

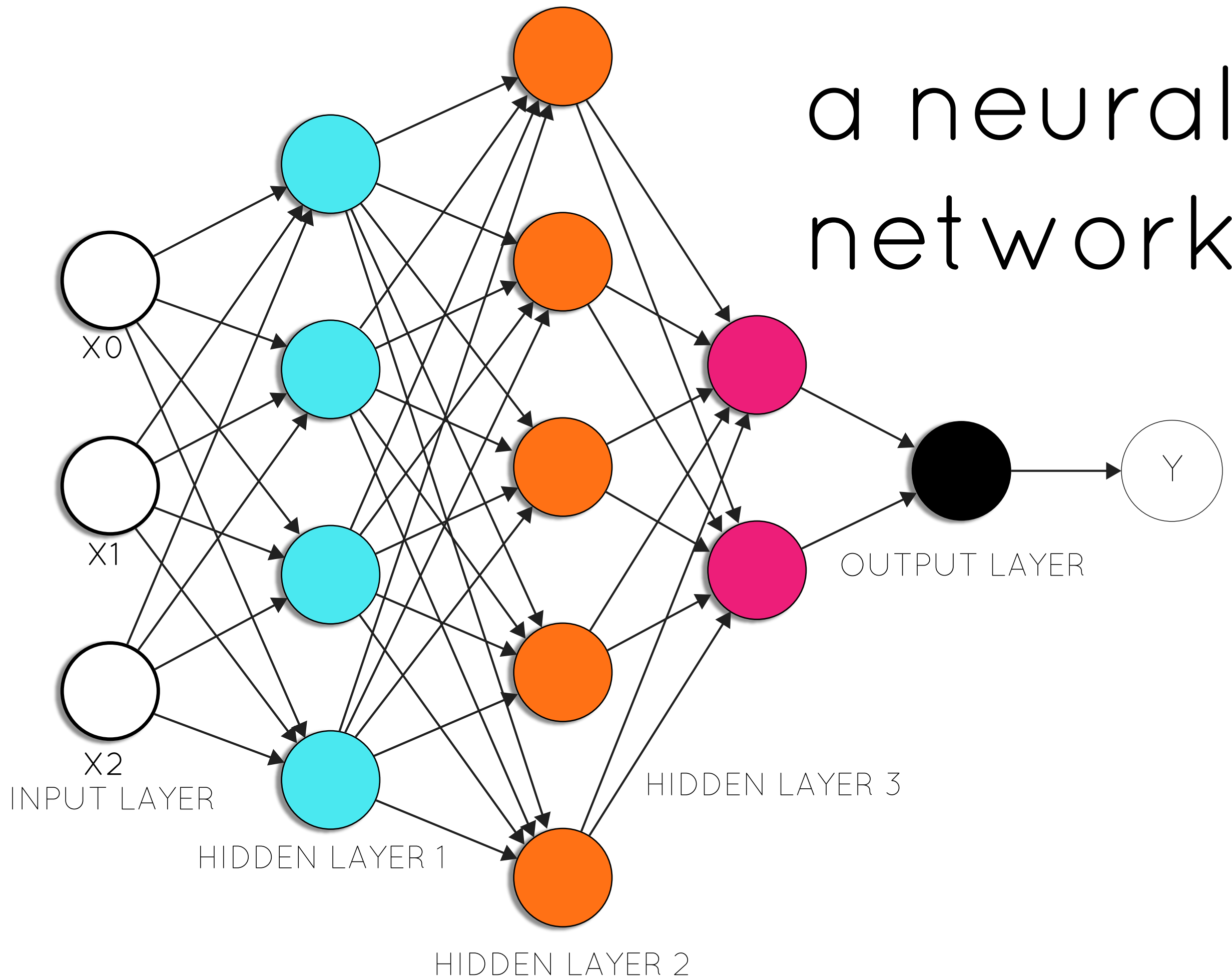
an introduction to neural networks

