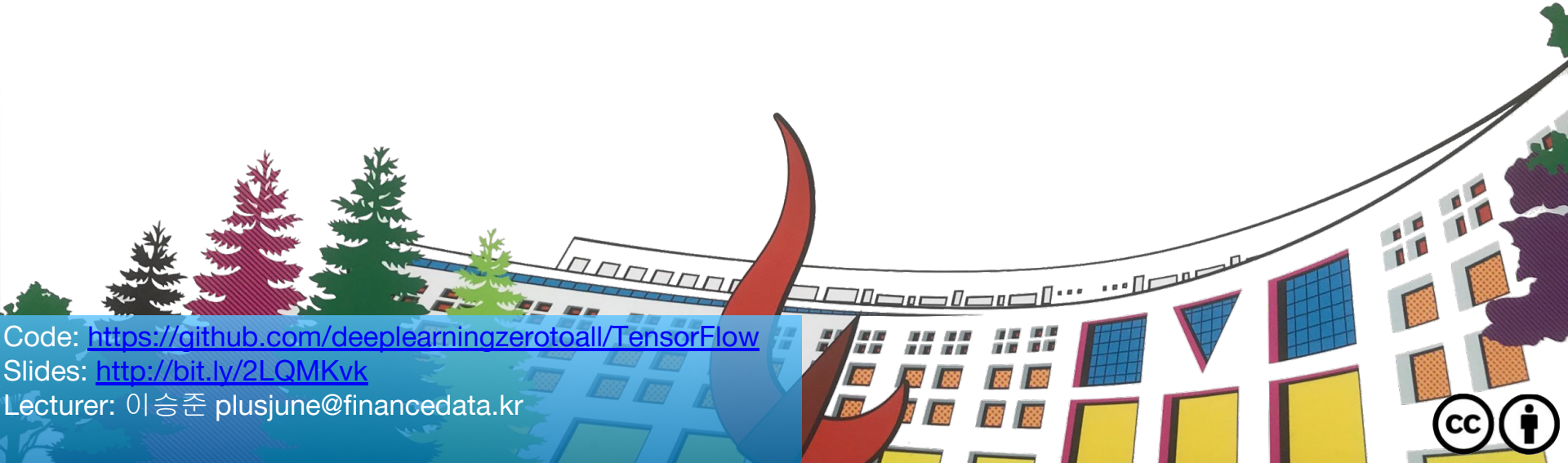
ML/DL for Everyone Season2

with TensorFlow

03 - How to minimize cost LAB



Code: https://github.com/deeplearningzerotoall/TensorFlow
Slides: http://bit.ly/2LQMKvk
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Simplified hypothesis

Hypothesis $H(x) = Wx$

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

우리의 가설(예측) - 실제

Cost function in pure Python

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

```python
import numpy as np

X = np.array([1, 2, 3])
Y = np.array([1, 2, 3])

def cost_func(W, X, Y):
    c = 0
    for i in range(len(X)):
        c += (W * X[i] - Y[i]) ** 2
    return c / len(X)

for feed_W in np.linspace(-3, 5, num=15):
    curr_cost = cost_func(feed_W, X, Y)
    print("{:6.3f} | {:10.5f}".format(feed_W, curr_cost))
```

-3부터 5까지 15개의. 구간으로 나누기

```
   W          cost
-3.000 |   74.66667
-2.429 |   54.85714
-1.857 |   38.09524
-1.286 |   24.38095
-0.714 |   13.71429
-0.143 |    6.09524
 0.429 |    1.52381
 1.000 |    0.00000
 1.571 |    1.52381
 2.143 |    6.09524
 2.714 |   13.71429
 3.286 |   24.38095
 3.857 |   38.09524
 4.429 |   54.85714
 5.000 |   74.66667
```

