code
3D plot:
Show contour lines
x
W

Gradient descent algorithm

$$W := W - \alpha \frac{1}{m} \sum_{i=1}^{m} (W(x_i) - y_i) x_i$$

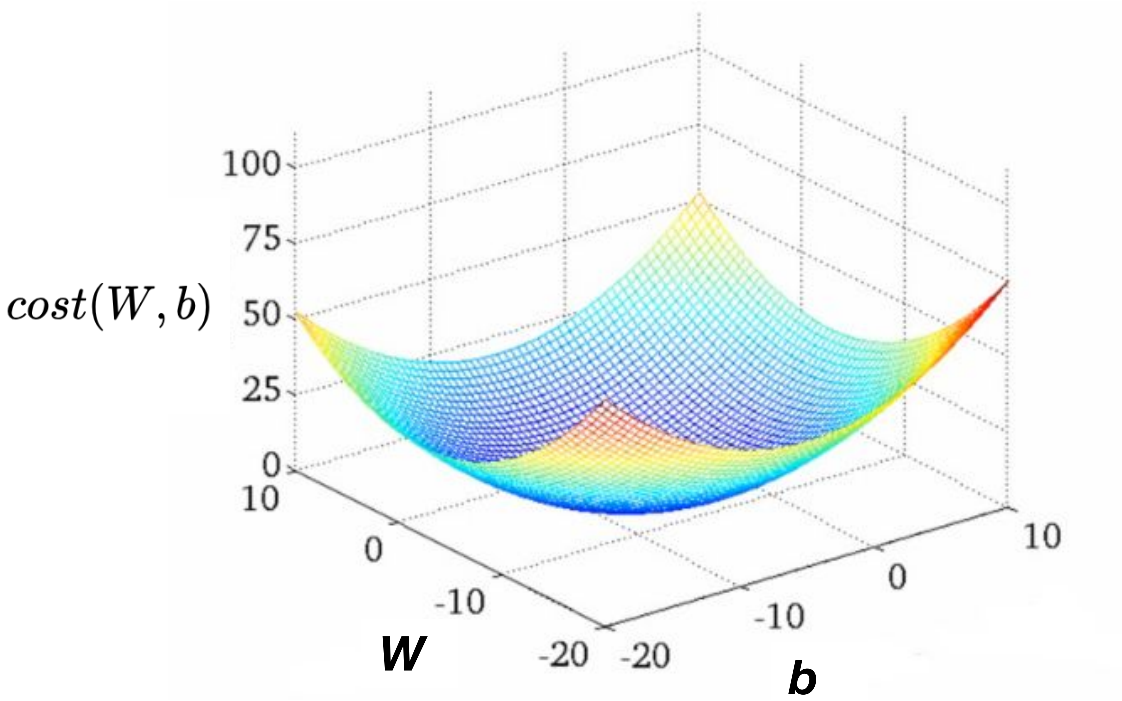
Convex function



http://www.holehouse.org/mlclass/

Convex function

$$cost(W,b) = \frac{1}{m}\sum_{i=1}^{m}\left(H(x_i) - y_i\right)^2$$



What's Next?

- Multi-Variable Linear regression