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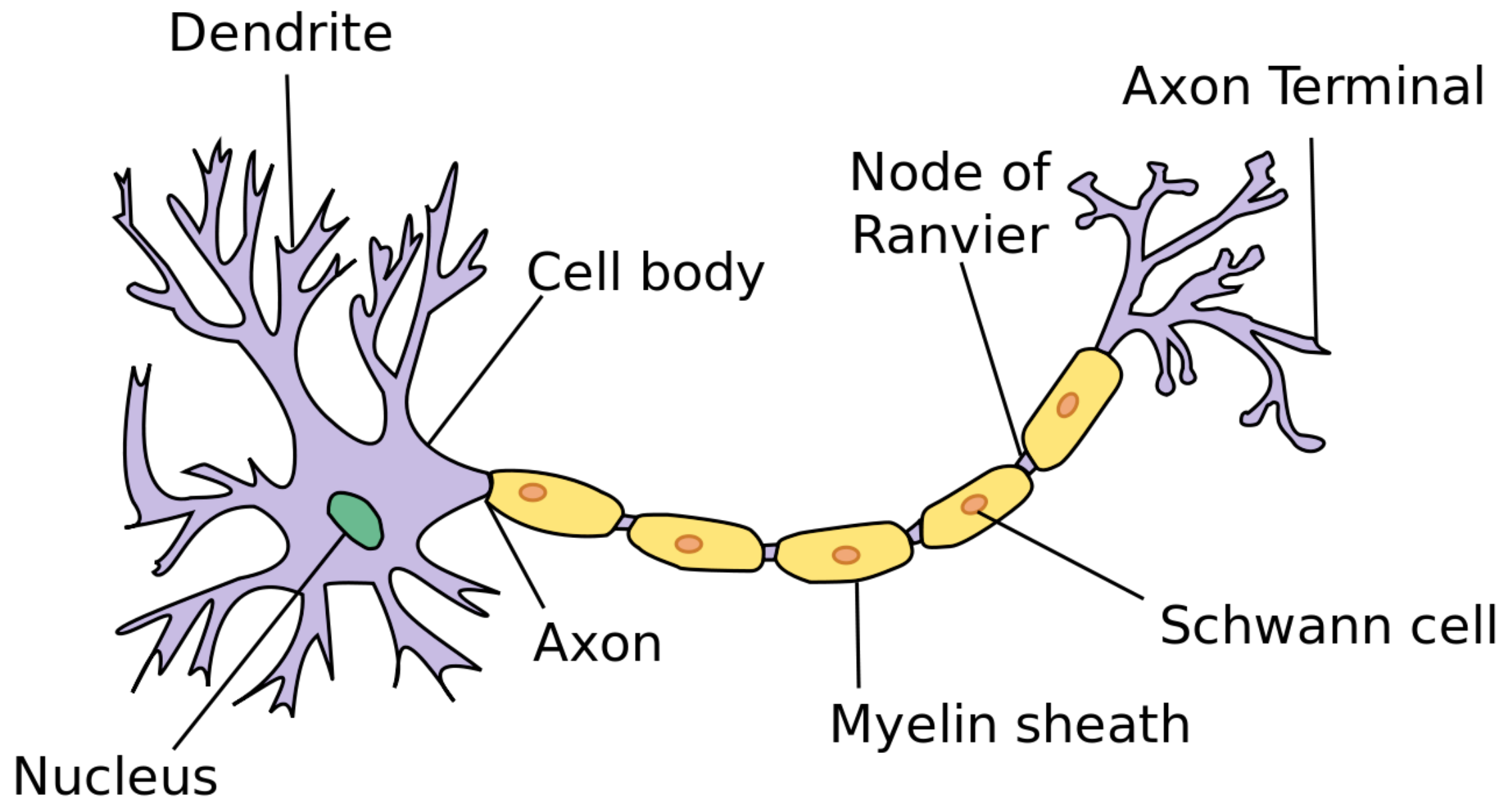
what even is a neural network

