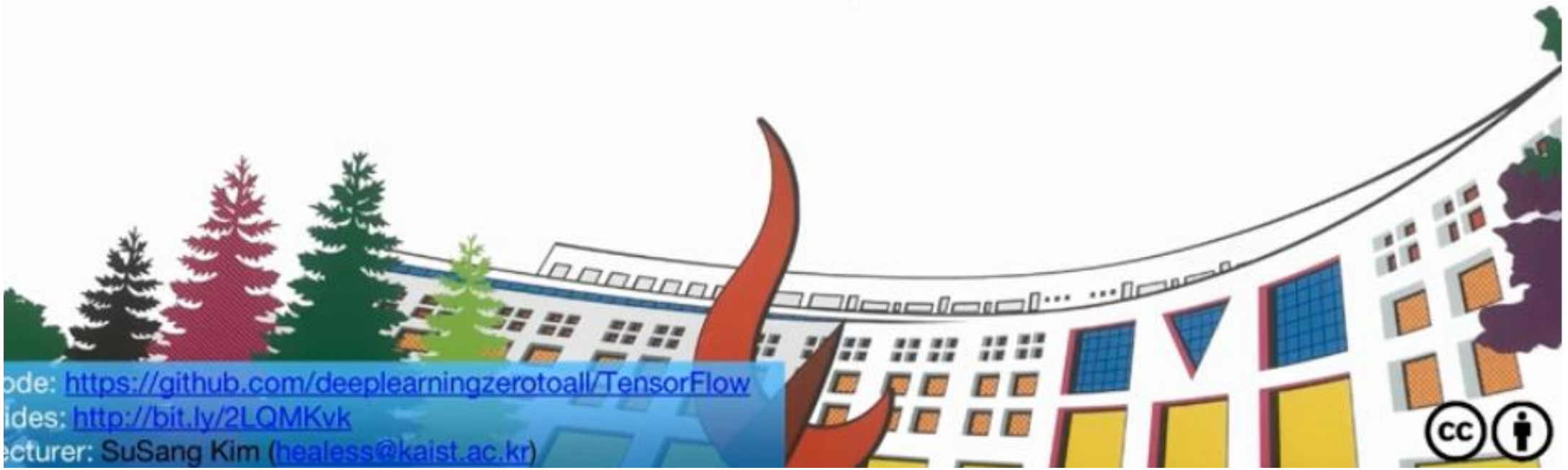
ML/DL for Everyone Season2

with TensorFlow

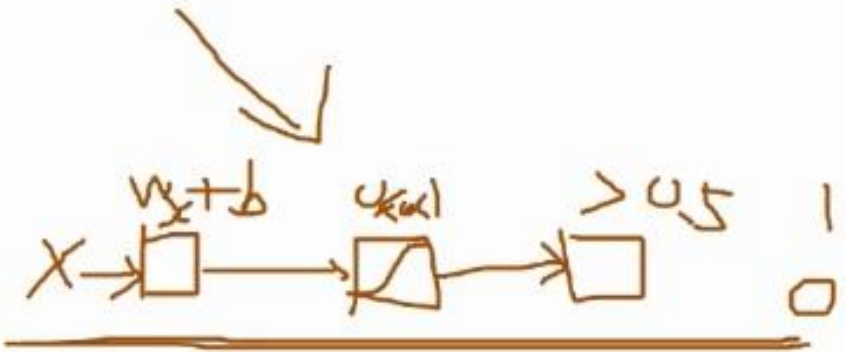
Lab 05-2 Logistic Regression

- cost function & optimizer



Logistic Regression

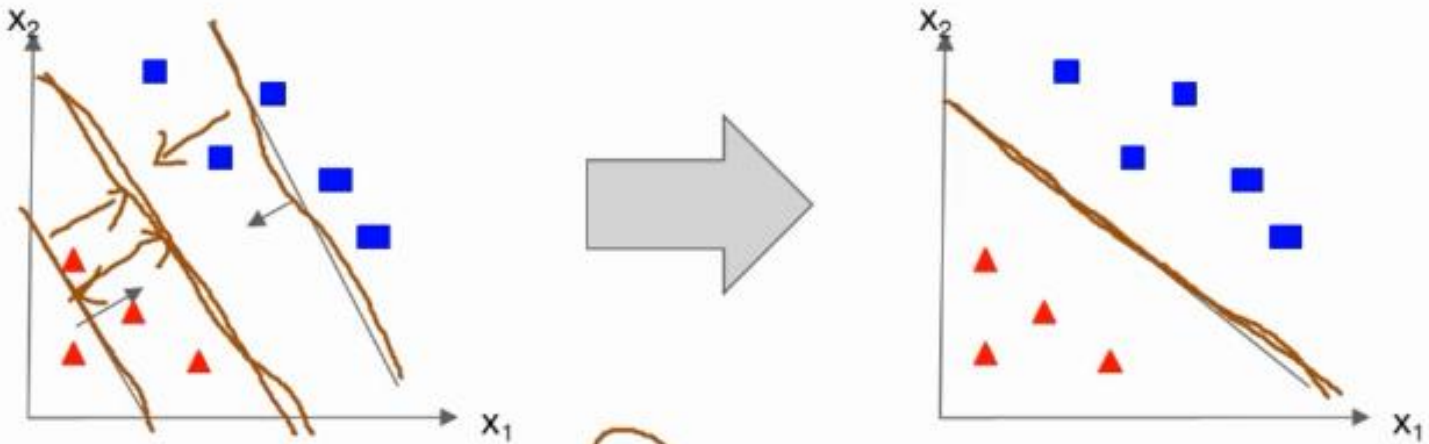
- What is Logistic Regression?
  - Classification
  - Logistic vs Linear
- How to solve?
  - Hypothesis Representation
  - Sigmoid/Logistic Function
