Neural Network Intro

송예은

What is Deep Learning?

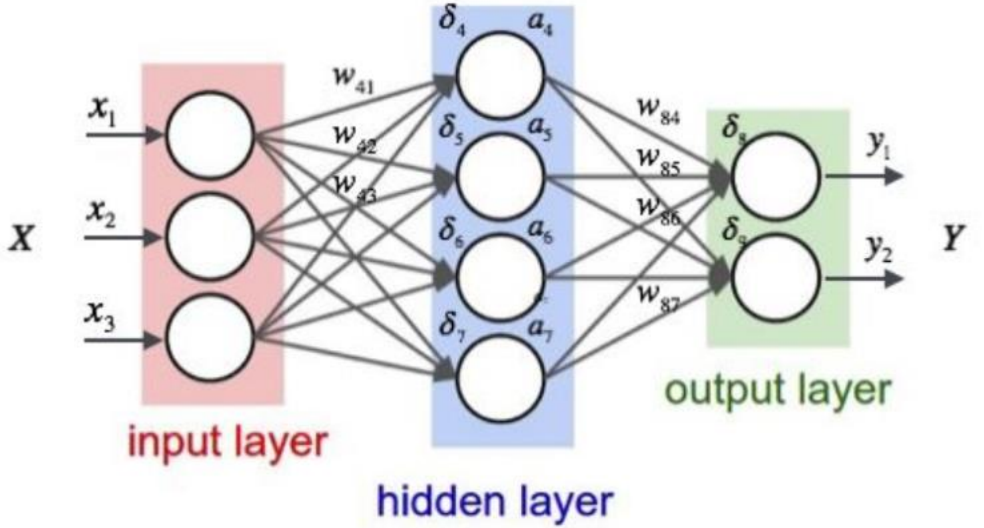
Deep Learning

- Deep Learning ⊂ Machine Learning
- Machine Learning: 인공 지능의 한 분야로, 컴퓨터가 학습할 수 있도록 하는 알고리즘과 기술을 개발하는 분야
- Deep Learning: Machine Learning의 분야 중 Deep Neural Network를 이용한 기법

Deep Learning

- Deep Learning: input layer, hidden layer, output layer에서 hidden layer가 2개 이상

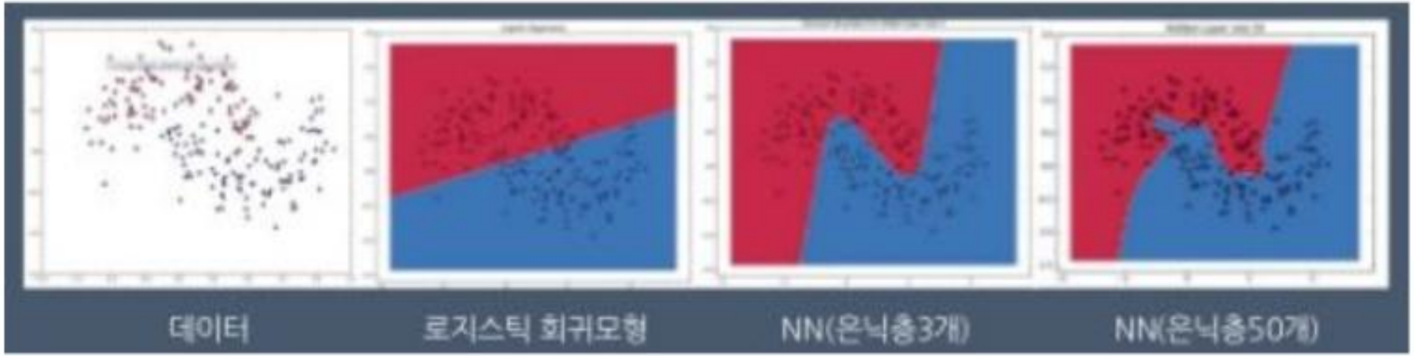
  → DEEP!



https://miro.medium.com/max/479/1*QVlyc5HnGDWTNX3m-nlm9w.png

Deep Learning

- Hidden layer를 여러 번 결합시킨다.
- Hidden layer 개수 ↑ → 정확한 classification
- What about overfitting?

