

# ML/DL for Everyone Season2

with  TensorFlow

## 02 - Simple Linear Regression LAB

Code: <https://github.com/deeplearningzerotoall/TensorFlow>

Slides: <http://bit.ly/2LQMKvk>

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# Hypothesis and Cost

**Hypothesis**

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

**Cost**

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

# Build hypothesis and cost

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

```
x_data = [1, 2, 3, 4, 5]
y_data = [1, 2, 3, 4, 5]

W = tf.Variable(2.9)
b = tf.Variable(0.5)

# hypothesis = W * x + b
hypothesis = W * x_data + b
```

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

```
cost = tf.reduce_mean(tf.square(hypothesis - y_data))
```

# Build hypothesis and cost

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

```
cost = tf.reduce_mean(tf.square(hypothesis - y_data))
```

- `tf.reduce_mean()`

```
v = [1., 2., 3., 4.]  
tf.reduce_mean(v) # 2.5
```

- `tf.square()`

```
tf.square(3) # 9
```

# Gradient descent

$$\underset{W, b}{\text{minimize cost}}(W, b)$$

```
# learning_rate initialize  
learning_rate = 0.01
```

```
# Gradient descent
```

```
with tf.GradientTape() as tape:
```

```
    hypothesis = W * x_data + b
```

```
    cost = tf.reduce_mean(tf.square(hypothesis - y_data))
```

이후에 tape의 gradient 메서드를 호출해서, 경사도(미분값)을 구한다

```
W_grad, b_grad = tape.gradient(cost, [W, b])
```

gradient(cost, [W, b])는 함수 cost의 변수 W, b에 대한 개별 미분값(기울기)을 구해서 tuple로 반환

```
W.assign_sub(learning_rate * W_grad)
```

```
b.assign_sub(learning_rate * b_grad)
```

A.assign\_sub(B)

A = A - B

A -= B

# Parameter(W,b) Update

```
W = tf.Variable(2.9)
b = tf.Variable(0.5)

for i in range(100):
    # Gradient descent
    with tf.GradientTape() as tape:
        hypothesis = W * x_data + b
        cost = tf.reduce_mean(tf.square(hypothesis - y_data))
    W_grad, b_grad = tape.gradient(cost, [W, b])
    W.assign_sub(learning_rate * W_grad)
    b.assign_sub(learning_rate * b_grad)
    if i % 10 == 0:
        print("{:5}|{:10.4}|{:10.4}|{:10.6f}".format(i, W.numpy(), b.numpy(), cost))
```

# Full Code (less than 20 lines)

```
import tensorflow as tf
tf.enable_eager_execution()

# Data
x_data = [1, 2, 3, 4, 5]
y_data = [1, 2, 3, 4, 5]

# W, b initialize
W = tf.Variable(2.9)
b = tf.Variable(0.5)

learning_rate = 0.01

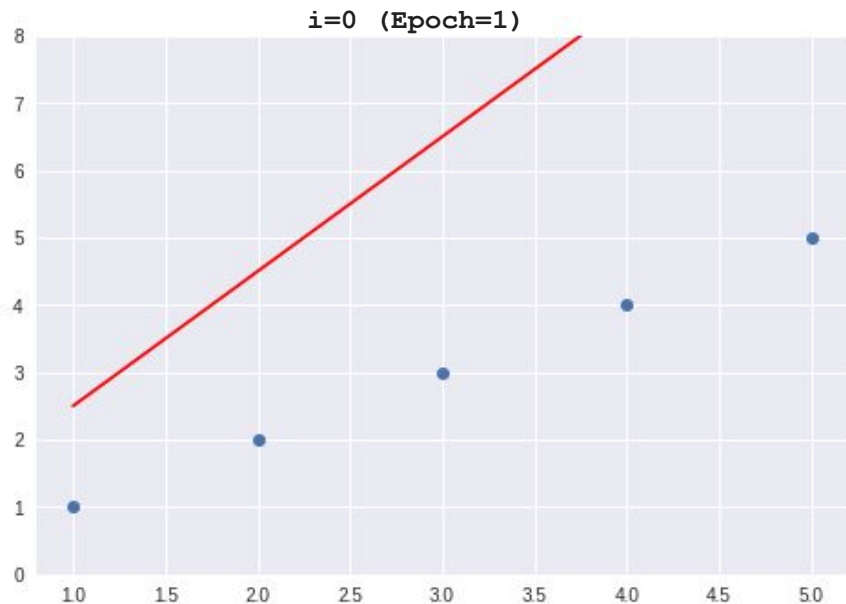
for i in range(100+1): # W, b update
    # Gradient descent
    with tf.GradientTape() as tape:
        hypothesis = W * x_data + b
        cost = tf.reduce_mean(tf.square(hypothesis - y_data))
    W_grad, b_grad = tape.gradient(cost, [W, b])
    W.assign_sub(learning_rate * W_grad)
    b.assign_sub(learning_rate * b_grad)
    if i % 10 == 0:
        print("{:5}|{:10.4f}|{:10.4f}|{:10.6f}".format(i, W.numpy(), b.numpy(), cost))
```