Cost function in pure Python

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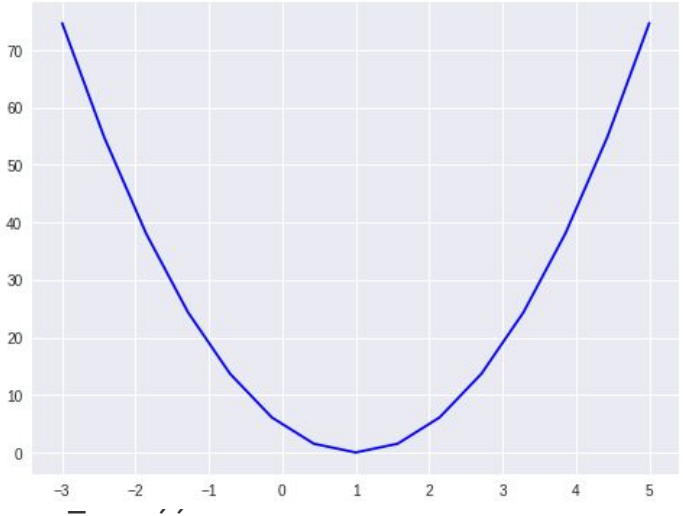
```



Cost function in TensorFlow

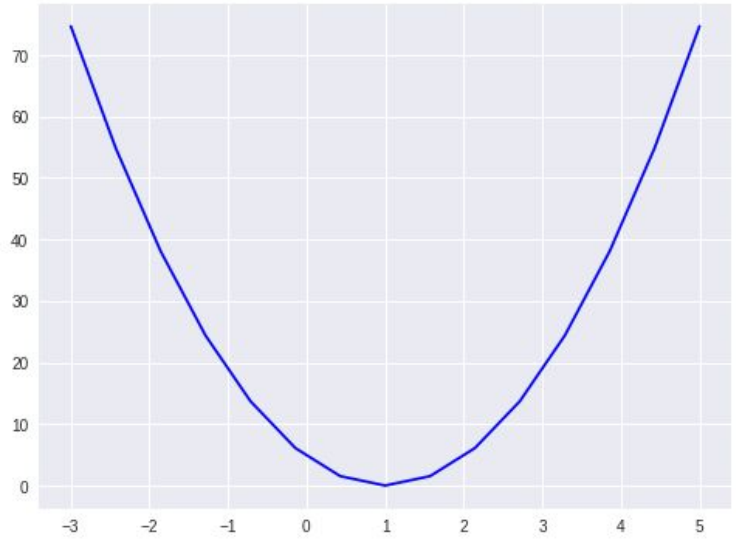
$$cost(W) = \frac{1}{m}\sum_{i=1}^{m}(Wx_i - y_i)^2$$

```
X = np.array([1, 2, 3])
Y = np.array([1, 2, 3])

def cost_func(W, X, Y):
  hypothesis = X * W
  return tf.reduce_mean(tf.square(hypothesis - Y))

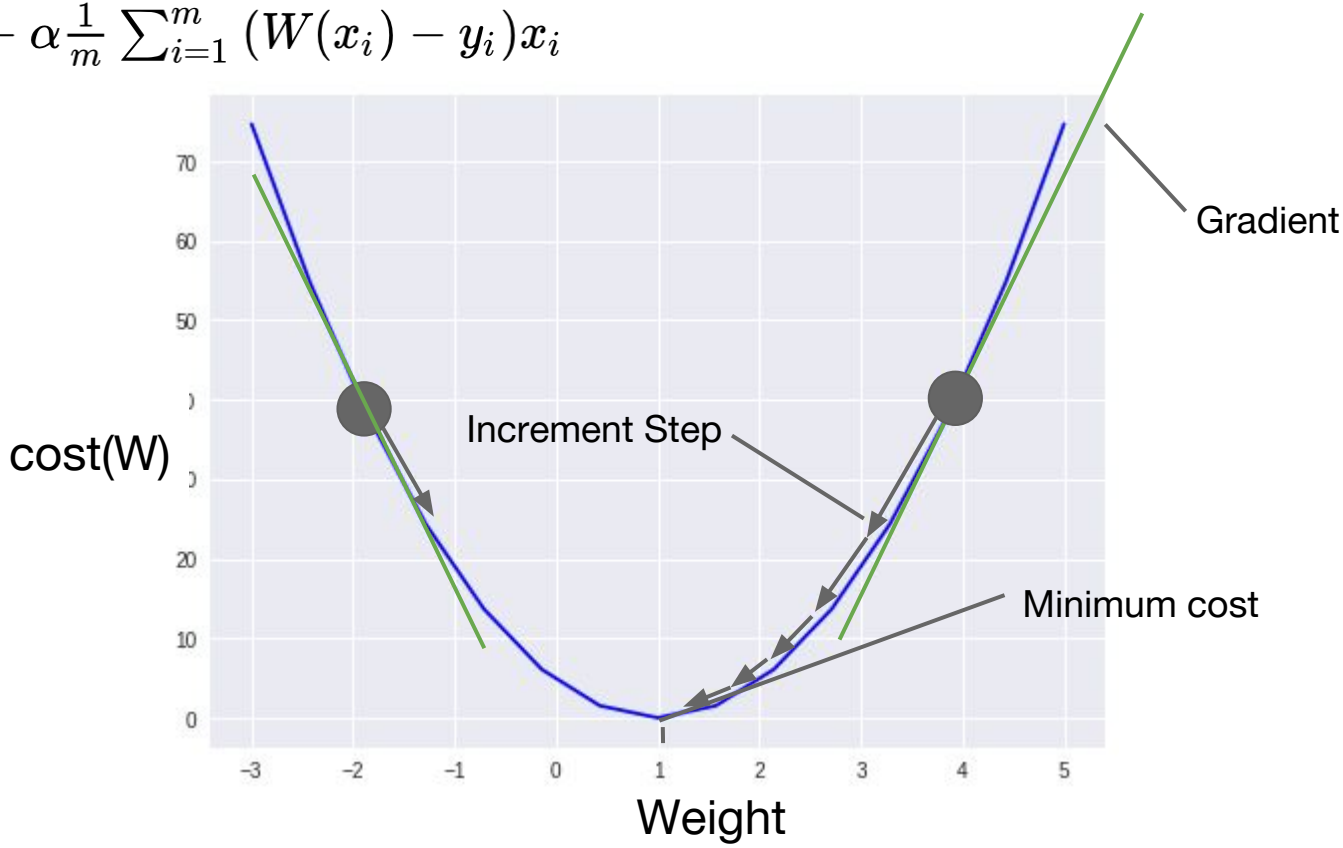
W_values = np.linspace(-3, 5, num=15)
cost_values = []

for feed_W in W_values:
    curr_cost = cost_func(feed_W, X, Y)
    cost_values.append(curr_cost)
    print("{:6.3f} | {:10.5f}".format(feed_W, curr_
```



Gradient descent

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



Gradient descent

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

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

Gradient

새로운 W 값