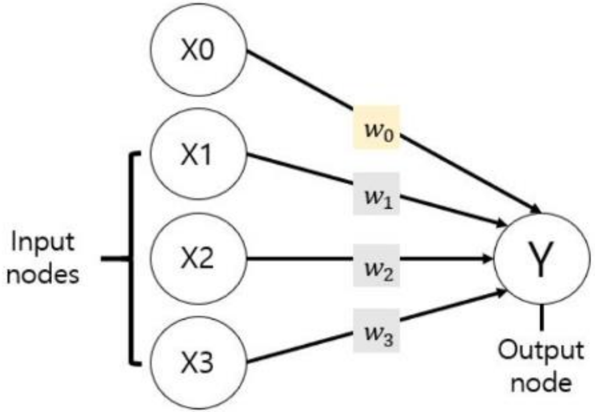


https://www.slideshare.net/HeeWonPark11/ss-80653977

Perceptron

Perceptron

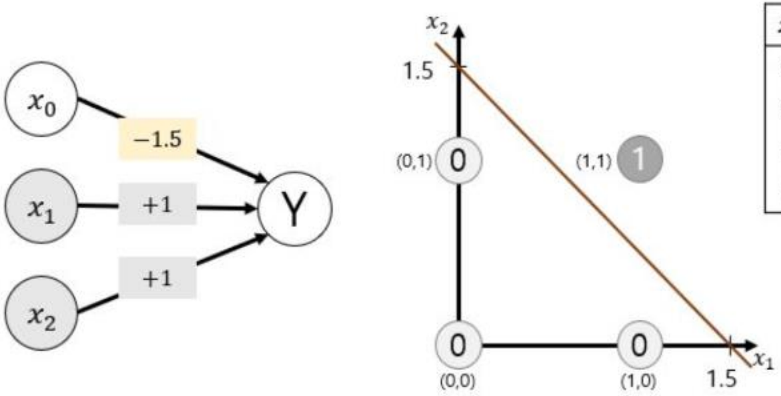
- 신경망 구성의 기본 단위
- Input node의 선형 결합으로 output node 도출



Perceptron Model
$Y = I(\sum_j w_j X_j - w_0)$
$Y = sign(\sum_j w_j X_j - w_0)$
$Y = w_0 + \sum_j w_j X_j$

Perceptron

- 그렇다면 Perceptron으로 Data를 어떻게 분류하는가?

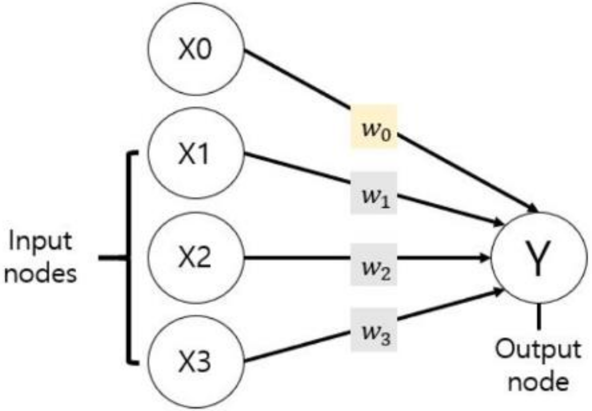


x_1	x_2	y
0	0	0
0	1	0
1	0	0
1	1	1

Perceptron

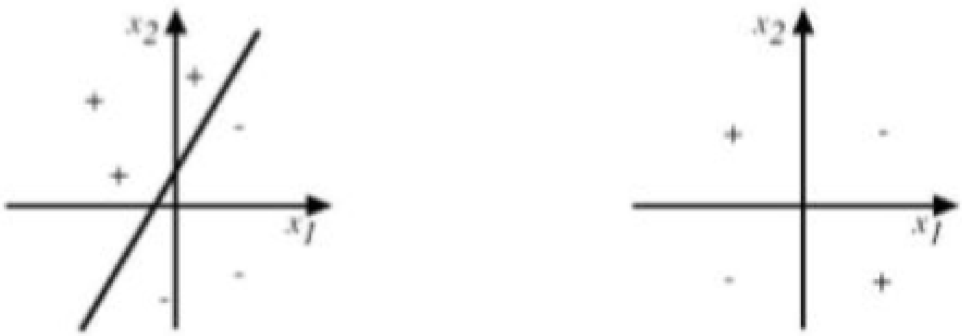
- Perceptron Model 최적화
- 최적화된 weight와 bias를 구해야 한다
- 예측값과 실제값의 차이를 최대한 줄이기

