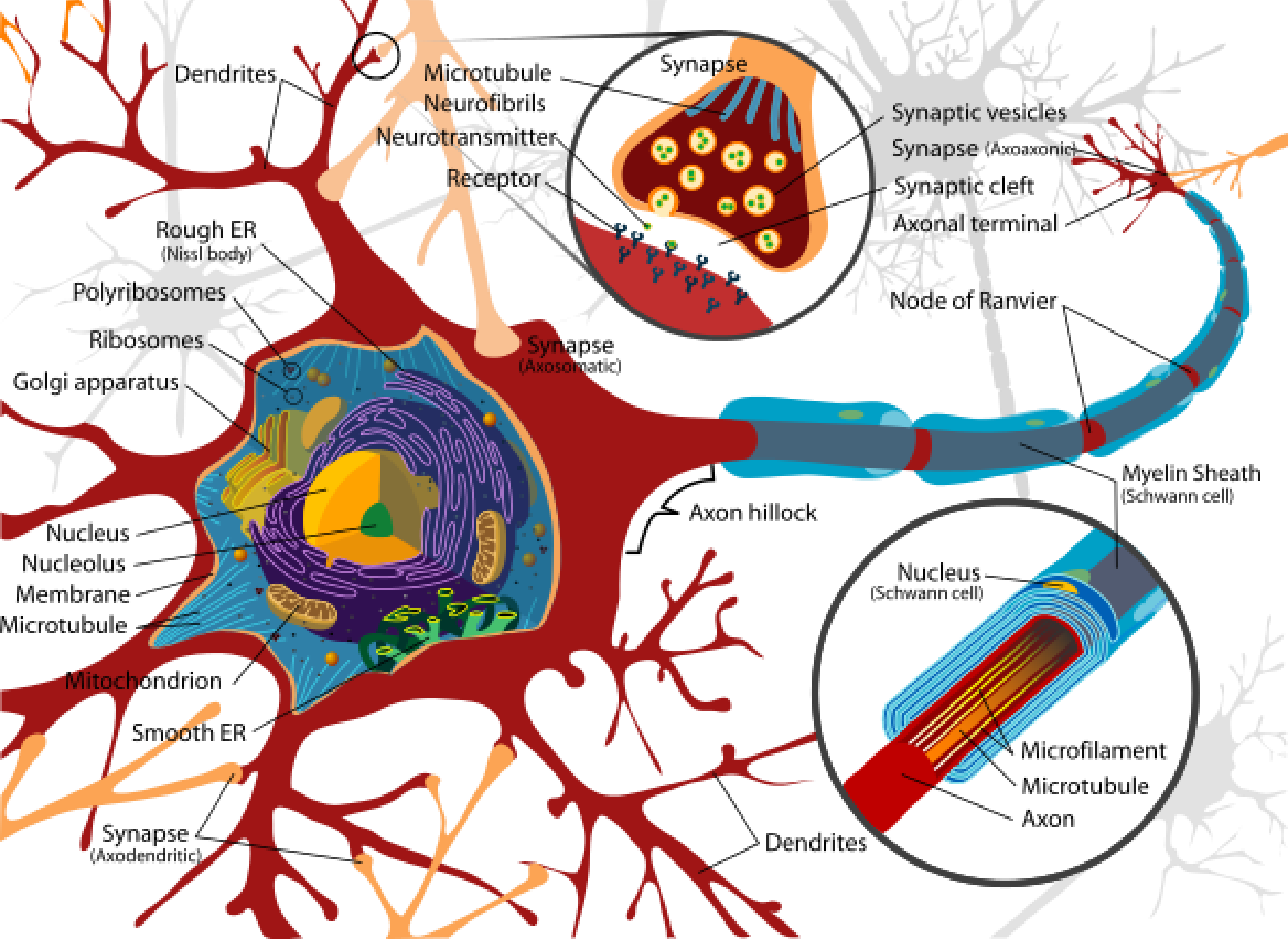
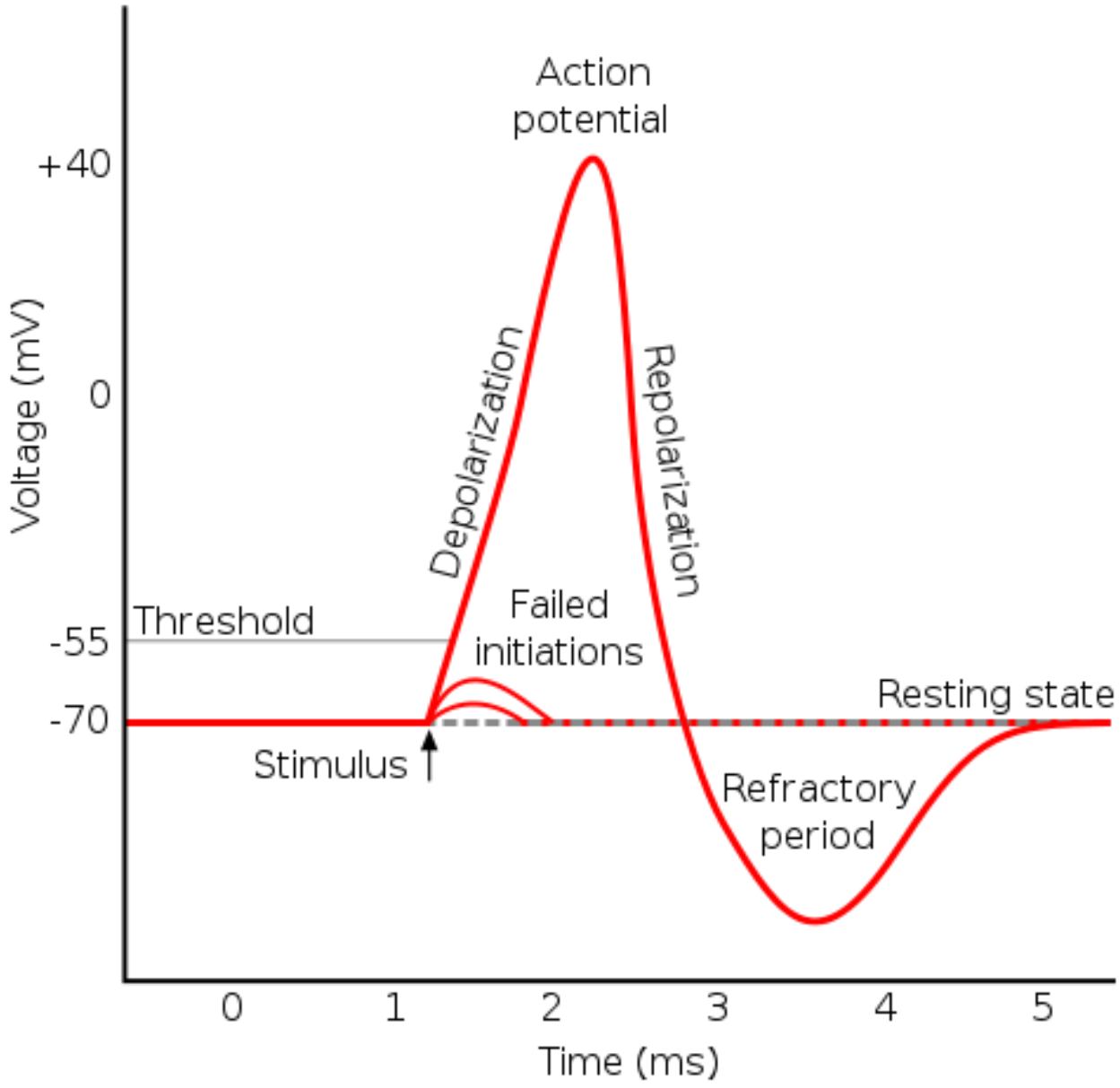
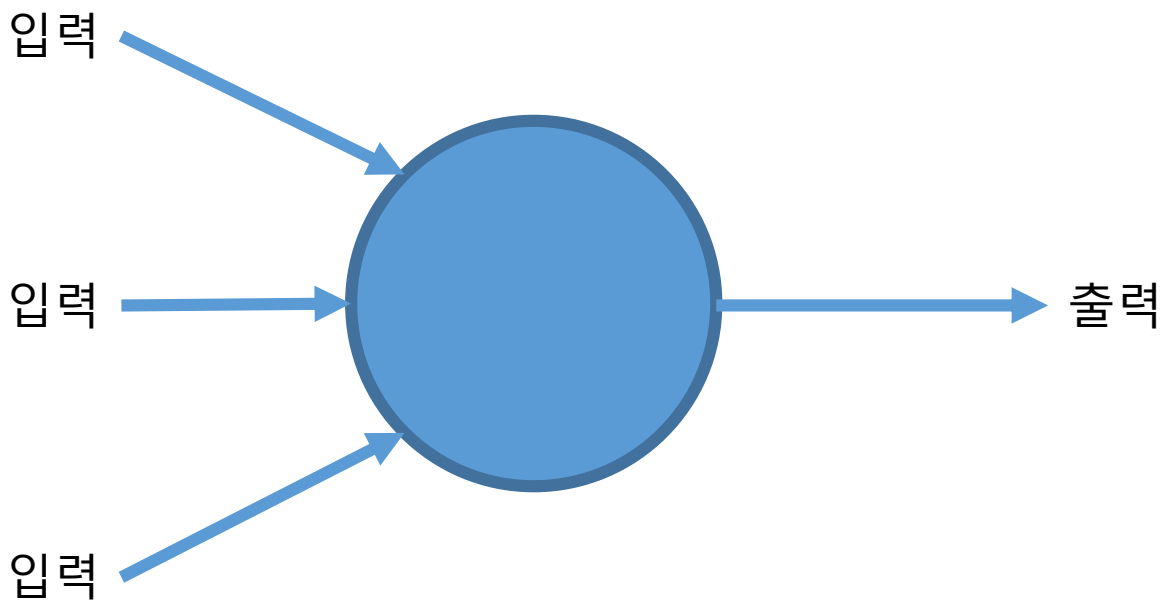
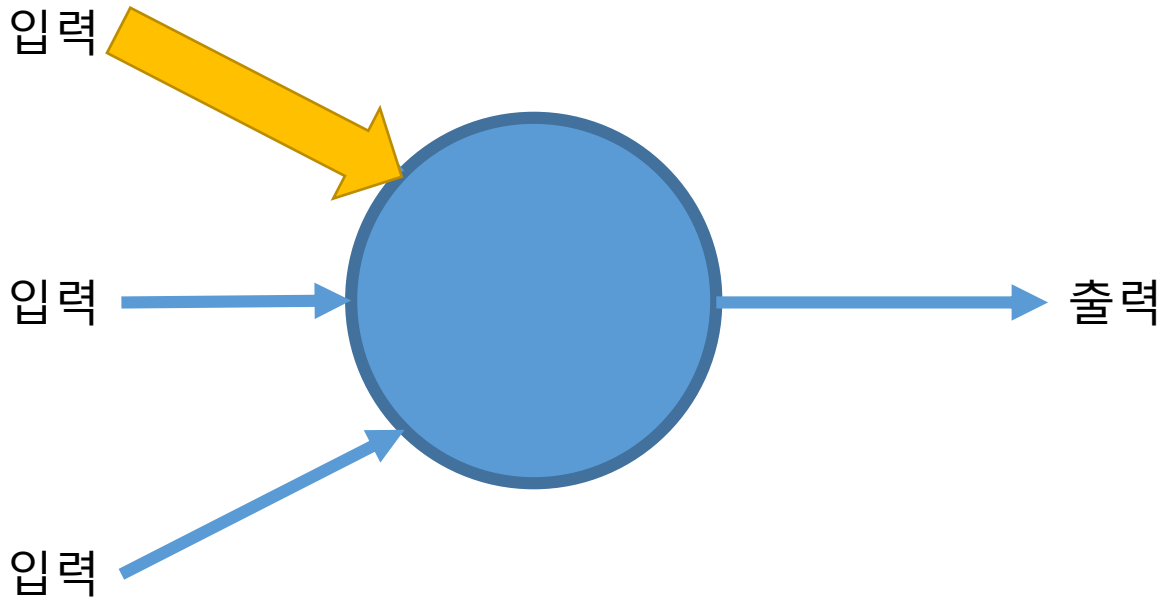
Neural Networks
&
Deep Learning