```
alpha = 0.01
gradient = tf.reduce_mean(tf.multiply(tf.multiply(W, X) - Y, X))
descent = W - tf.multiply(alpha, gradient)
W.assign(descent)
```

Gradient descent

랜덤 시드를 특정한 값으로 초기화 (다음 다시 이 코드를 실행해도 동일한 결과를 위해서)

```
tf.set_random_seed(0)  # for reproducibility

x_data = [1., 2., 3., 4.]
y_data = [1., 3., 5., 7.]

W = tf.Variable(tf.random_normal([1], -100., 100.))

for step in range(300):
    hypothesis = W * X
    cost = tf.reduce_mean(tf.square(hypothesis - Y))

    alpha = 0.01
    gradient = tf.reduce_mean(tf.multiply(tf.multiply(W, X) - Y, X))
    descent = W - tf.multiply(alpha, gradient)
    W.assign(descent)

    if step % 10 == 0:
        print('{:5} | {:10.4f} | {:10.6f}'.format(
            step, cost.numpy(), W.numpy()[0]))
```

정규 분포를 따르는 행렬 1개짜리
.random_normal([행렬 수], 평균, 편차

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

Gradient descent

```
tf.set_random_seed(0)  # for reproducibility

x_data = [1., 2., 3., 4.]
y_data = [1., 3., 5., 7.]

W = tf.Variable(tf.random_normal([1], -100., 100.))

for step in range(300):
    hypothesis = W * X
    cost = tf.reduce_mean(tf.square(hypothesis - Y))

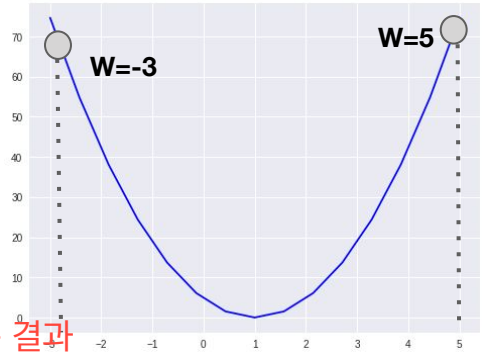
    alpha = 0.01
    gradient = tf.reduce_mean(tf.multiply(tf.multiply(W, X) - Y, X)
    descent = W - tf.multiply(alpha, gradient)
    W.assign(descent)

    if step % 10 == 0:
        print('{:5} | {:10.4f} | {:10.6f}'.format(
            step, cost.numpy(), W.numpy()[0]))
```

```
step        cost             W

  0 | 11716.3086 |   48.767971
 10 |  4504.9126 |   30.619968
 20 |  1732.1364 |   19.366755
 30 |   666.0052 |   12.388859
 40 |   256.0785 |    8.062004
 50 |    98.4620 |    5.379007
 60 |    37.8586 |    3.715335
 70 |    14.5566 |    2.683725
 80 |     5.5970 |    2.044044
 ......
240 |     0.0000 |    1.000499
250 |     0.0000 |    1.000309
260 |     0.0000 |    1.000192
270 |     0.0000 |    1.000119
280 |     0.0000 |    1.000074
290 |     0.0000 |    1.000046
```

Output when W=5




```
tf.set_random_seed(0)  # for reproducibility

x_data = [1., 2., 3., 4.]
y_data = [1., 3., 5., 7.]

W = tf.Variable([5.0])

for step in range(300):
    hypothesis = W * X
    cost = tf.reduce_mean(tf.square(hypothesis - Y))

    alpha = 0.01
    gradient = tf.reduce_mean(tf.multiply(tf.multiply(W, X) - Y, X)
    descent = W - tf.multiply(alpha, gradient)
    W.assign(descent)

    if step % 10 == 0:
        print('{:5} | {:10.4f} | {:10.6f}'.format(
            step, cost.numpy(), W.numpy()[0]))
```

W를 값을 앞에서는 랜덤 값을 주었는데, 특정 값을 줘도 같은 결과

```
 step    cost          W
    0 |    74.6667 |   4.813334
   10 |    28.7093 |   3.364572
   20 |    11.0387 |   2.466224
   30 |     4.2444 |   1.909177
   40 |     1.6320 |   1.563762
   50 |     0.6275 |   1.349578
   60 |     0.2413 |   1.216766
   70 |     0.0928 |   1.134412
   80 |     0.0357 |   1.083346
.... ....
  270 |     0.0000 |   1.000009
  280 |     0.0000 |   1.000006
  290 |     0.0000 |   1.000004
```

What’s Next?

- Multi-Variable Linear regression