

Lecture 3

How to minimize cost

Sung Kim <hunkim+mr@gmail.com>

Acknowledgement

- Andrew Ng's ML class
 - <https://class.coursera.org/ml-003/lecture>
 - <http://www.holehouse.org/mlclass/> (note)
- Convolutional Neural Networks for Visual Recognition.
 - <http://cs231n.github.io/>
- Tensorflow
 - <https://www.tensorflow.org>
 - <https://github.com/aymericdamien/TensorFlow-Examples>

Hypothesis and Cost

$x^{(1)}$
↘

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

$\frac{1}{m} \sum$
↗

$$\text{cost}(W, b) = \frac{1}{m} \sum_{i=1}^m (H(x^{(i)}) - y^{(i)})^2$$

Simplified hypothesis

$$H(x) = Wx$$

설명을 위해 "x" 삭제!

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

↑
W 만의 함수가 됨.

↓
하지만 충분히
"일반적" 있음.

What $cost(W)$ looks like?

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

x	Y
1	1
2	2
3	3

- $W=I, cost(W)=?$

What $\text{cost}(W)$ looks like?

$$\text{cost}(W) = \frac{1}{m} \sum_{i=1}^m (W x^{(i)} - y^{(i)})^2$$

x	Y
1	1
2	2
3	3

- $W=1, \text{cost}(W)=0$

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

- $W=0, \text{cost}(W)=4.67$

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

- $W=2, \text{cost}(W)=?$

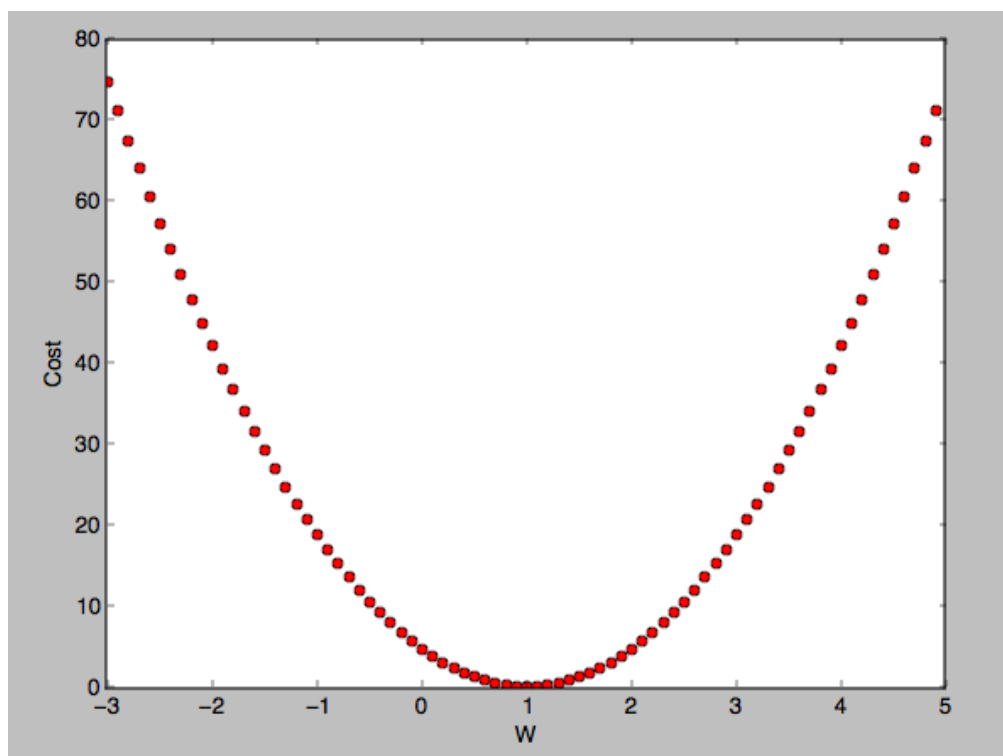
What $\text{cost}(W)$ looks like?