Dendrites
Microtubule
Neurofibrils
Neurotransmitter
Receptor
Synapse
Synaptic vesicles
Synapse (Axoaxonic)
Synaptic cleft
Axonal terminal
Rough ER
(Nissl body)
Polyribosomes
Ribosomes
Golgi apparatus
Synapse
(Axosomatic)
Node of Ranvier
Myelin Sheath
(Schwann cell)
Axon hillock
Nucleus
Nucleolus
Membrane
Microtubule
Mitochondrion
Smooth ER
Nucleus
(Schwann cell)
Microfilament
Microtubule
Axon
Synapse
(Axodendritic)
Dendrites

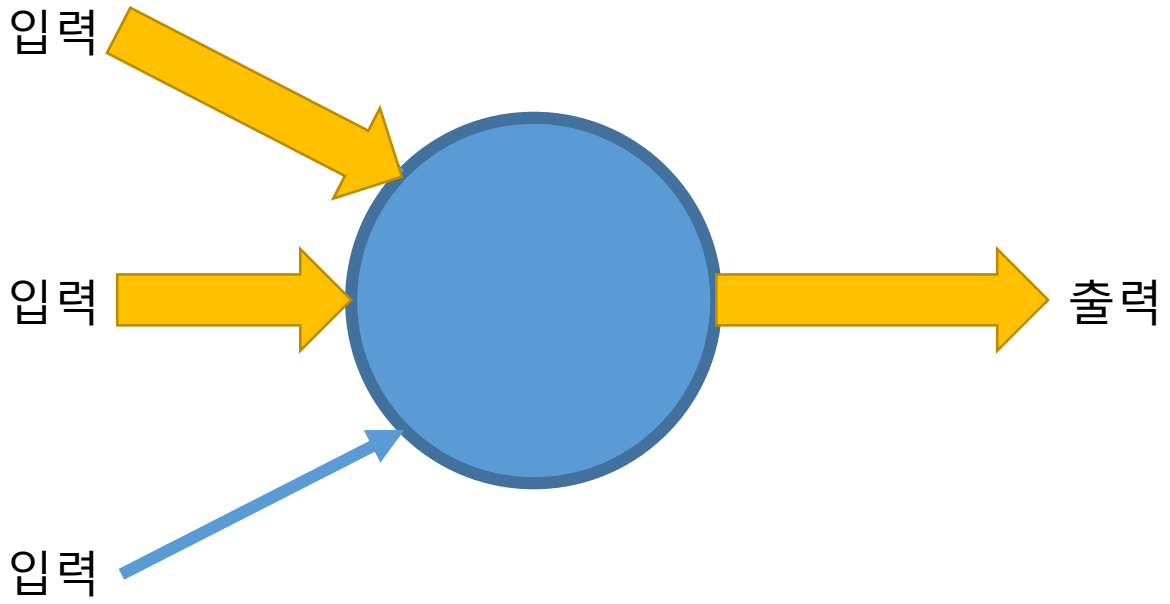

Action
potential
+40
0
Voltage (mV)
Depolarization
Repolarization
Threshold
-55
Failed
initiations
Resting state
-70
Stimulus
Refractory
period
0
1
2
3
4
5
Time (ms)


