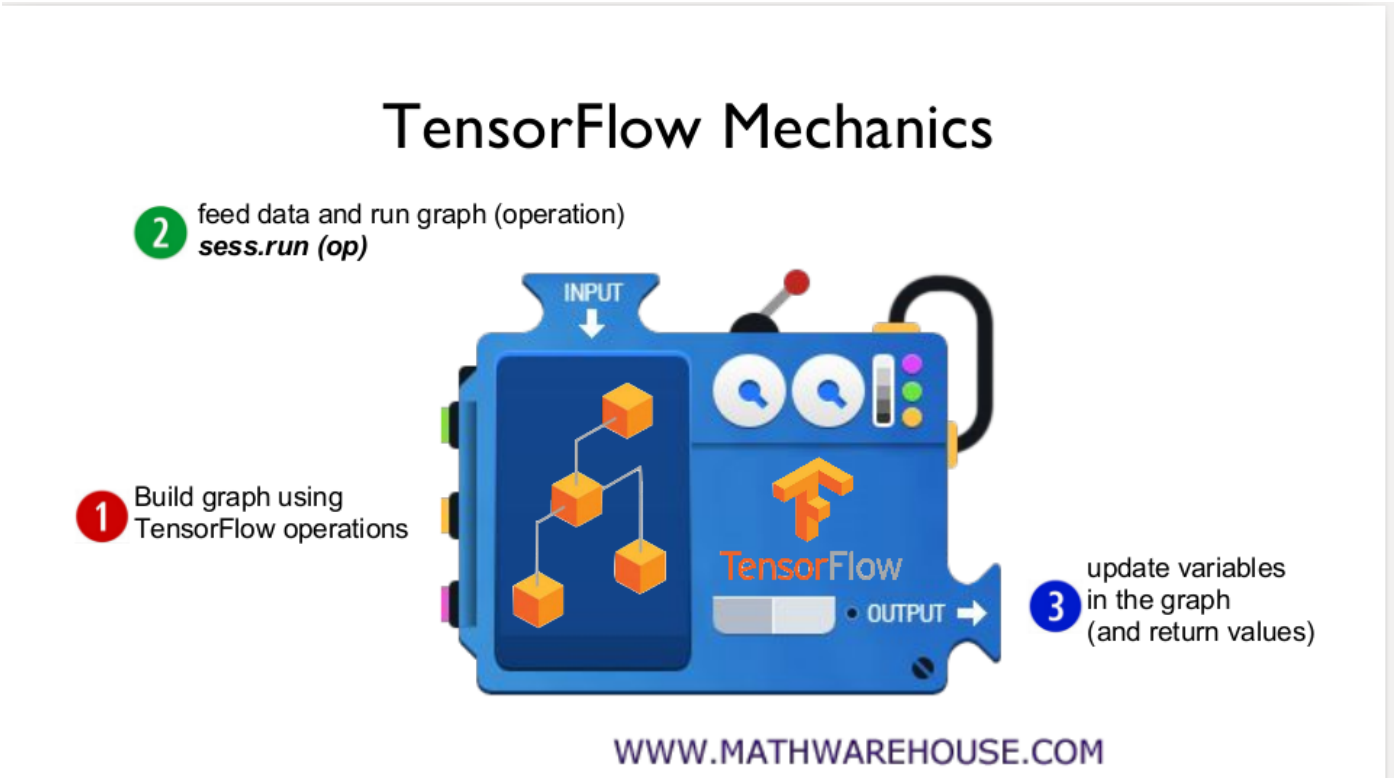
Deep Learning / Machine Learning Seminar

- Basic to MNIST -

박성현

How TensorFlow Works?

Build Graph → Feed Data → Run Graph → Update Variables

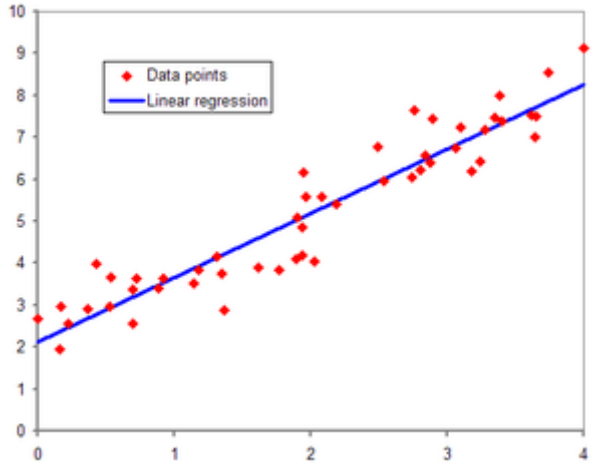


Basic TensorFlow

- Session
- constant
- Variable
- add / mul
- matmul
- initialize_all_variables

How to Predict Next Value?