- a computer system modeled on the human brain
- used for problems that cannot be hard-coded
- specified by:
 - architecture
 - activity
 - learning

a neural
network



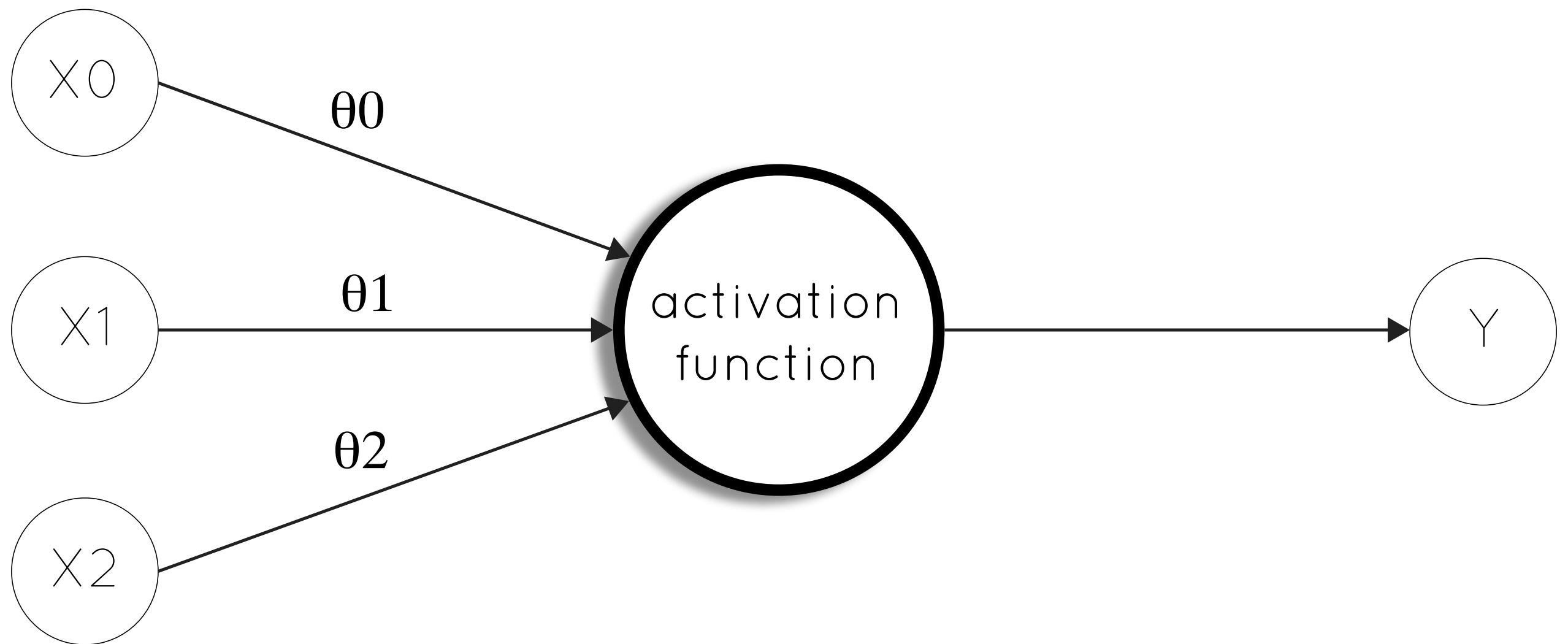
neurons