입력
입력
입력
출력

입력 신호가 역치를 넘지 못하면 출력 신호를 내보내지 않는다

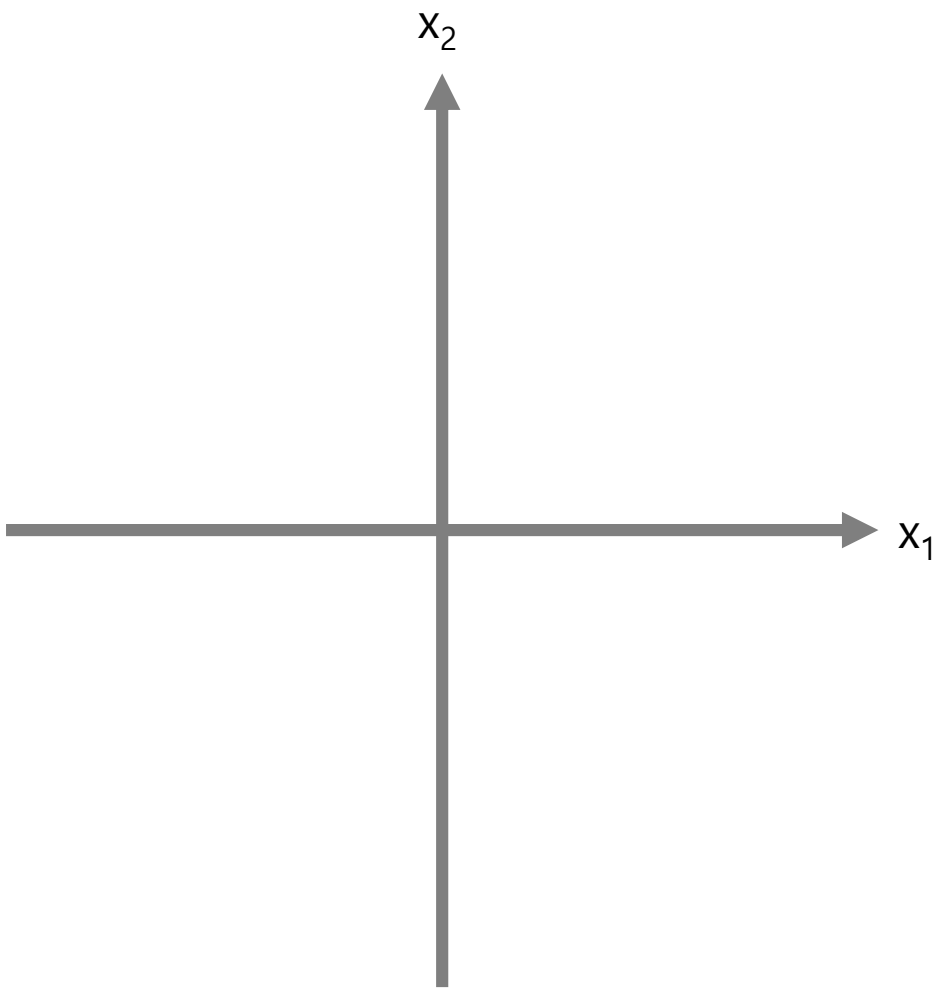


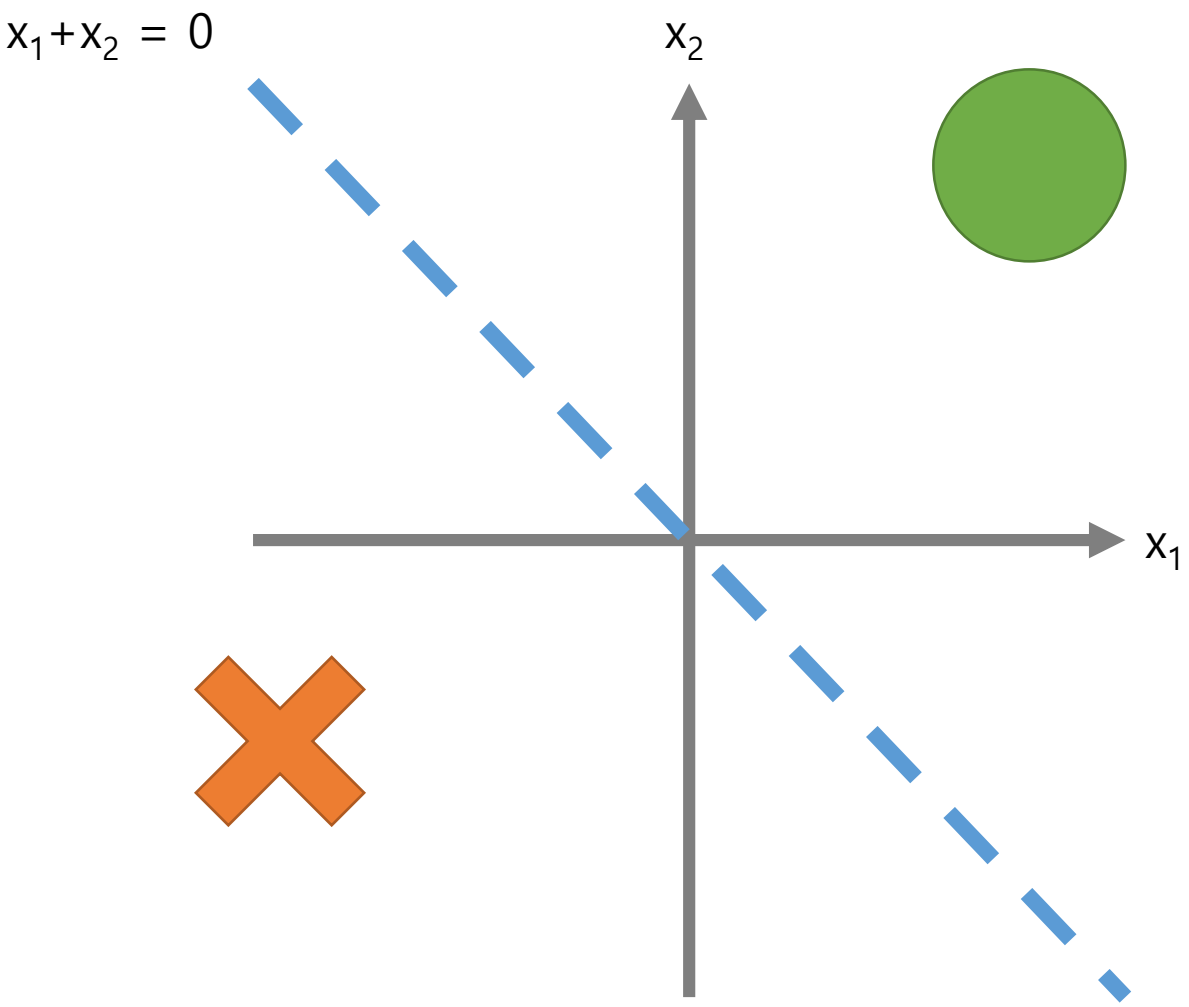
입력 신호가 역치를 넘어서면 출력 신호를 내보낸다

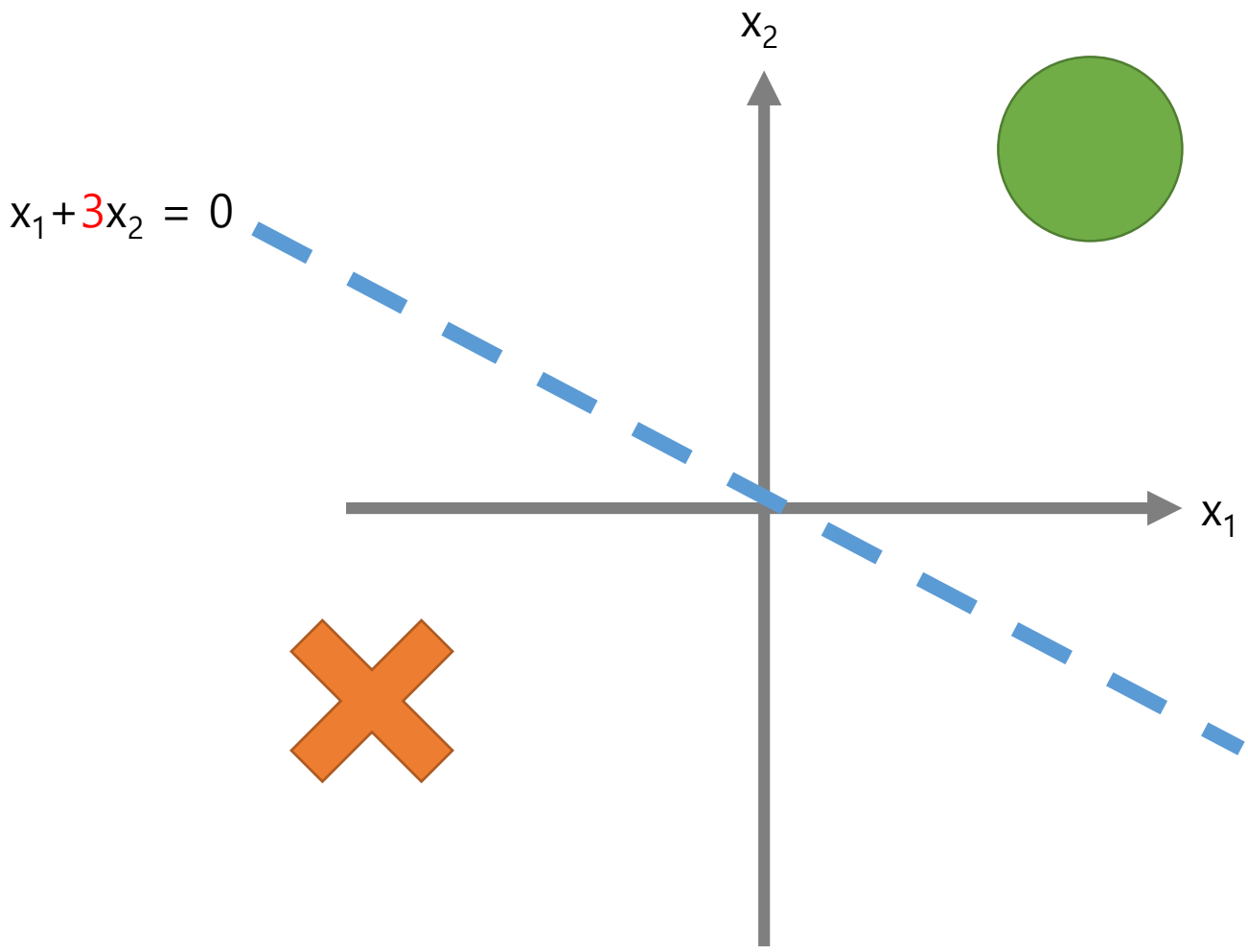


수식으로 표현

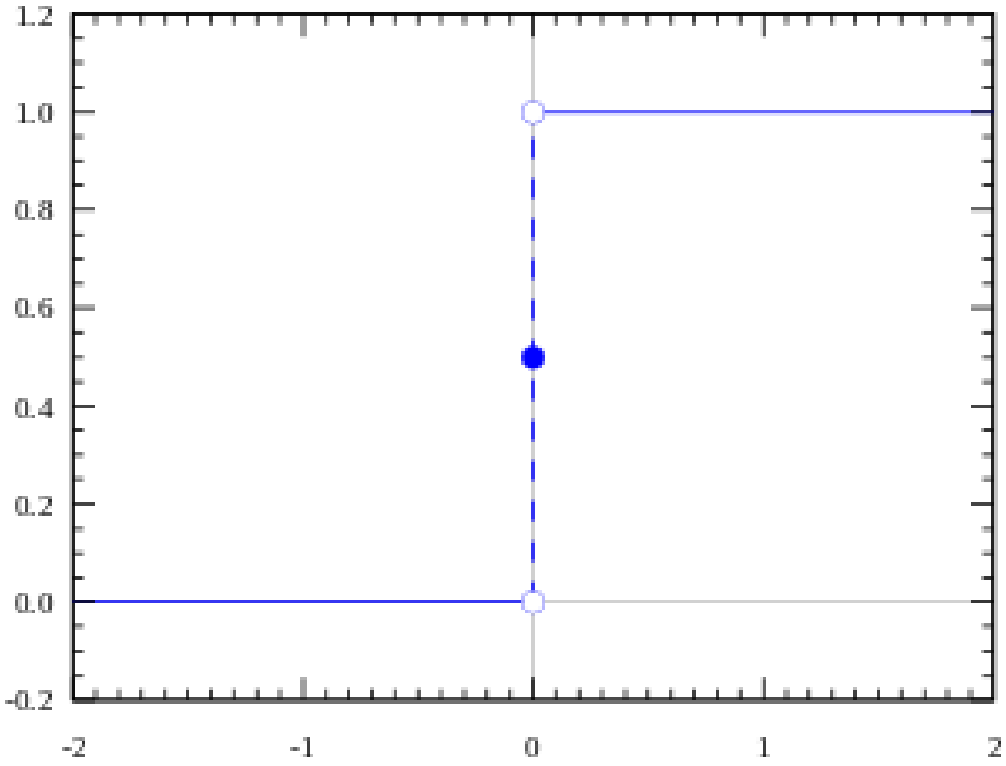
- 입력의 합계 > 역치 → 1
- 입력의 합계 < 역치 → 0


x_2
x_1