- 기존의 데이터에서 다음값을 “어떻게” 추측할 것인가
- 가장 간단하게 하는 법 : linear regression [선형 회귀분석]
- $H(x) = W \cdot x + b$ // W : weight, b : bias
- 예측은 했는데 그대로 써도 될까?
- 실제값과의 차이를 나타내는 함수를 쓰자
- $C(x) = H(x) - y$
- $\text{Cost} = \frac{1}{m} \sum_{\square}^{last} (H(x) - y)^2$



How to Predict Next Value?

- Goal : minimize “cost value”
- cost(W,b) = $\frac{1}{m}\sum_{\square}^{last}(\mathrm{H}(x)-y)^2$

- MINIMIZE cost by changing Weight and bias

How It Works?

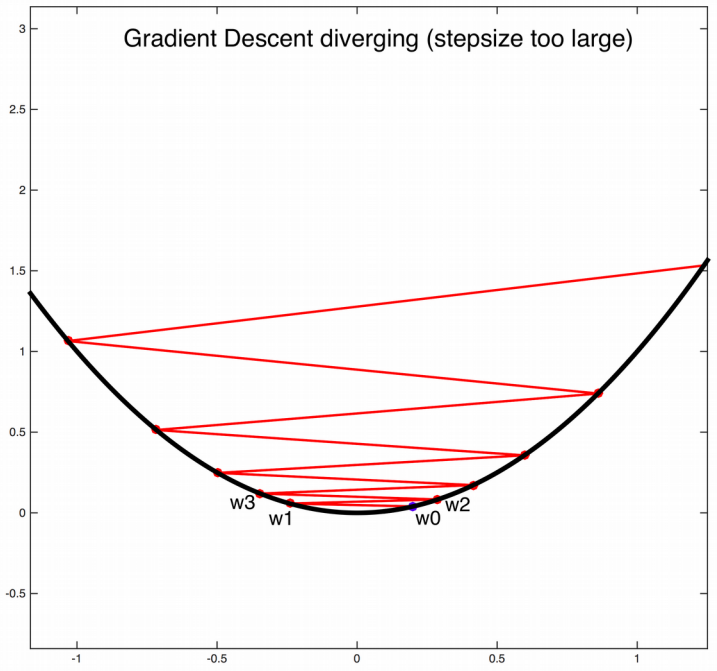
Gradient descent algorithm

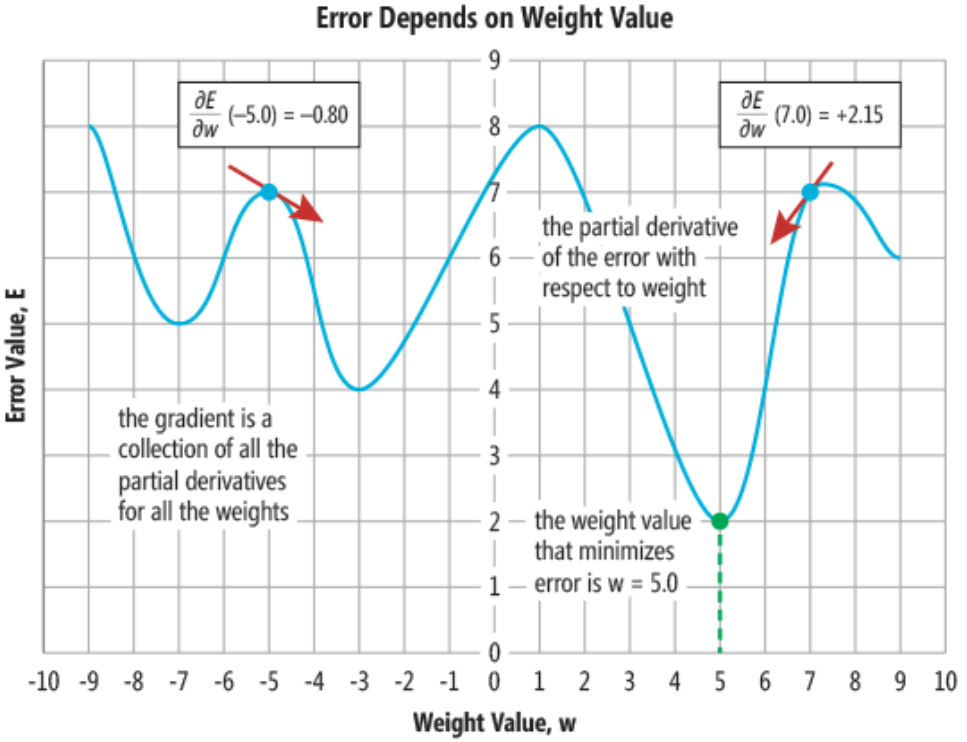
repeat until convergence {

$$\theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta_0, \theta_1)$$

(for $j = 1$ and $j = 0$)

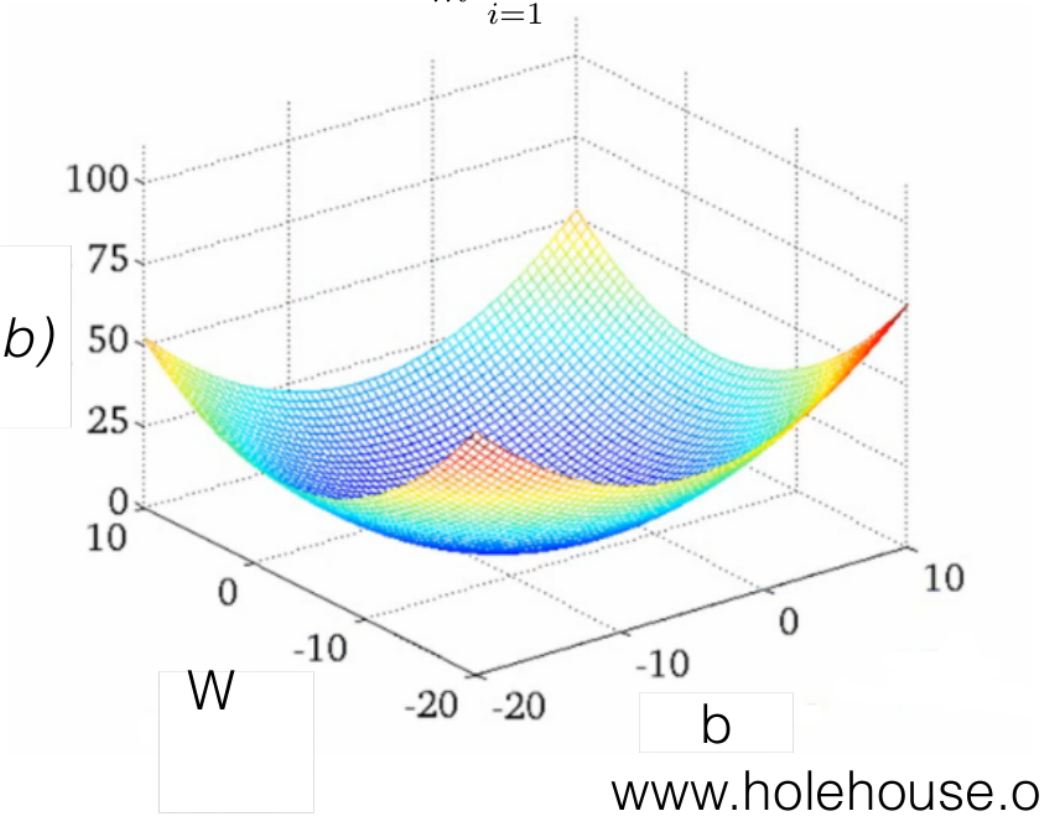
}





How It Works?

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



www.holehouse.org/mlclass/

Multi-Variable Linear Regression

- 말 그대로 “여러개”의 linear regression을 적용하는 것
- 왜?