|  | i  | W      | b       | cost      |
|--|----|--------|---------|-----------|
|  | 0  | 2.4520 | 0.3760  | 45.660004 |
|  | 10 | 1.1036 | 0.0034  | 0.206336  |
|  | 20 | 1.0128 | -0.0209 | 0.001026  |
|  | 30 | 1.0065 | -0.0218 | 0.000093  |
|  | 40 | 1.0059 | -0.0212 | 0.000083  |
|  | 50 | 1.0057 | -0.0205 | 0.000077  |
|  | 60 | 1.0055 | -0.0198 | 0.000072  |
|  | 70 | 1.0053 | -0.0192 | 0.000067  |
|  | 80 | 1.0051 | -0.0185 | 0.000063  |
|  | 90 | 1.0050 | -0.0179 | 0.000059  |

# Training

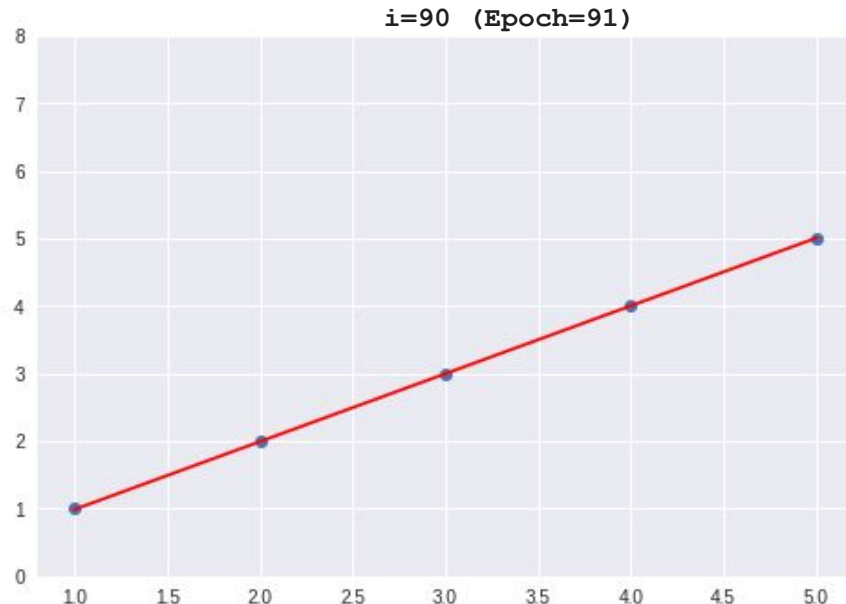
`W = tf.Variable(2.9)`

`b = tf.Variable(0.5)`



`W = 2.4520`

`b = 0.3760`



`W = 1.0050`

`b = -0.0179`



# Predict

Hypothesis  $H(x) = Wx + b$

*# Data*

x\_data = [1, 2, 3, 4, 5]

y\_data = [1, 2, 3, 4, 5]

```
print(W * 5 + b)
print(W * 2.5 + b)
```

tf.Tensor(5.0066934, shape=(), dtype=float32)

tf.Tensor(2.4946523, shape=(), dtype=float32)

# What's Next?

- How to minimize cost