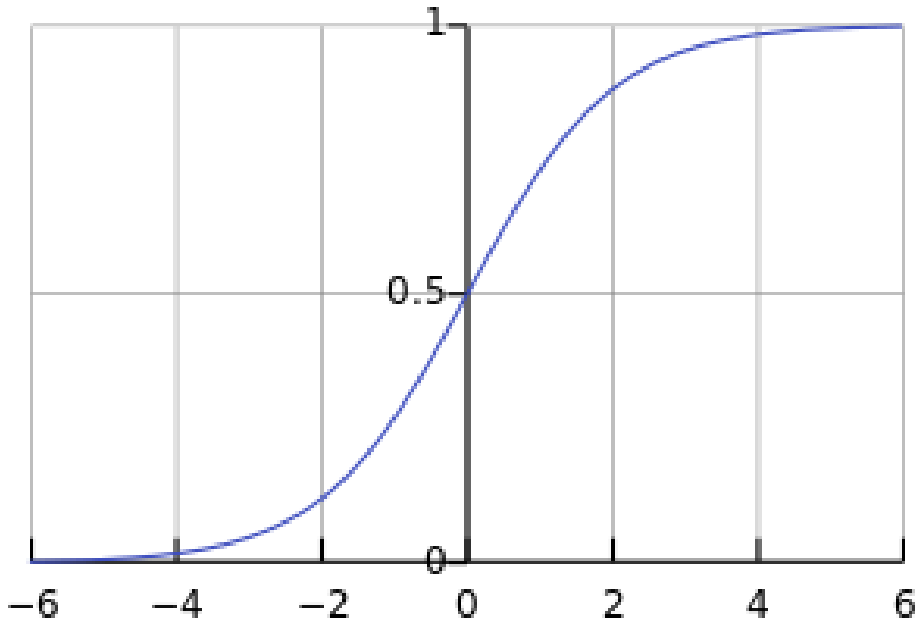

$x_1+x_2 = 0$
x_2
x_1


$x_1+3x_2 = 0$
x_2
x_1

계단 함수(step function)



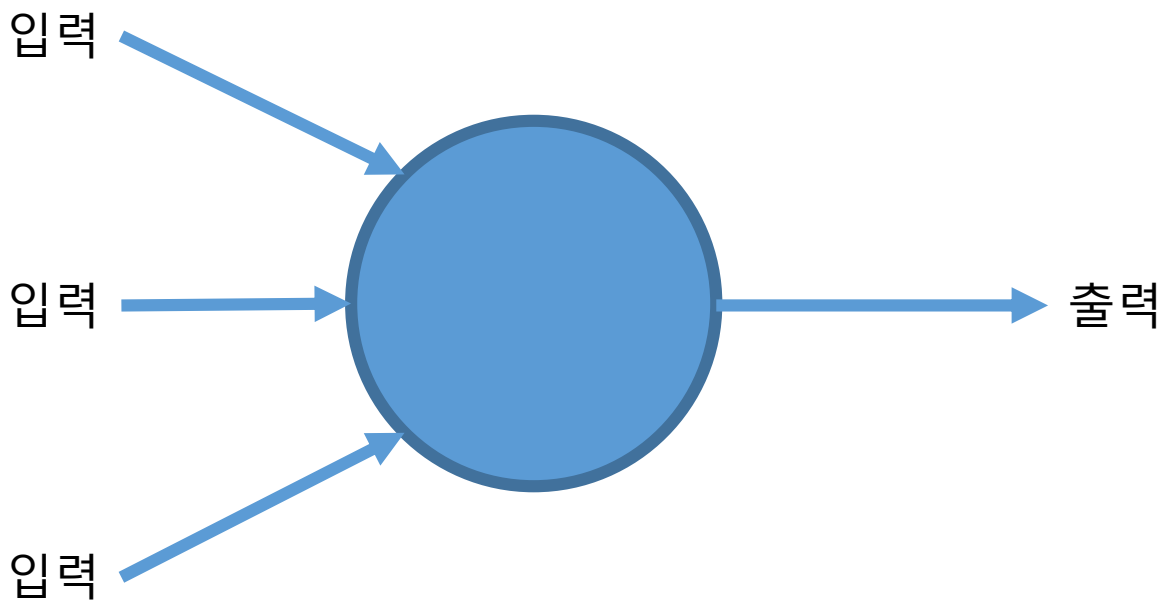
로지스틱 함수

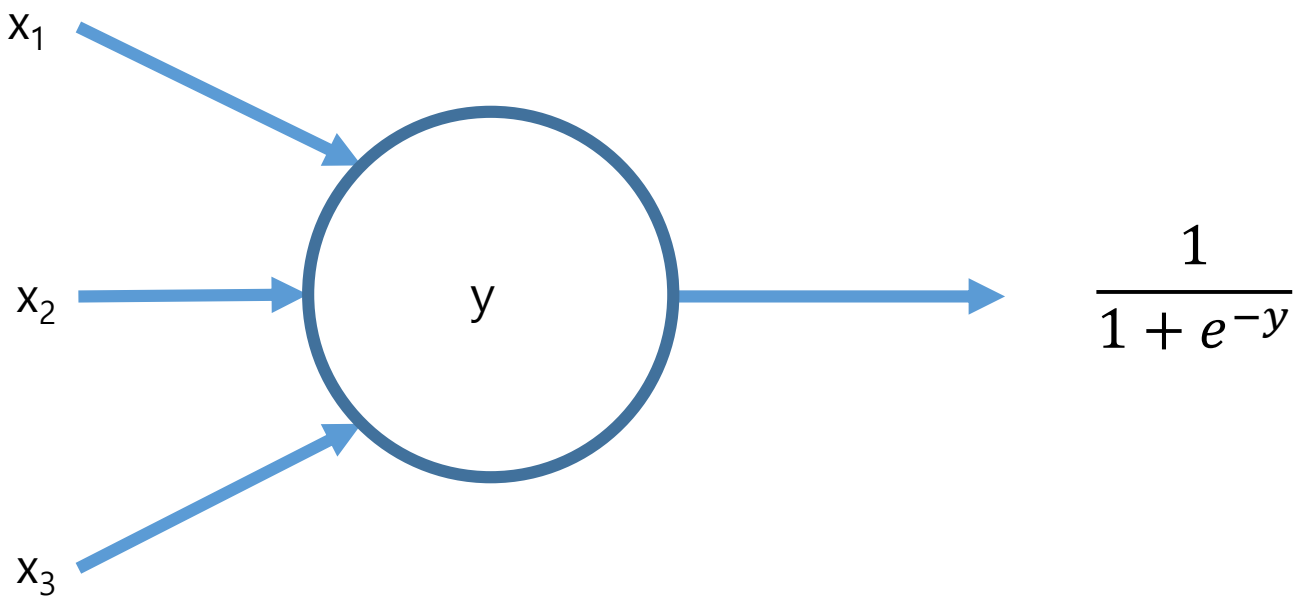


Logistic function

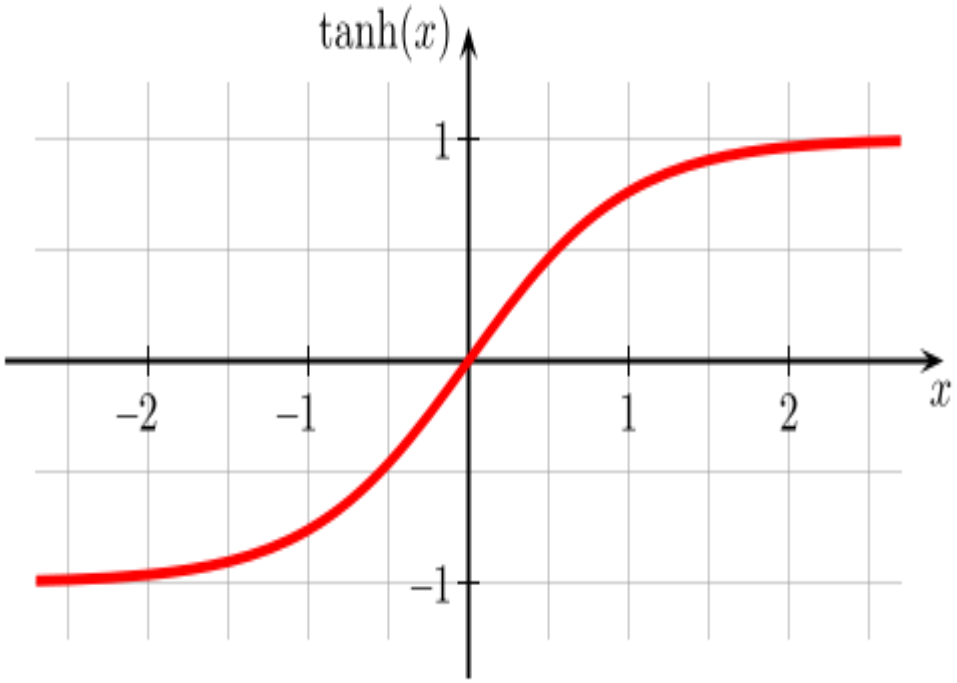
$$\frac{e^y}{1+e^y} = \frac{1}{1+e^{-y}}$$