  → 여러 개의 기준을 적용할 때 !!
- 그냥 하기엔 힘드니까, “행렬 연산”을 통해 간단하게 하자

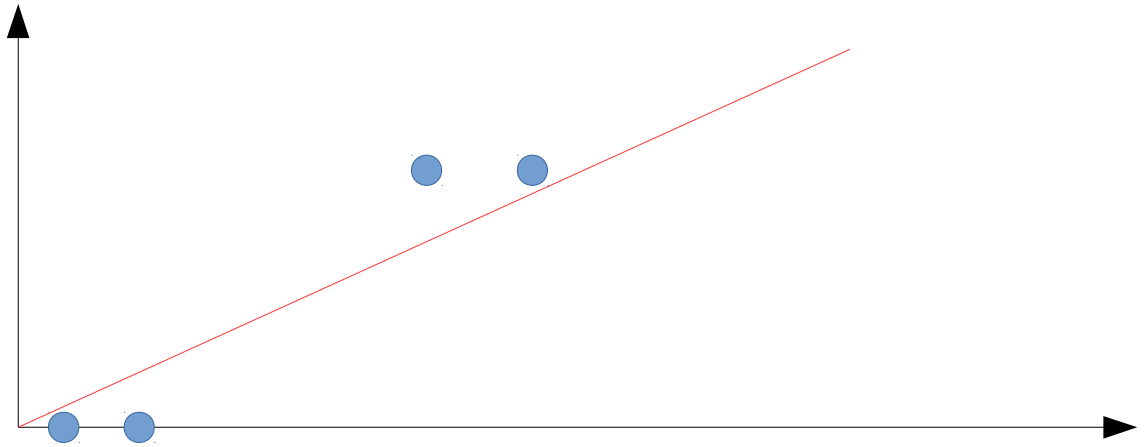
$$H(x_1, x_2, x_3, ..., x_n) = w_1x_1 + w_2x_2 + w_3x_3 + ... + w_nx_n + b$$

$$\begin{pmatrix} x_1 & x_2 & x_3 \end{pmatrix} \cdot \begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix} = \begin{pmatrix} x_1w_1 + x_2w_2 + x_3w_3 \end{pmatrix}$$

$$H(X) = XW$$

소올직히 linear 쓰레기 ㅇㅈ?ㅇㅇㅈ~

- 겨우 선형회귀분석하려고 TensorFlow를 쓸까 "NO"
- 컴퓨터에서 보통 상태를 0, 1로 표현을 함
- 이런 경우엔 어떻게 해야 되는가



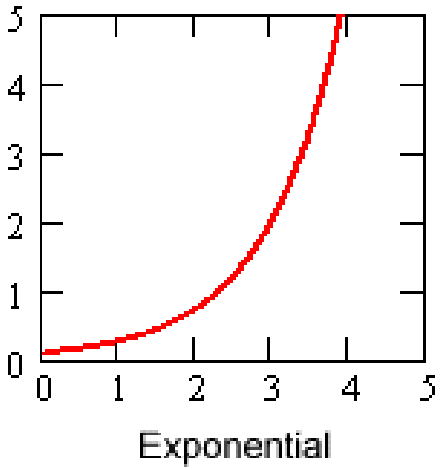
답은 “Logistic Regression” 이다

Logistic Function : $\frac{1}{1+e^{Wx+b}}$

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

$$J(\theta) = -\frac{1}{m}[\sum_{i=1}^{m} y^{(i)} \log h_\theta(x^{(i)}) + (1 - y^{(i)}) \log (1 - h_\theta(x^{(i)}))]$$

$L1(x) := \frac{1}{10} \cdot e^{x}$ $L2(x) := 10 \cdot \left(1 - 100 \cdot e^{-x}\right)$ $L(x) := \frac{10}{1 + 100 \cdot e^{-x}}$



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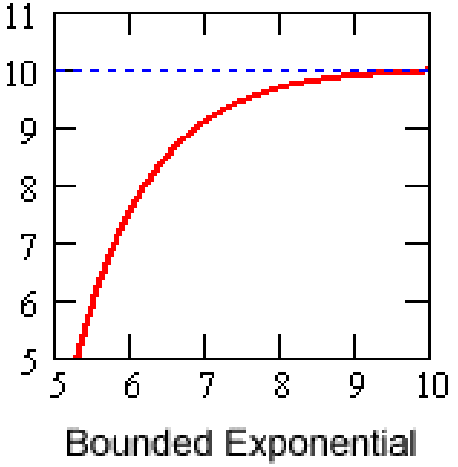