→ 오차 최소화 → 가중치 최적화



Multilayer Perceptron

Multilayer Perceptron



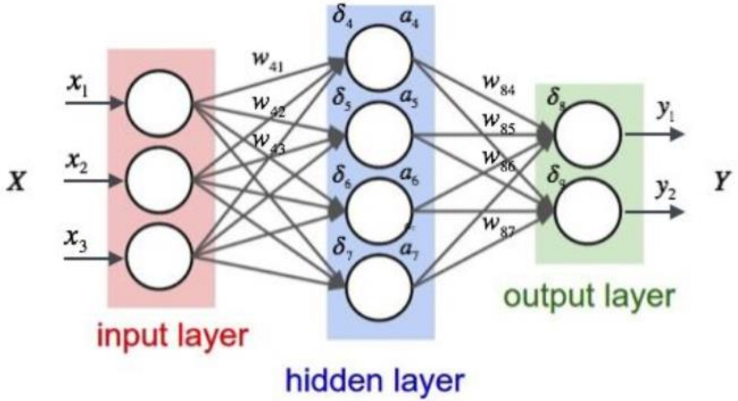
(a) (b)

- 직선 하나로는 분류 불가능! → Multilayer Perceptron!

KU-BIG

Multilayer Perceptron

- 직선 하나로는 분류 불가능! → Multilayer Perceptron!
- “Hidden Layer”
- 여러 개의 decision boundary



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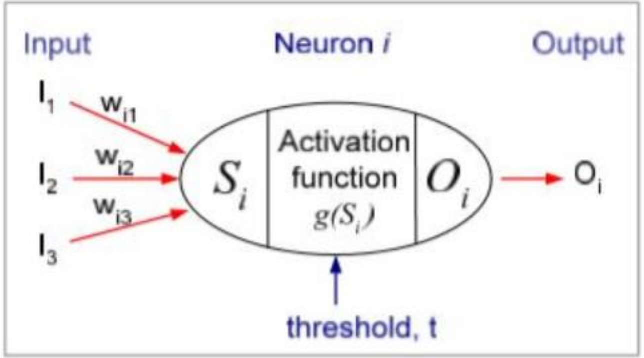
Activation Function

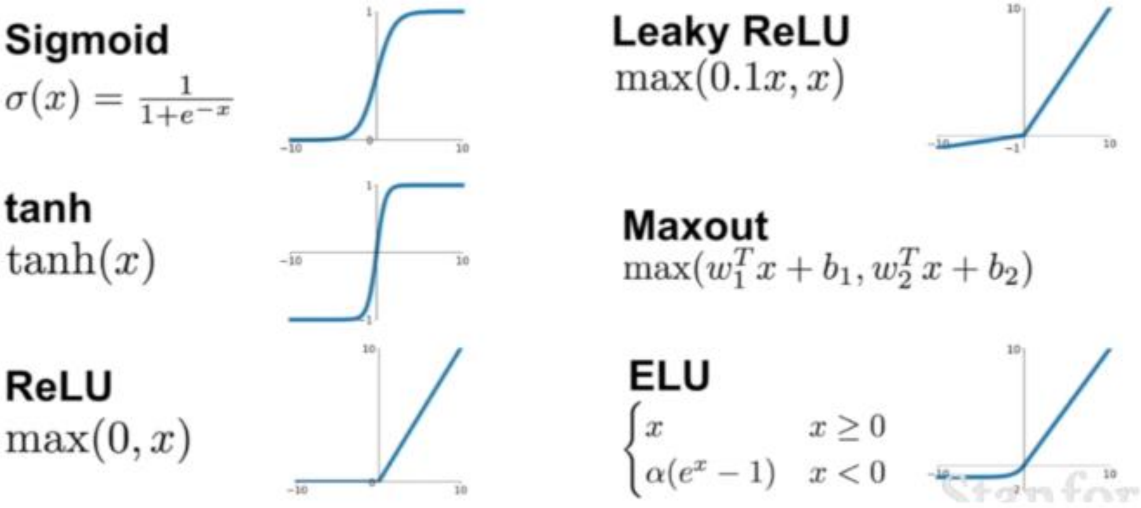
Activation Function

- 한 가지 의문: 우리의 Decision Boundary는 선형이었는데 다른 형태는 불가능한가?!
- "Activation Function": 활성화 함수 연결