$$y = w_0 + w_1 x_1 + w_2 x_2$$


입력
입력
입력
출력


x1
x2
x3
y
1
1 + e^-y

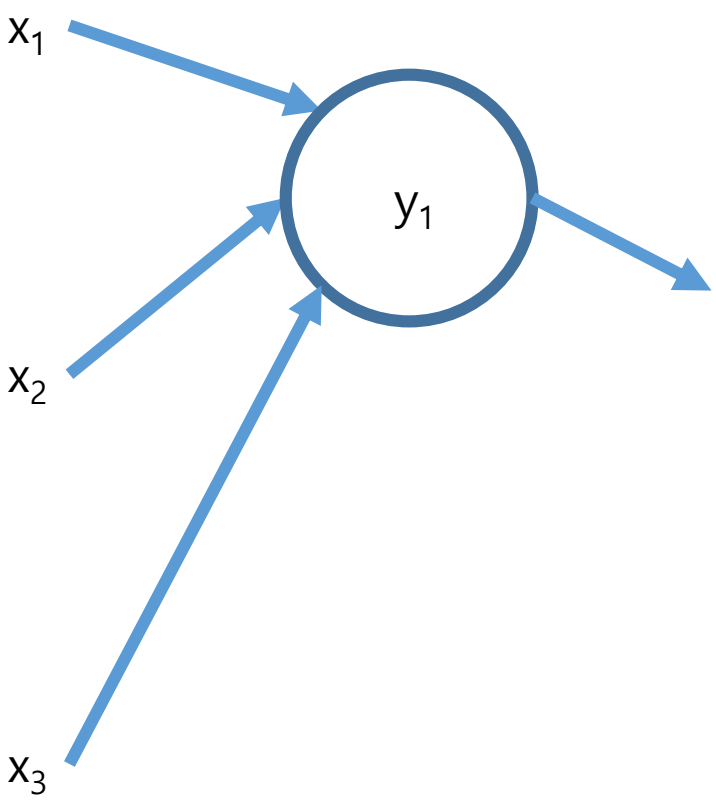
쌍곡탄젠트(hyperbolic tangent)



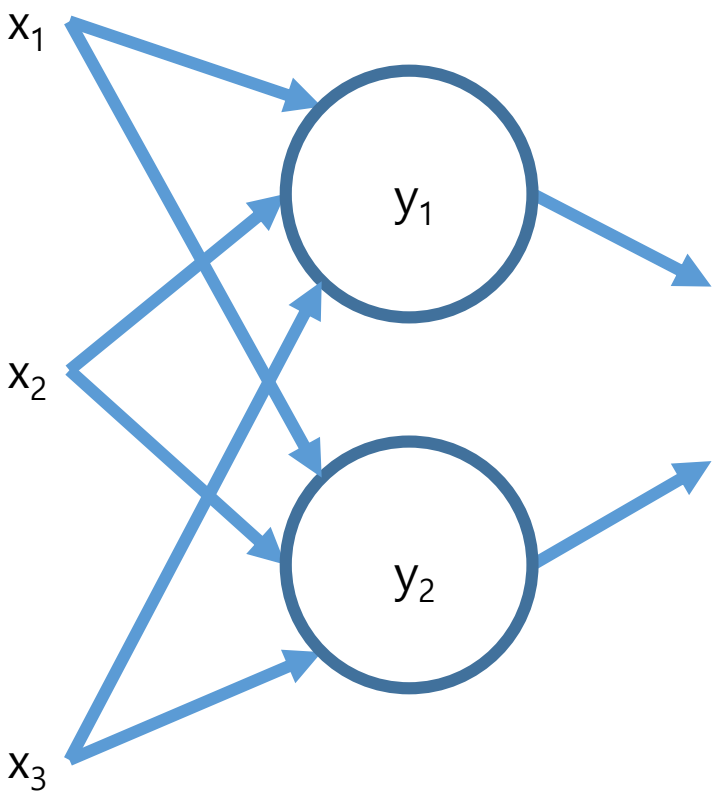
경사 하강법(gradient descent)

- 현재 모형의 오차를 구한다
- 오차를 가장 많이 줄일 수 있는 방향을 찾는다
- 그 방향으로 일정 폭만큼 계수를 수정한다
- 더 이상 오차가 줄어들지 않을 때까지 반복한다