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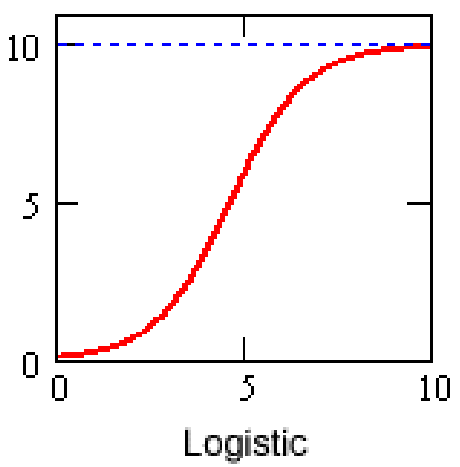
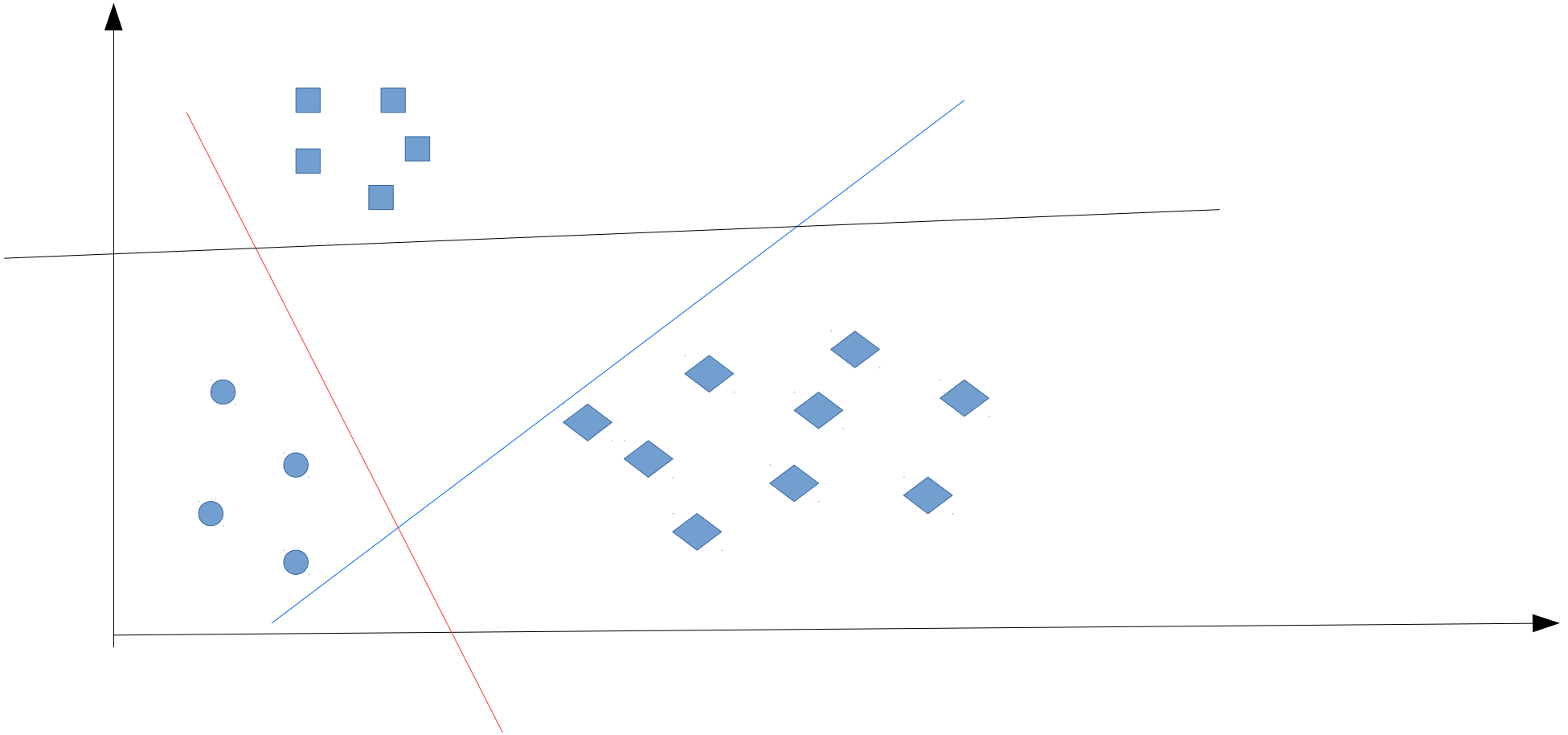