  - Decision Boundary
  - Cost Function
  - Optimizer (Gradient Descent)
- Codes (Eager Execution)
- Summary



Cost Function

the cost function to fit the parameters(θ)

W



Given the training set how to we chose/fit θ?

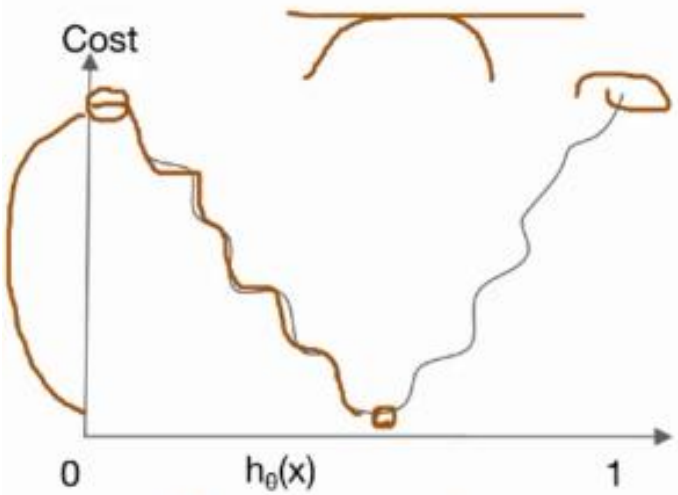
$h_\theta(x) = y$ then Cost = 0

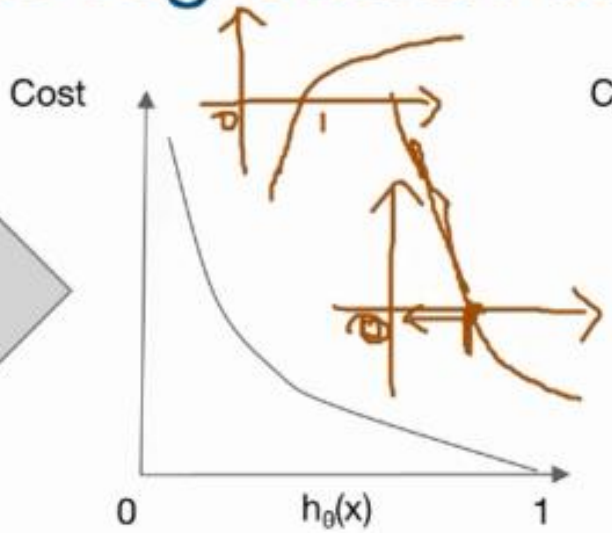
$cost(h_\theta(x), y) = -y\log(h_\theta(x)) - (1-y)\log(1 - h_\theta(x))$