single synthetic neuron

Inputs

Output

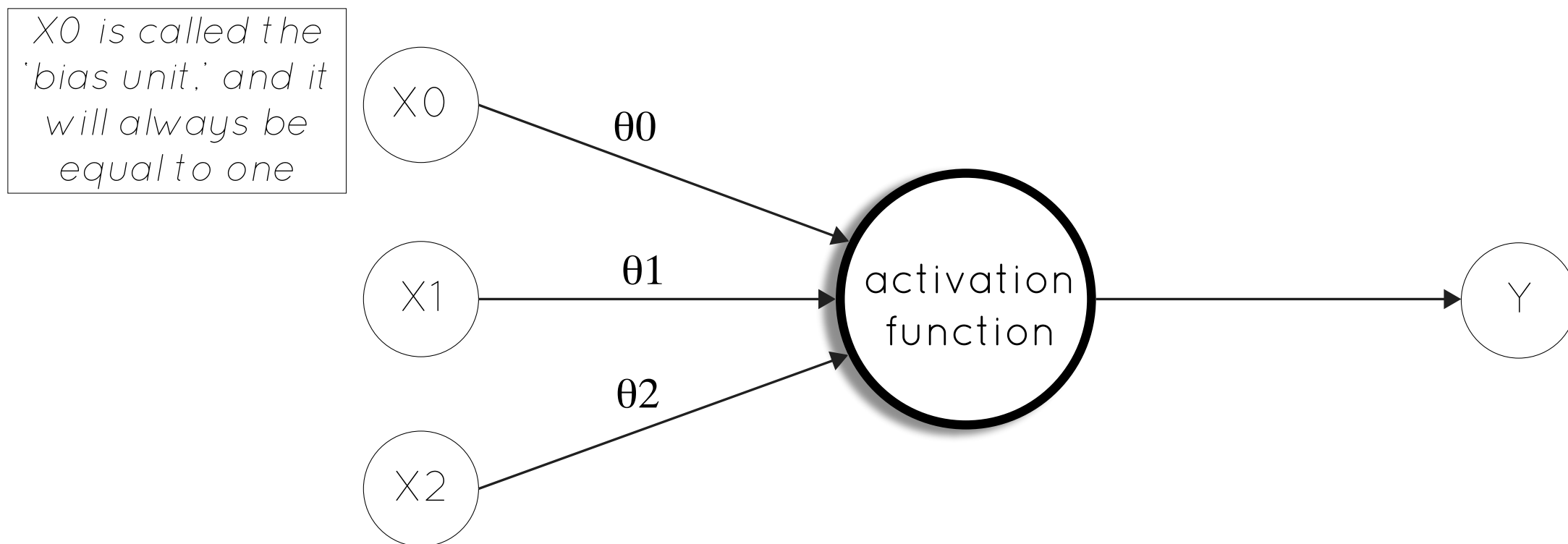


$$(\theta_0 * X_0) + (\theta_1 * X_1) + (\theta_2 * X_2) \longrightarrow \text{Activation Function} \longrightarrow \text{Output}$$