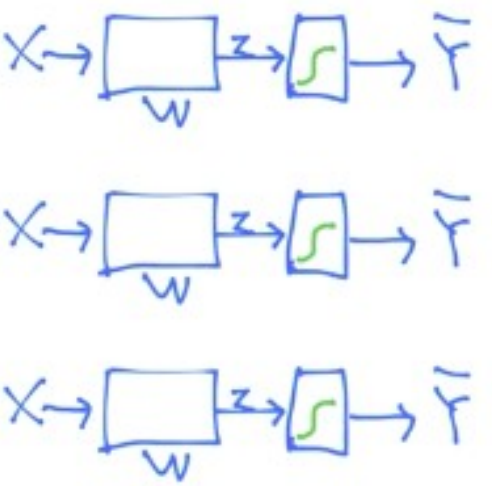
Multinomial Classification

- Only one boundary?
- No



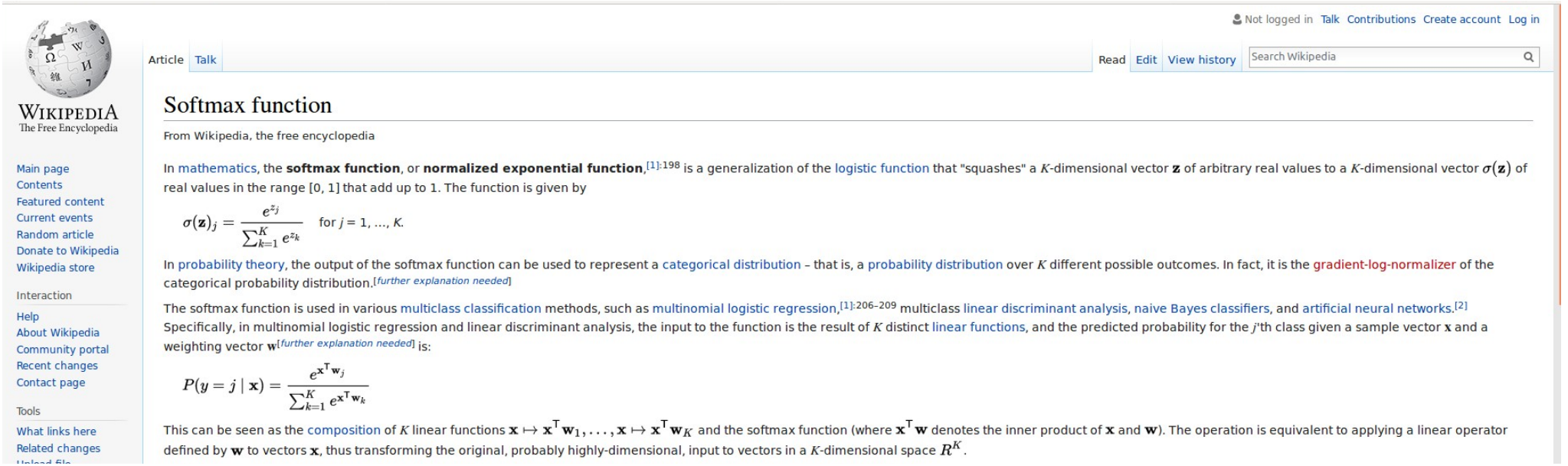
Multinomial Classification

$$\begin{bmatrix} w_{A1} & w_{A2} & w_{A3} \\ w_{B1} & w_{B2} & w_{B3} \\ w_{C1} & w_{C2} & w_{C3} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} w_{A1}x_1 + w_{A2}x_2 + w_{A3}x_3 \\ w_{B1}x_1 + w_{B2}x_2 + w_{B3}x_3 \\ w_{C1}x_1 + w_{C2}x_2 + w_{C3}x_3 \end{bmatrix} = \begin{bmatrix} \bar{y}_A \\ \bar{y}_B \\ \bar{y}_C \end{bmatrix}$$