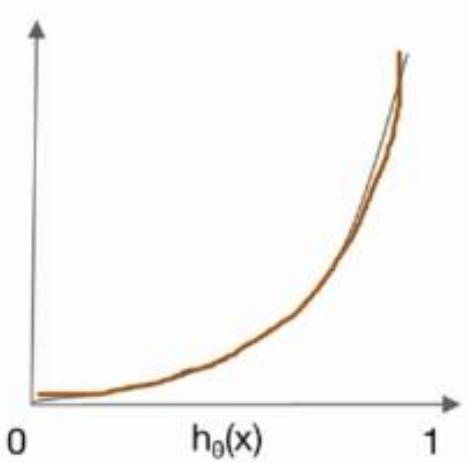
```
[Tensorflow Code]
def loss_fn(hypothesis, labels):
    cost = -tf.reduce_mean(labels * tf.log(hypothesis) + (1 - labels) * tf.log(1 - hypothesis))
    return cost
```

Cost Function

A convex logistic regression cost function







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

$$\mathrm{Cost}(h_\theta(x), y) = \begin{cases} -\log(h_\theta(x)) & \text{if } y = 1 \\ -\log(1 - h_\theta(x)) & \text{if } y = 0 \end{cases}$$

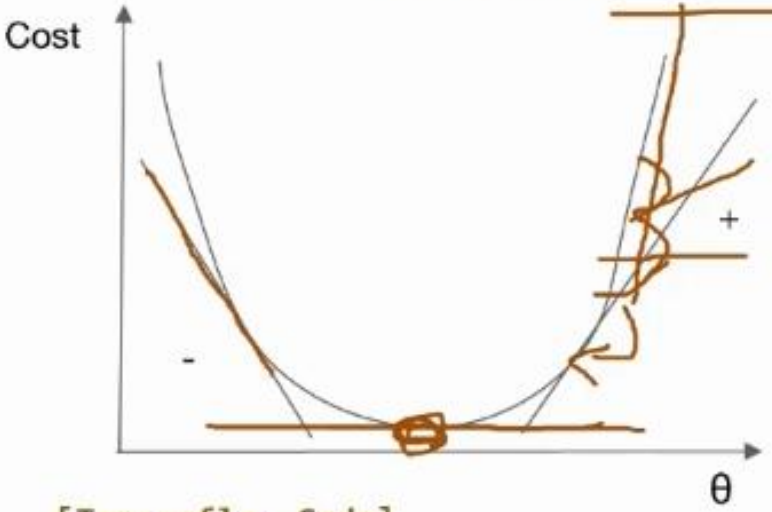
$$\mathrm{cost}(h_\theta(x), y) = -y \log(h_\theta(x)) - (1 - y) \log(1 - h_\theta(x))$$

[Tensorflow Code]

```
cost = -tf.reduce_mean(labels * tf.log(hypothesis) + (1 - labels) * tf.log(1 - hypothesis))
```

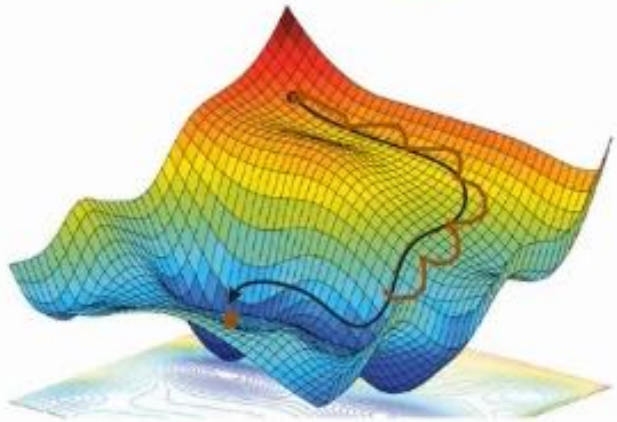
Optimization

How to minimize the cost function



$\text{cost}(h_\theta(x), y) = -y \log(h_\theta(x)) - (1-y)\log(1-h_\theta(x))$

Repeat $\{ \theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta) \}$



```
[Tensorflow Code]
def grad(hypothesis, labels):
    with tf.GradientTape() as tape:
        loss_value = loss_fn(hypothesis, labels)
    return tape.gradient(loss_value, [W,b])
optimizer = tf.train.GradientDescentOptimizer(learning_rate=0.01)
optimizer.apply_gradients(grads_and_vars=zip(grads,[W,b]))
```

https://www.sciencemag.org/news/2018/05/ai-researchers-allege-machine-learning-alchemy