the bias unit & the activation function

Inputs

Output



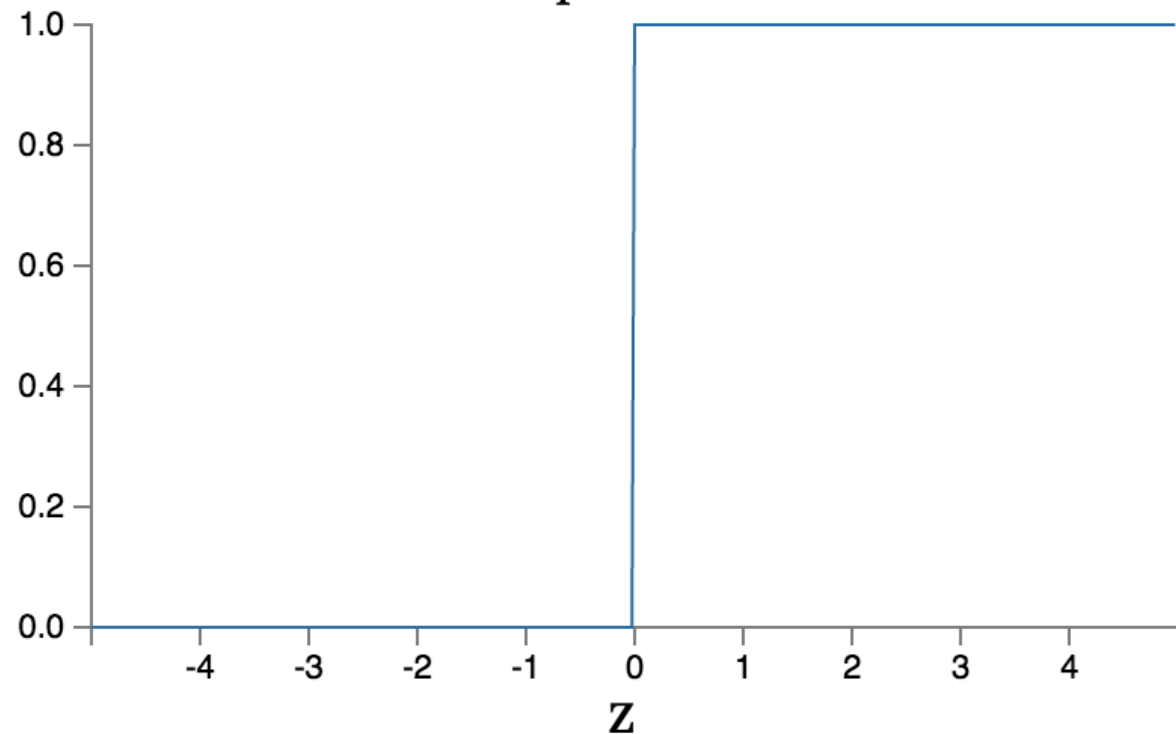
Parameters

$$\begin{bmatrix} X0 & X1 & X2 \end{bmatrix} * \begin{bmatrix} \theta0 \\ \theta1 \\ \theta2 \end{bmatrix} = (\theta0 * X0) + (\theta1 * X1) + (\theta2 * X2)$$

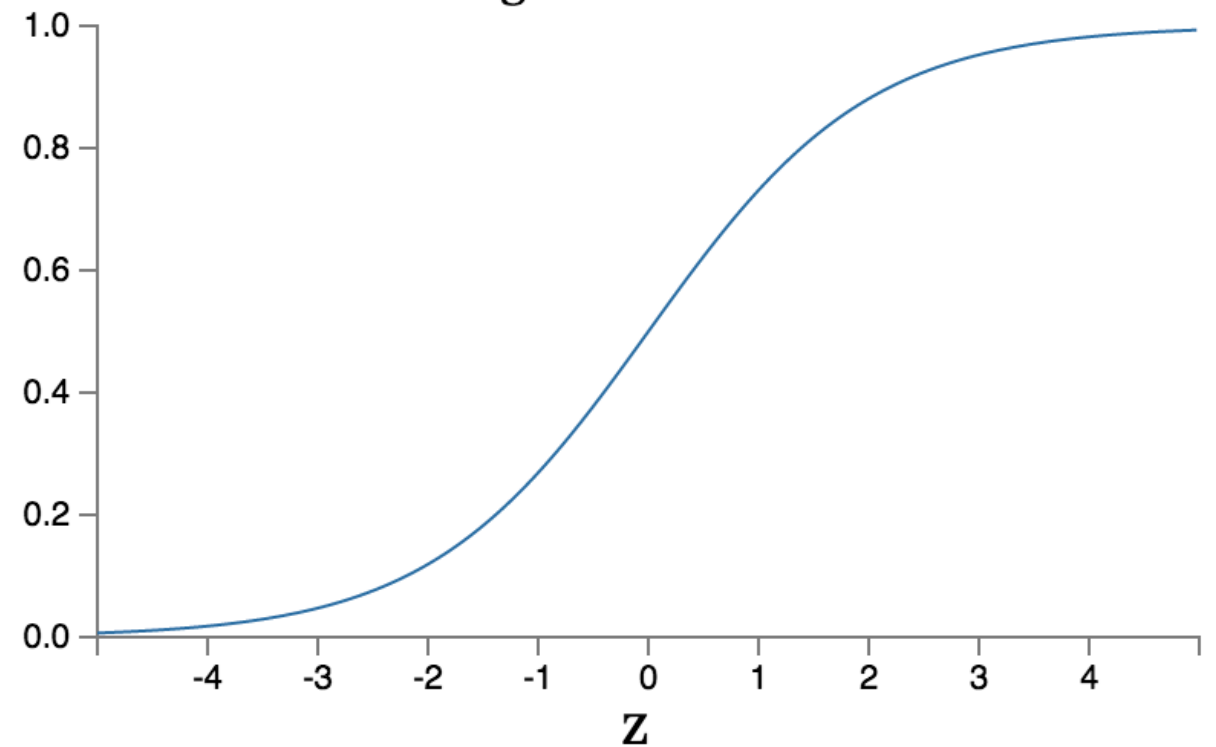
↑
this is what ultimately gets fed to the neuron's activation function