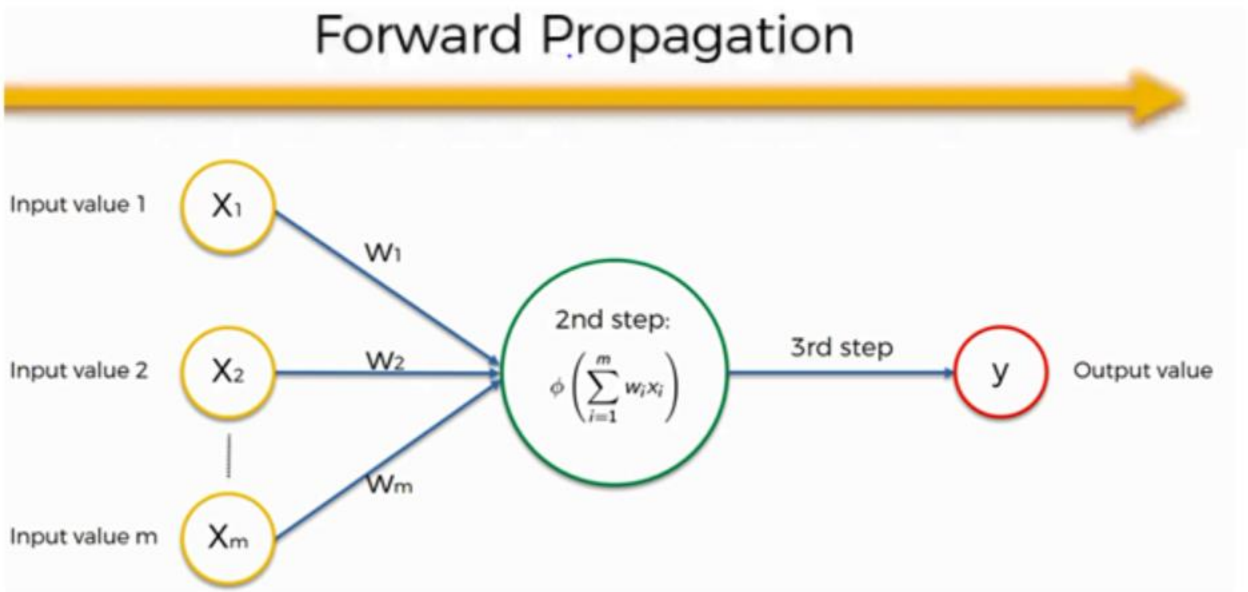
Activation Function

- Activation Function Types



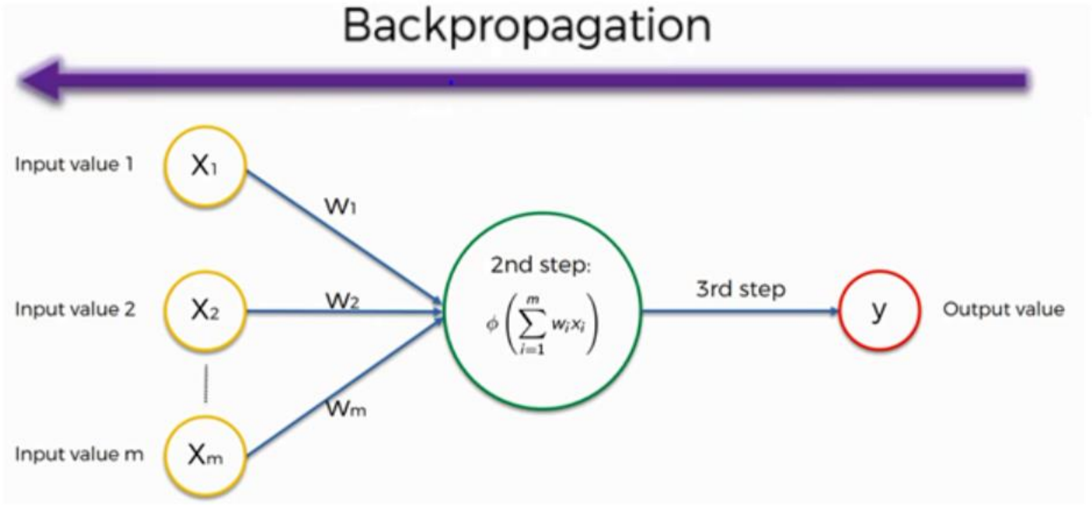
Training Neural Network

Forward Propagation



Backward Propagation

- 최적화된 weight, bias 찾기
- 오차의 기울기를 output layer에서 input layer로 전달 → "backward"



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Backward Propagation

- 최적화된 weight, bias 찾기

$$\frac{\partial \ell}{\partial \widehat{x}_i} = \frac{\partial \ell}{\partial y_i} \cdot \gamma$$

$$\frac{\partial \ell}{\partial \sigma_{\mathcal{B}}^2} = \sum_{i=1}^{m} \frac{\partial \ell}{\partial \widehat{x}_i} \cdot (x_i - \mu_{\mathcal{B}}) \cdot \frac{-1}{2}(\sigma_{\mathcal{B}}^2 + \epsilon)^{-3/2}$$

$$\frac{\partial \ell}{\partial \mu_{\mathcal{B}}} = \left(\sum_{i=1}^{m} \frac{\partial \ell}{\partial \widehat{x}_i} \cdot \frac{-1}{\sqrt{\sigma_{\mathcal{B}}^2 + \epsilon}} \right) + \frac{\partial \ell}{\partial \sigma_{\mathcal{B}}^2} \cdot \frac{\sum_{i=1}^{m} -2(x_i - \mu_{\mathcal{B}})}{m}$$