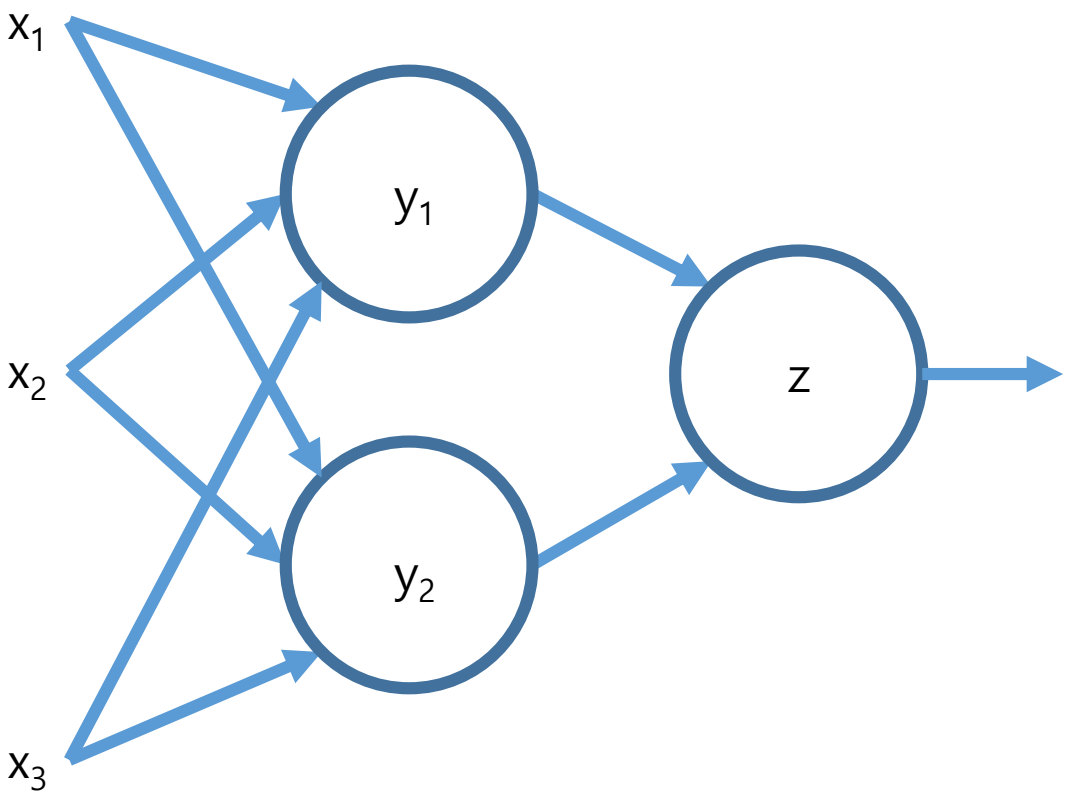
인공신경망



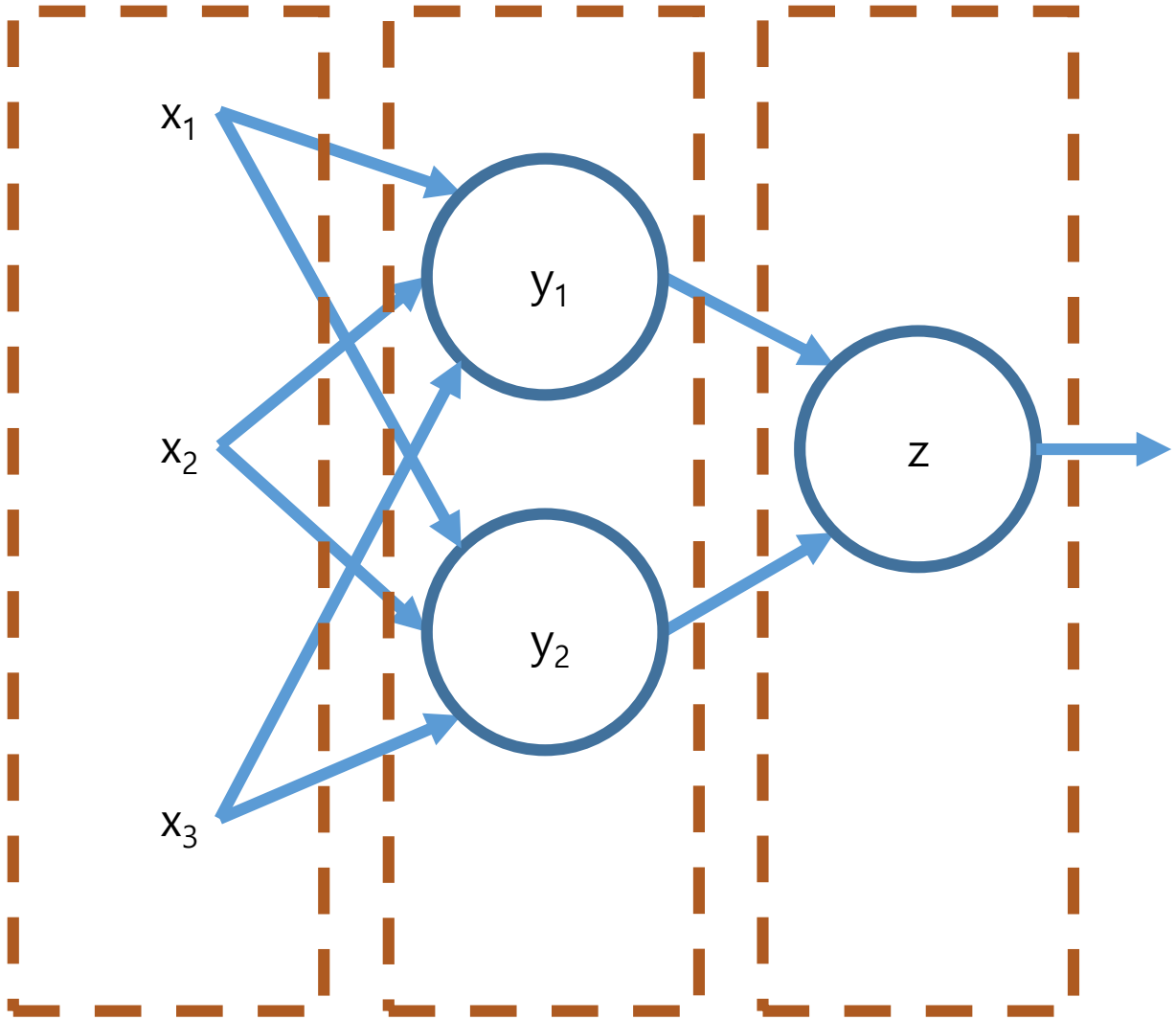
인공신경망



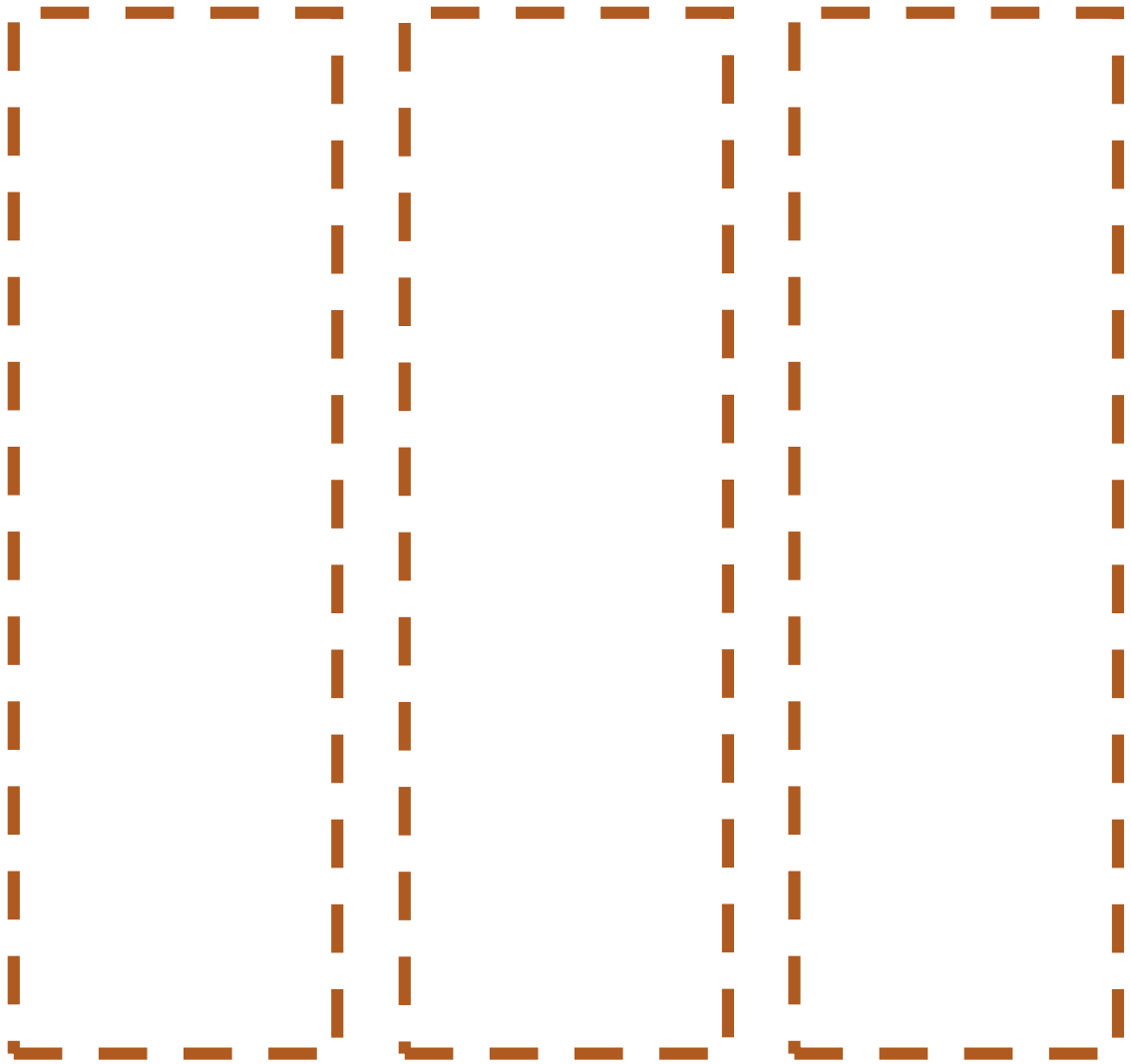
다층 신경망



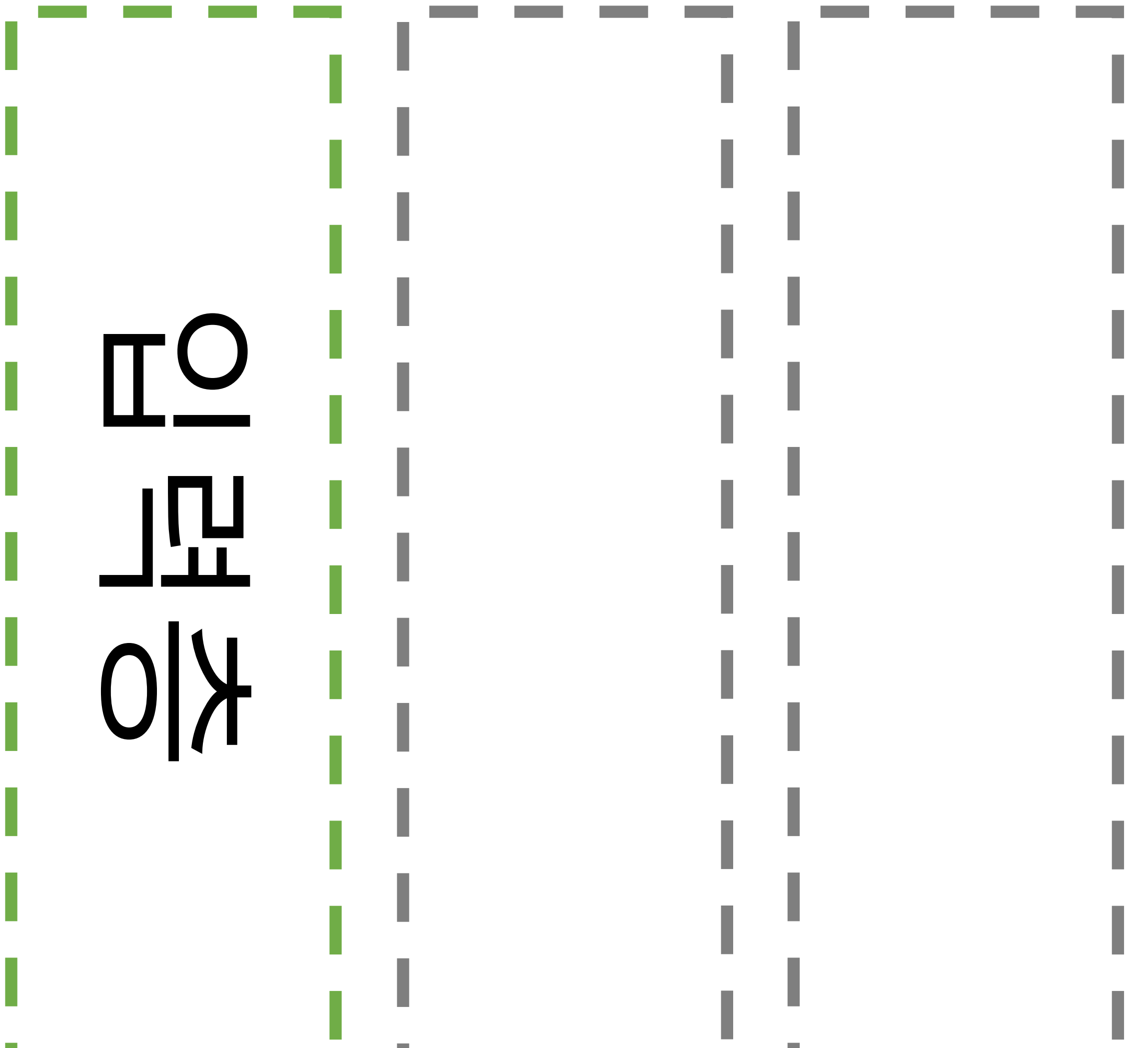
다층 신경망



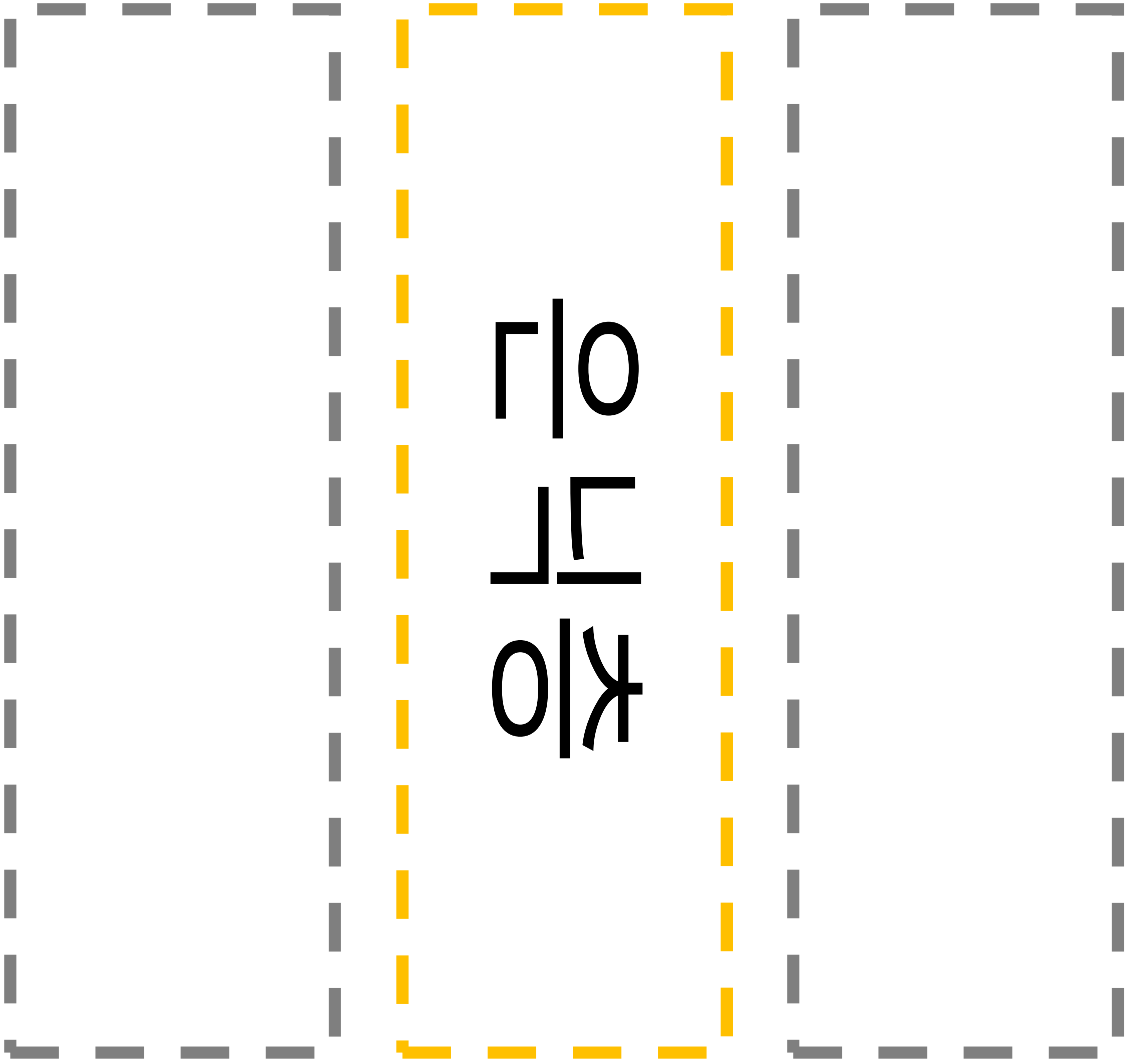
다층 신경망



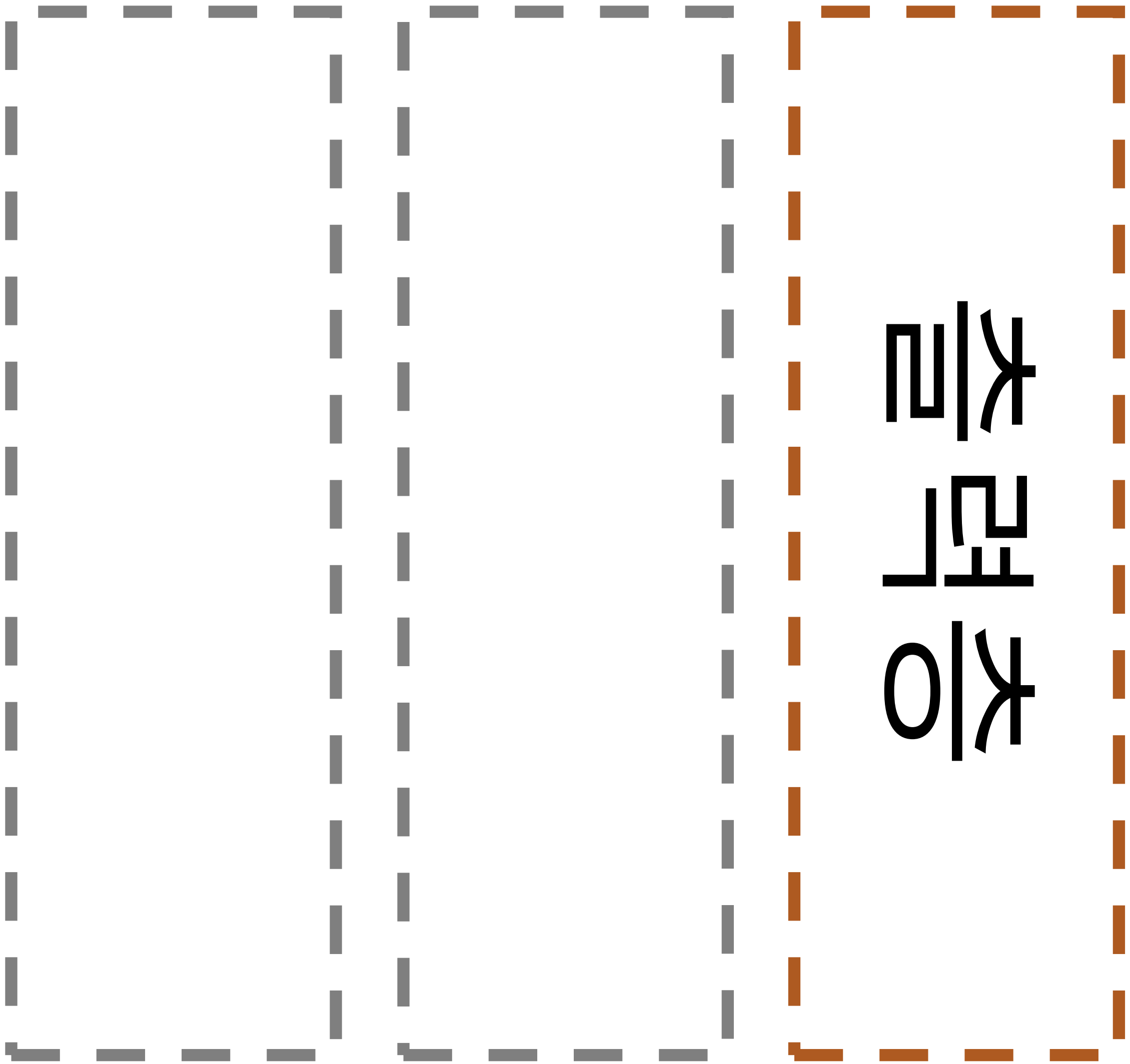
다층 신경망



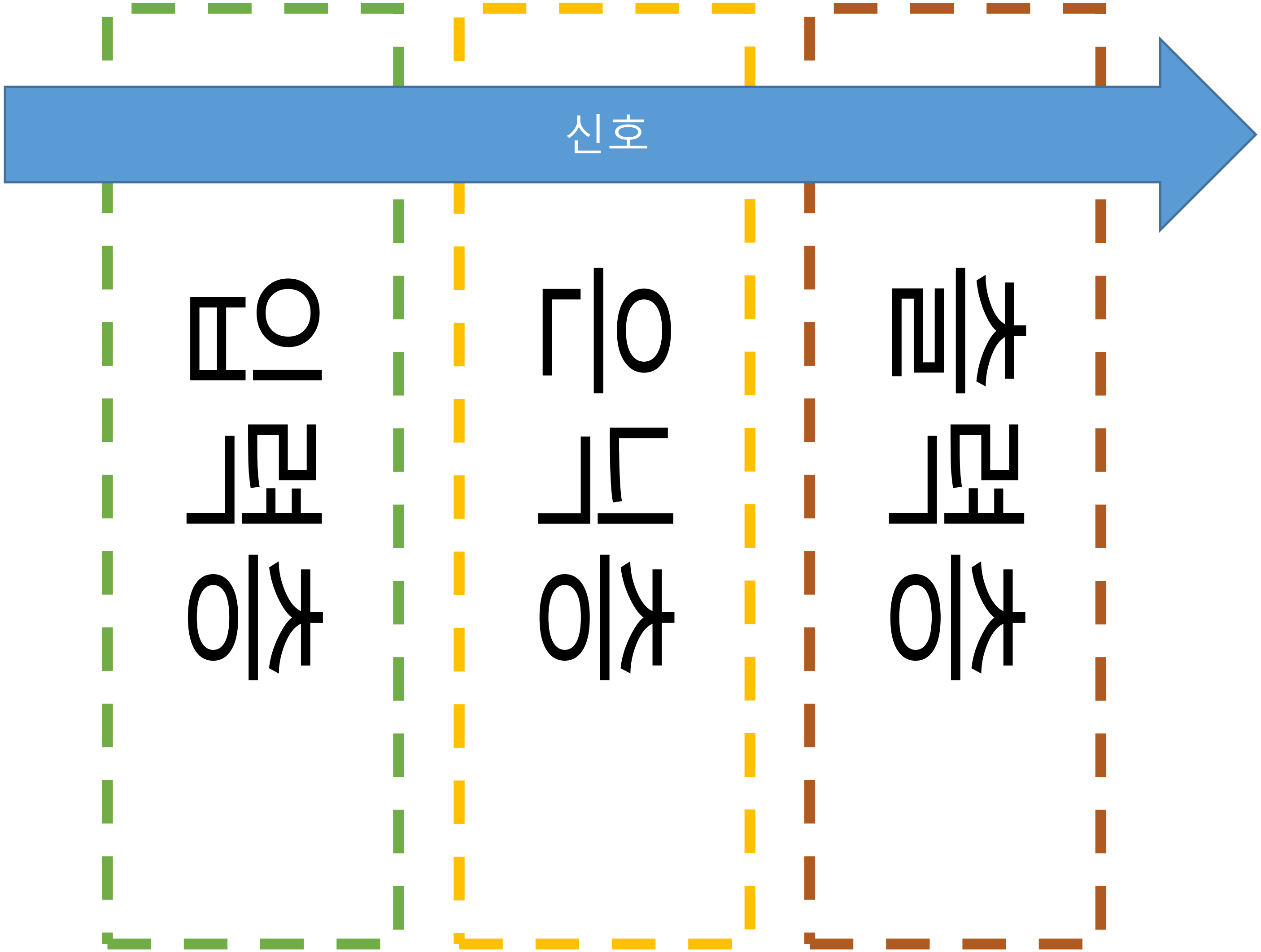