Softmax Function

- 0~1의 확률로 변환하는 함수



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Softmax function

From Wikipedia, the free encyclopedia

In mathematics, the **softmax function**, or **normalized exponential function**,[1]:198 is a generalization of the logistic function that "squashes" a K-dimensional vector $\mathbf{z}$ of arbitrary real values to a K-dimensional vector $\sigma(\mathbf{z})$ of real values in the range [0, 1] that add up to 1. The function is given by

$$\sigma(\mathbf{z})_j = \frac{e^{z_j}}{\sum_{k=1}^{K} e^{z_k}} \quad \text{for } j = 1, \ldots, K.$$

In probability theory, the output of the softmax function can be used to represent a categorical distribution – that is, a probability distribution over K different possible outcomes. In fact, it is the gradient-log-normalizer of the categorical probability distribution.[*further explanation needed*]

The softmax function is used in various multiclass classification methods, such as multinomial logistic regression,[1]:206–209 multiclass linear discriminant analysis, naive Bayes classifiers, and artificial neural networks.[2] Specifically, in multinomial logistic regression and linear discriminant analysis, the input to the function is the result of K distinct linear functions, and the predicted probability for the j'th class given a sample vector $\mathbf{x}$ and a weighting vector $\mathbf{w}$[*further explanation needed*] is:

$$P(y = j \mid \mathbf{x}) = \frac{e^{\mathbf{x}^\mathsf{T}\mathbf{w}_j}}{\sum_{k=1}^{K} e^{\mathbf{x}^\mathsf{T}\mathbf{w}_k}}$$

This can be seen as the composition of K linear functions $\mathbf{x} \mapsto \mathbf{x}^\mathsf{T}\mathbf{w}_1, \ldots, \mathbf{x} \mapsto \mathbf{x}^\mathsf{T}\mathbf{w}_K$ and the softmax function (where $\mathbf{x}^\mathsf{T}\mathbf{w}$ denotes the inner product of $\mathbf{x}$ and $\mathbf{w}$). The operation is equivalent to applying a linear operator defined by $\mathbf{w}$ to vectors $\mathbf{x}$, thus transforming the original, probably highly-dimensional, input to vectors in a K-dimensional space R^K.

One-Hot Encoding

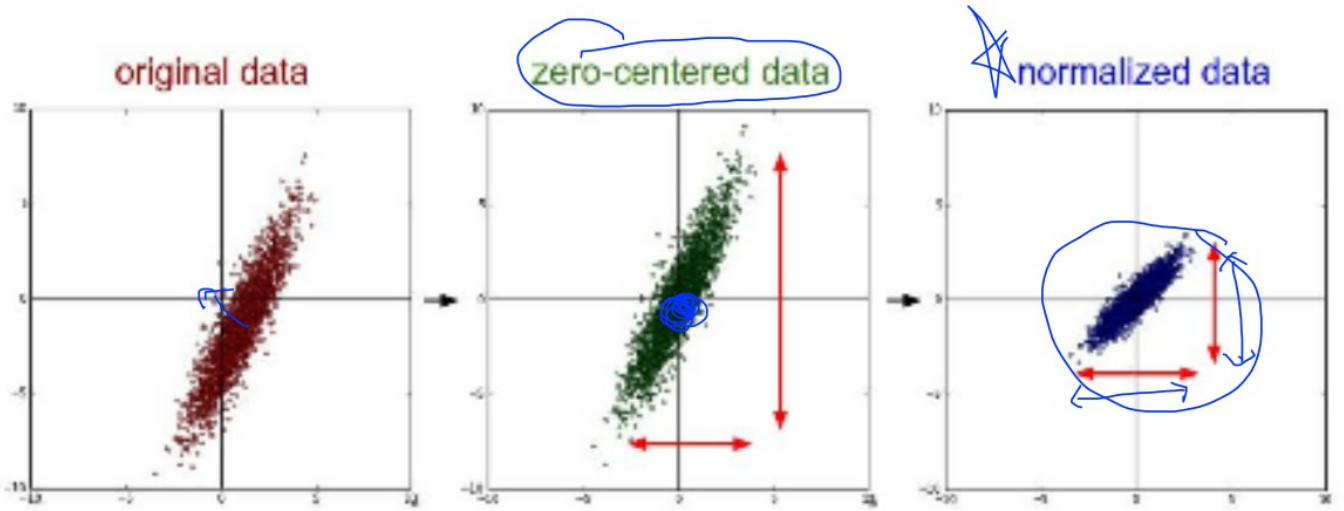
- Why?
- Logistic function or Linear Regression → ex] 2.5, 3.4, … 그냥 숫자
- 의도하지 않은 우위 [priority]를 부여하는 경우가 생길 수도 있음
- One-Hot Encoding : ex] [1,0,0,0] [0,1,0,0]