- $W=1, \text{cost}(W)=0$
- $W=0, \text{cost}(W)=4.67$
- $W=2, \text{cost}(W)=4.67$

What $\text{cost}(W)$ looks like?

$$\text{cost}(W) = \frac{1}{m} \sum_{i=1}^m (W x^{(i)} - y^{(i)})^2$$

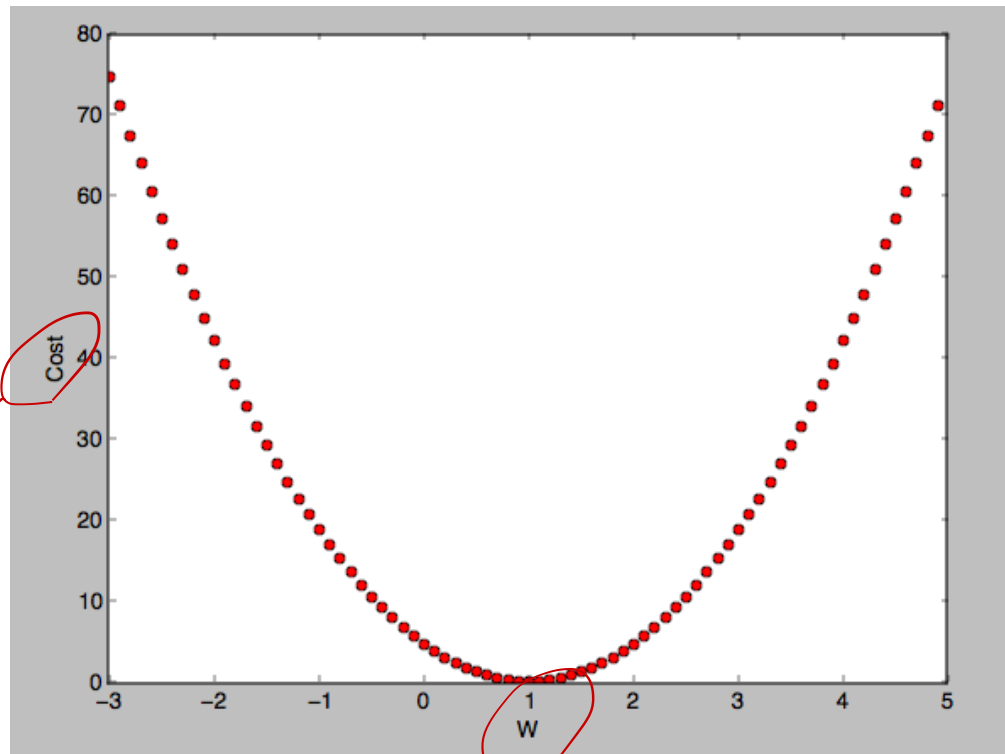
← W의 함수!



↓ 그래프

How to minimize cost?

$$\text{cost}(W) = \frac{1}{m} \sum_{i=1}^m (W x^{(i)} - y^{(i)})^2$$



Cost가
최소 되는
W 값?

↗ 가계적으로 찾아야 함.