다층 신경망



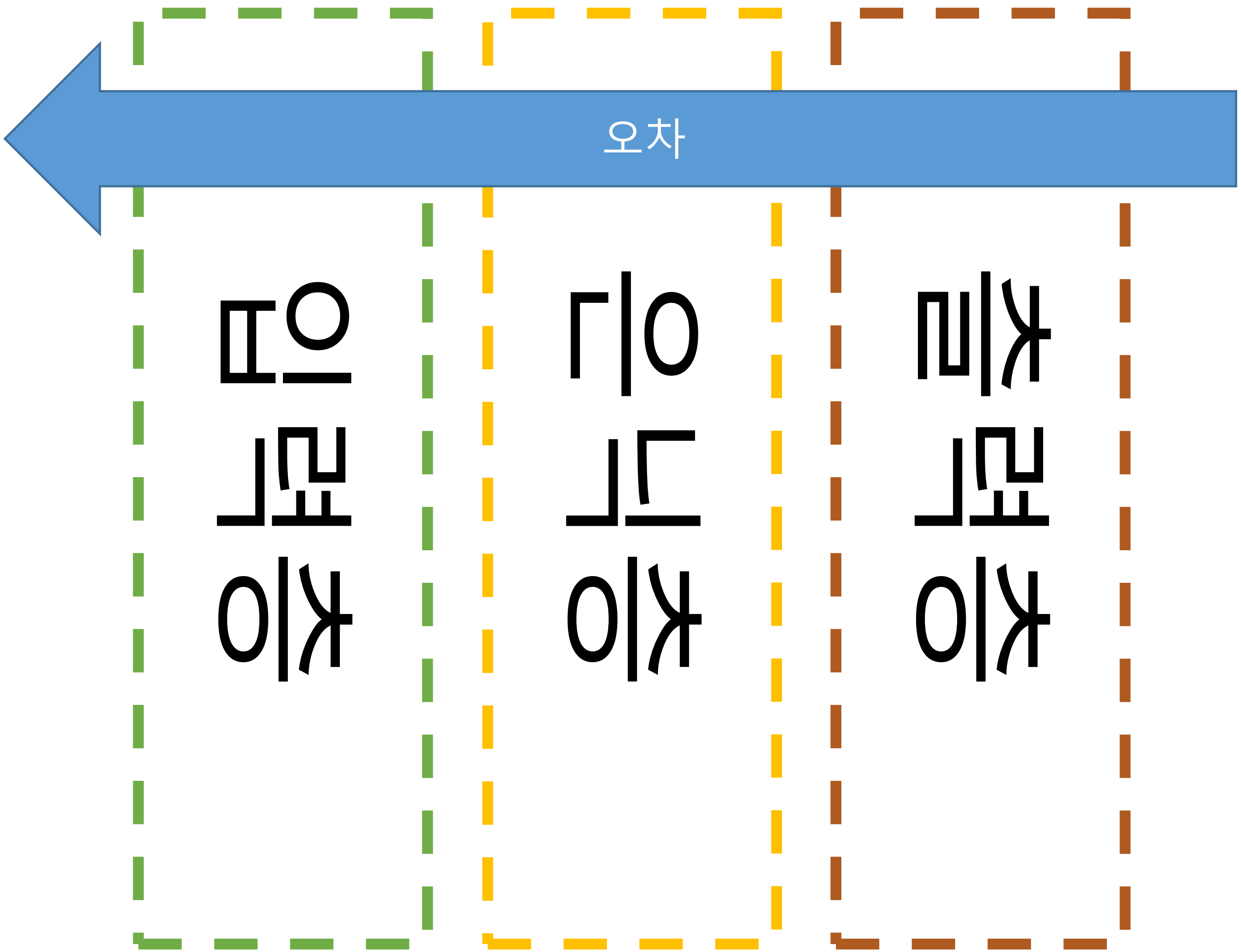
다층 신경망



앞먹임 네트워크(feedforward network)

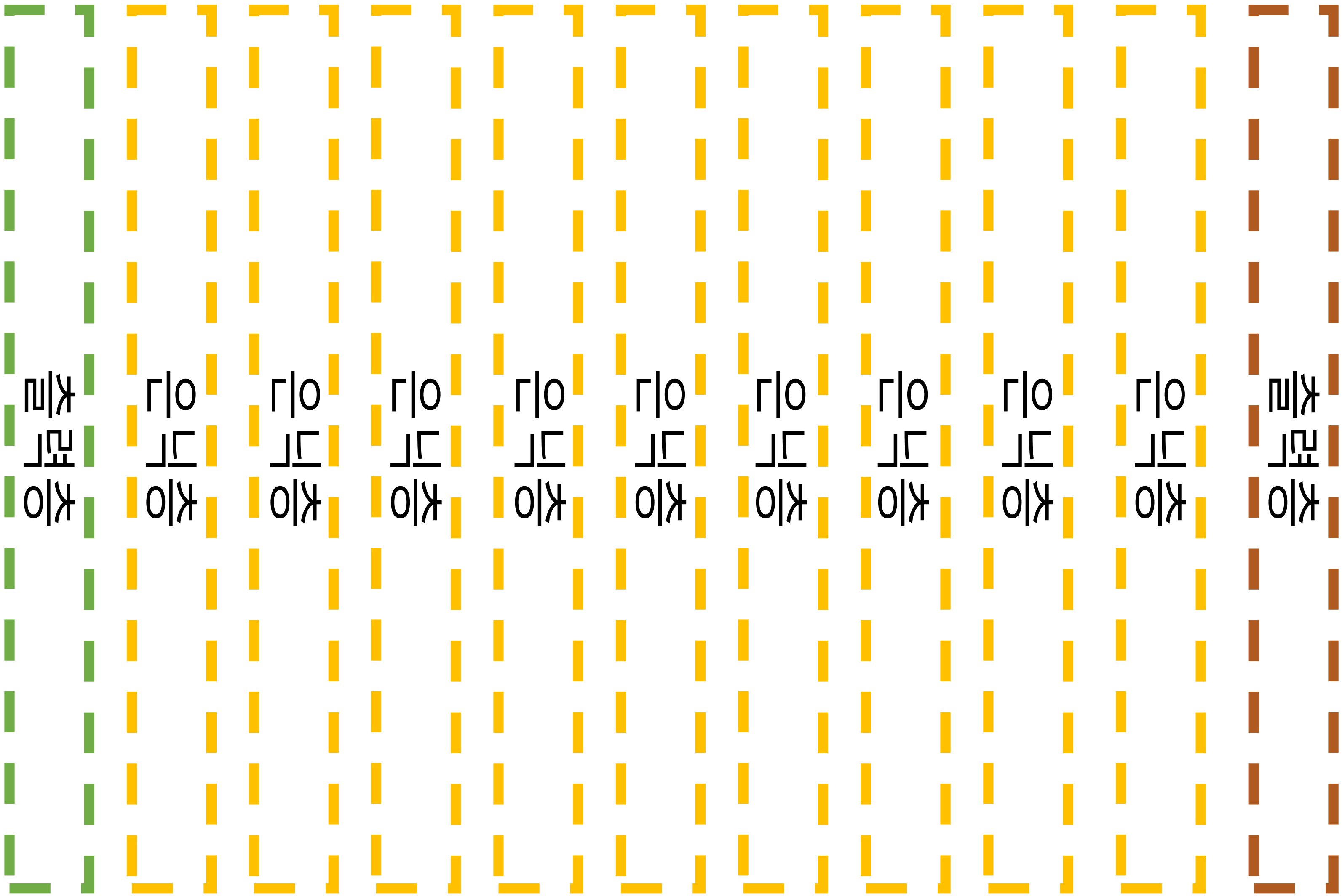


역전파 (backpropagation)



얕은 학습(shallow learning)

깊은 학습(deep learning)



딥러닝의 어려움

- 느린 학습 속도
- 사라지는 경사 문제(vanishing gradient)
- 과적합

해결책

- 컴퓨터 성능 향상 + GPGPU
- 빅데이터
- 정규화(L1, L2, Dropout …)

GPU

- GPU: 그래픽 카드에 들어가는 칩
- 그래픽 관련 계산에 특화
- 많은 코어 수(GTX 1080의 경우 2,560코어)
- 그래픽 외의 대량의 특수 계산을 하는데 써보자(GPGPU)
- 엔비디아 그래픽 카드가 사실상 표준(CUDA)
- 딥러닝의 돌파구 마련

GPU

- GPU 프로그래밍은 매우 어려움
- GPU를 이용한 딥러닝 라이브러리
  - Torch, Caffe, Theano, TensorFlow, MXNet, CNTK …
- TensorFlow: 구글에서 개발 최근 각광
- Keras: TensorFlow와 Theano의 고수준 wrapper