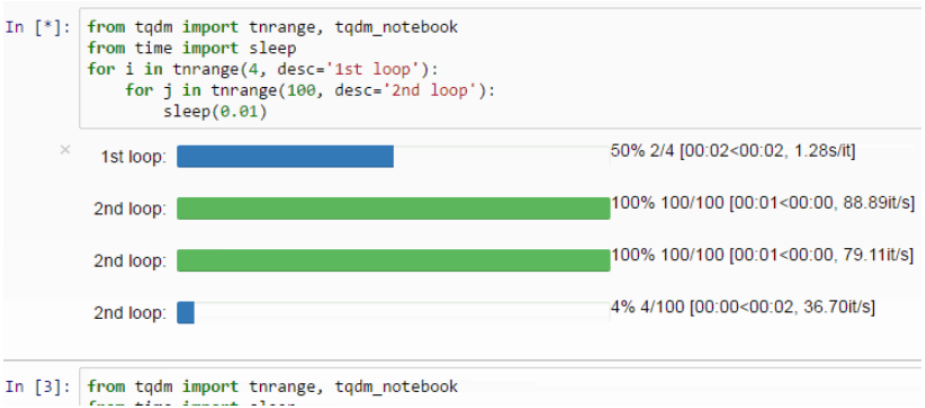
$$\frac{\partial \ell}{\partial x_i} = \frac{\partial \ell}{\partial \widehat{x}_i} \cdot \frac{1}{\sqrt{\sigma_{\mathcal{B}}^2 + \epsilon}} + \frac{\partial \ell}{\partial \sigma_{\mathcal{B}}^2} \cdot \frac{2(x_i - \mu_{\mathcal{B}})}{m} + \frac{\partial \ell}{\partial \mu_{\mathcal{B}}} \cdot \frac{1}{m}$$

$$\frac{\partial \ell}{\partial \gamma} = \sum_{i=1}^{m} \frac{\partial \ell}{\partial y_i} \cdot \widehat{x}_i$$

$$\frac{\partial \ell}{\partial \beta} = \sum_{i=1}^{m} \frac{\partial \ell}{\partial y_i}$$

tqdm

- Progress bars in Python
  - You get a reliable estimate of how long the progress will take.
  - You can see immediately if the progress is stuck.



tqdm in action

Thank You