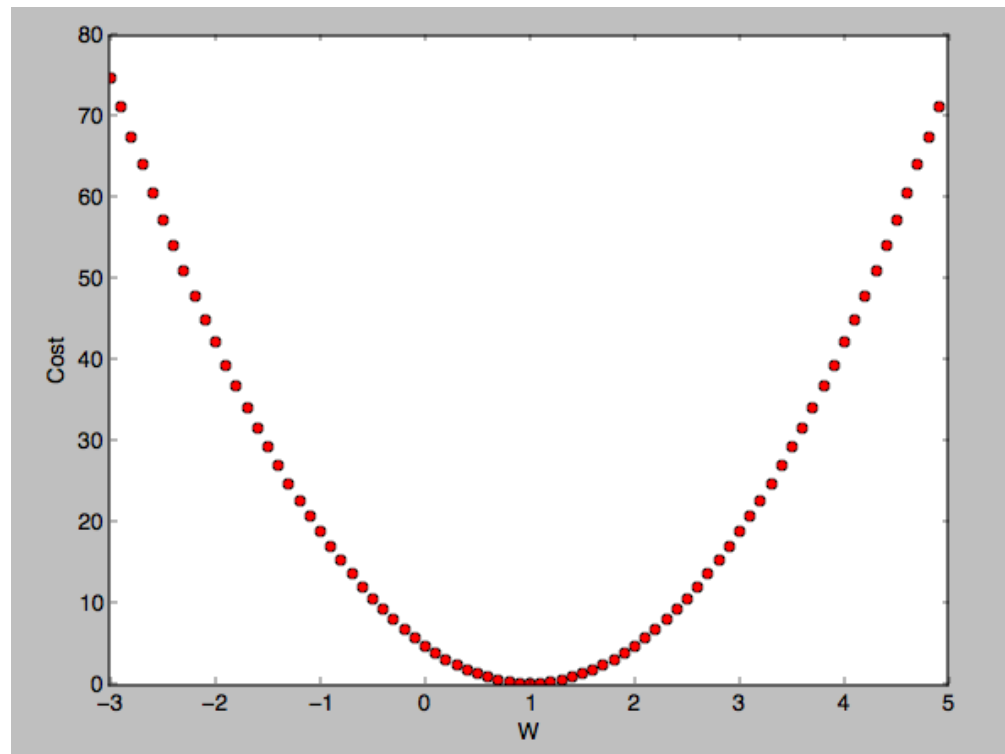
Gradient descent algorithm (정사각형 알고리즘)

- Minimize cost function
- Gradient descent is used many minimization problems
- For a given cost function, $\text{cost}(W, b)$, it will find W, b to minimize cost
- It can be applied to more general function: $\text{cost}(w_1, w_2, \dots)$

↑
매우 어려움!

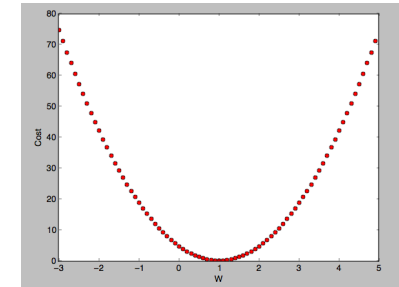
How it works?

How would you find the lowest point?



How it works?

- Start with initial guesses
 - ← *가정해두거나 시작!*
 - Start at 0,0 (or any other value)
 - Keeping changing W and b a little bit to try and reduce $\text{cost}(W, b)$
- Each time you change the parameters, you select the gradient which reduces $\text{cost}(W, b)$ 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



} 항상 성공하는 것이 아님!
↗ 여러개의 골짜기!

Formal definition

$$\text{cost}(W) = \frac{1}{m} \sum_{i=1}^m (Wx^{(i)} - y^{(i)})^2$$



미분하기 용!

$$\text{cost}(W) = \frac{1}{2m} \sum_{i=1}^m (Wx^{(i)} - y^{(i)})^2$$

↑
수식은 간단함께 하기위해!
결과론 동일!

Formal definition

$$\text{cost}(W) = \frac{1}{2m} \sum_{i=1}^m (W x^{(i)} - y^{(i)})^2$$

$$W := W - \alpha \frac{\partial}{\partial W} \text{cost}(W)$$

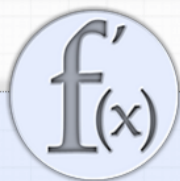
learning rate (学習率)

Formal definition

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

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

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



Derivative Calculator

Calculate derivatives online
— with steps and graphing!

Also check the [Integral Calculator!](#)
[Ableitungsrechner](#) auf Deutsch



Hello there!

Was this calculator helpful to you? Then I would highly appreciate **small donations** via PayPal:



... or use [this link](#) for shopping on Amazon, without affecting your order.

Thank you!

Calculate the Derivative of ...

(x-a)^2

Go!

This will be calculated:

$$\frac{d}{dx} \left[(xa - y)^2 \right]$$

Not what you mean? *Use parentheses!* Set differentiation variable and order in "Options".