Practice Lab

- 1. Basic TensorFlow
- 2. Linear / Logistic Regression
- 3. XOR solve

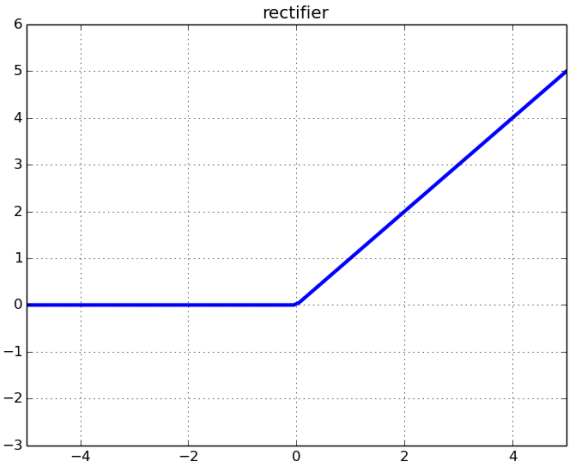
Data Preprocessing

Data (X) preprocessing for gradient descent



ReLU

- ReLU = Rectified Linear Unit
- Why ReLU?
- To solve XOR problem !



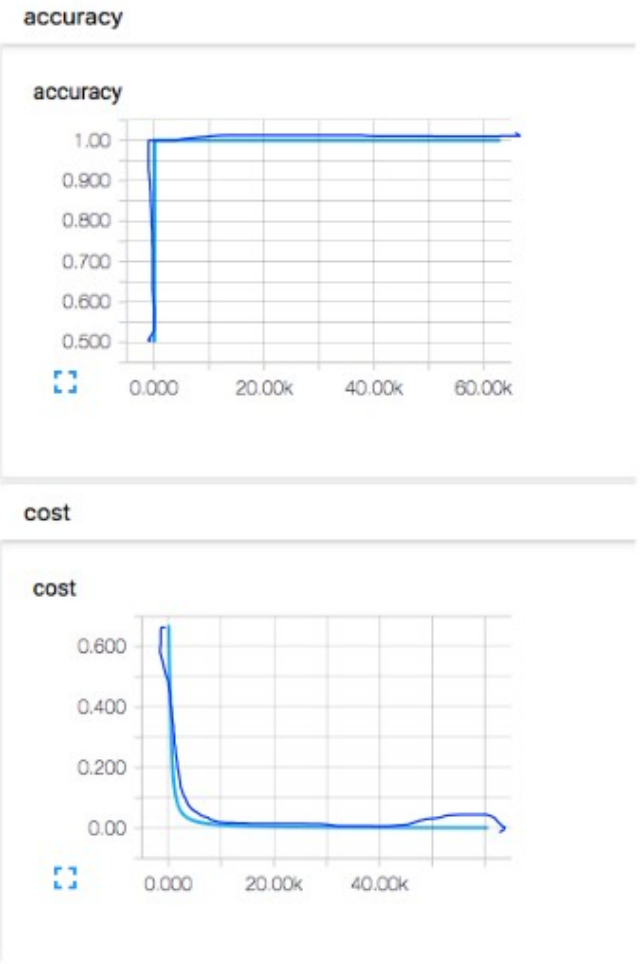
- Result of 9 layers of sigmoid for XOR

Tensorboard
Cost &
Accuracy

ReLU

- ReLU = Rectified Linear Unit
- Why ReLU?
- To solve XOR problem !

- Result of 9 layers of “ReLU” for XOR



Practice Lab

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