About

Help

Examples

Options

The Derivative Calculator lets you calculate derivatives of functions online — for free!

Our calculator allows you to check your solutions to calculus exercises. It helps you practice by showing you the full working (step by step differentiation).

The Derivative Calculator supports computing first, second, ..., fifth derivatives as well as differentiating functions with many variables (partial derivatives), implicit differentiation and calculating roots/zeros. Interactive graphs/plots help visualize and better understand the functions.

For more about how to use the Derivative Calculator, go to "Help" or take a look at the examples.

And now: Happy differentiating!

Recommend this Website

If you like this website, then please support it by clicking the +1 and +d like buttons.

Result

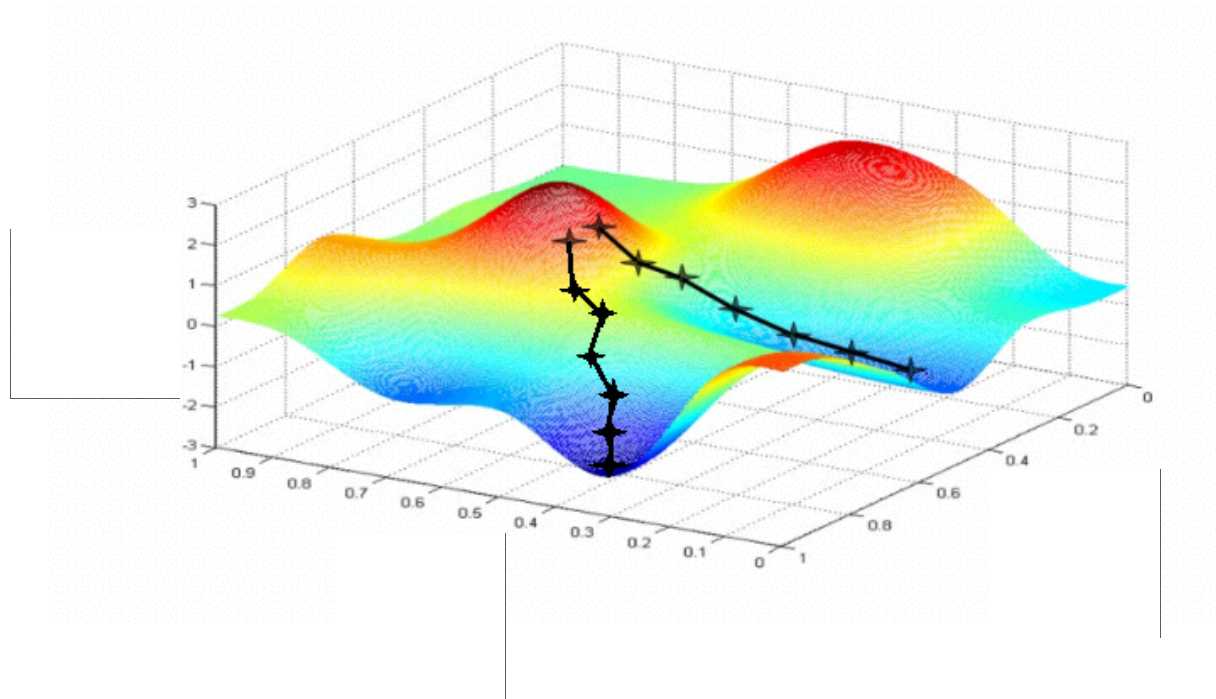
Done! See the result further below.

In order to not miss anything, please scroll all the way down.

Gradient descent algorithm

$$W := W - \alpha \frac{1}{m} \sum_{i=1}^m (Wx^{(i)} - y^{(i)})x^{(i)}$$

Convex function (볼록함수)



www.holehouse.org/mlclass/

Convex function

$$\text{cost}(W, b) = \frac{1}{m} \sum_{i=1}^m (H(x^{(i)}) - y^{(i)})^2$$

→ 이걸로
cost 관리가 항상
적절함을 가짐!