activation functions: **perceptrons** and **sigmoids**

step function

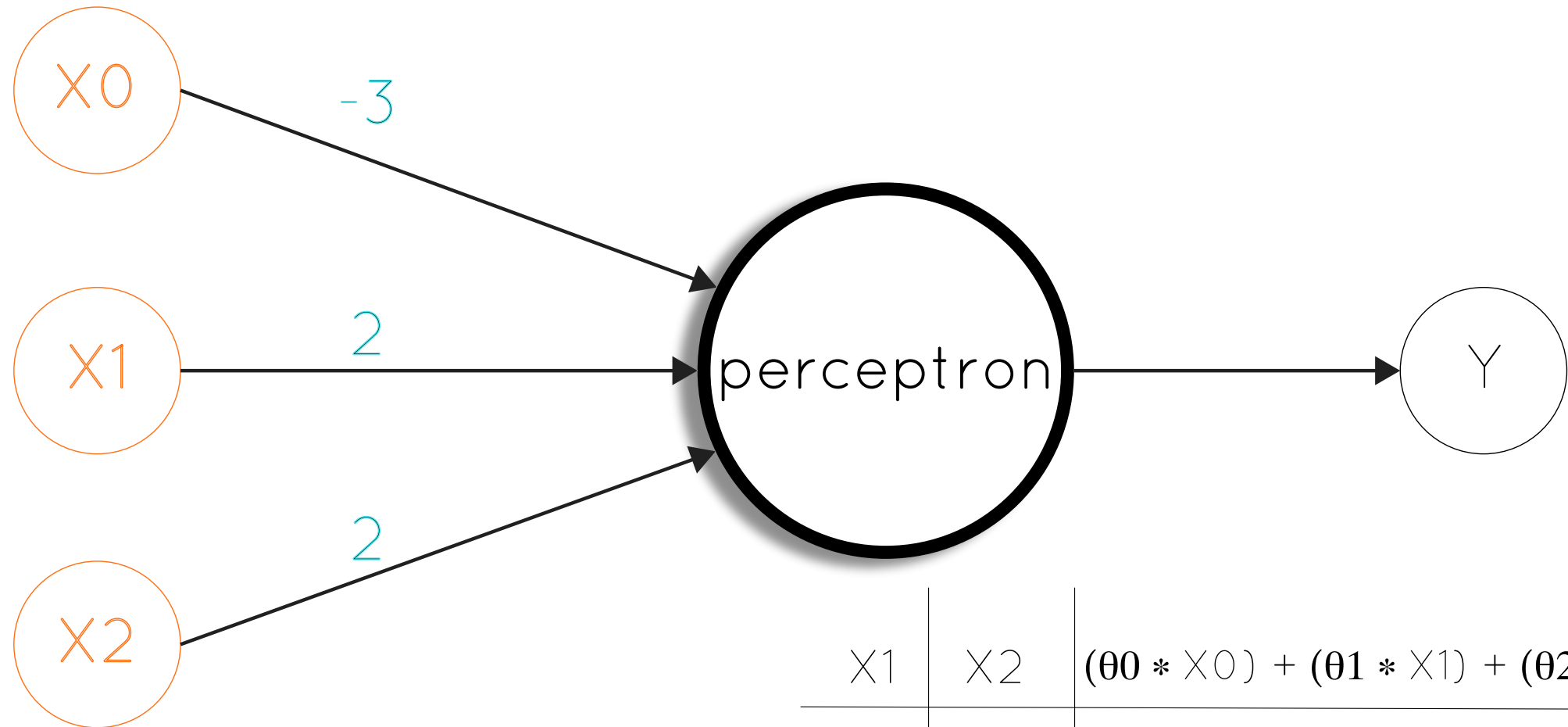


sigmoid function



example neuron: AND

Remember:
 $X_0 = 1$



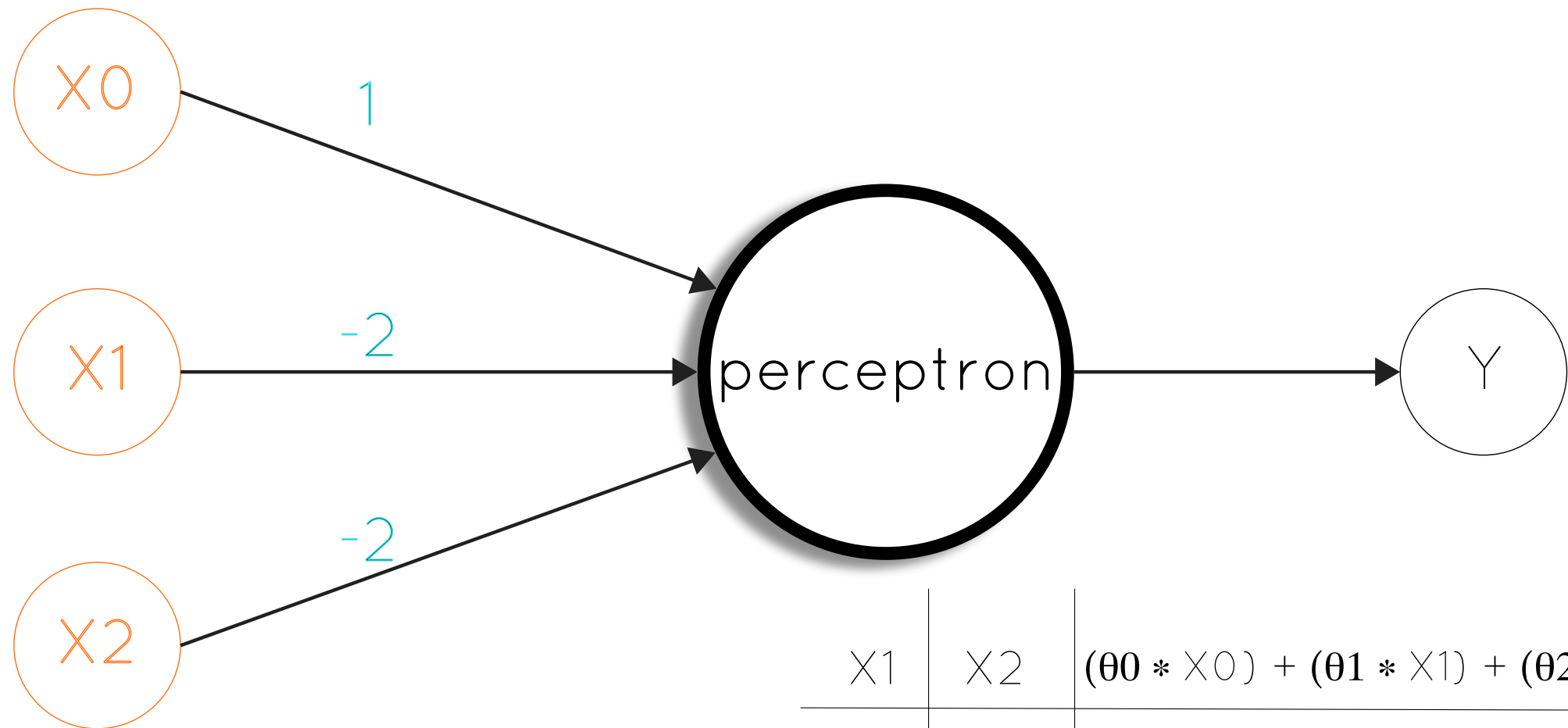
X_1	X_2	$(\theta_0 * X_0) + (\theta_1 * X_1) + (\theta_2 * X_2)$	Y
0	0	-3	0
0	1	-1	0
1	0	-1	0
1	1	1	1

$[X_0 \ X_1 \ X_2]$

$\begin{bmatrix} -3 \\ 2 \\ 2 \end{bmatrix}$

example neuron: NOT

Remember:
 $X_0 = 1$



$\begin{bmatrix} X_0 & X_1 & X_2 \end{bmatrix}$

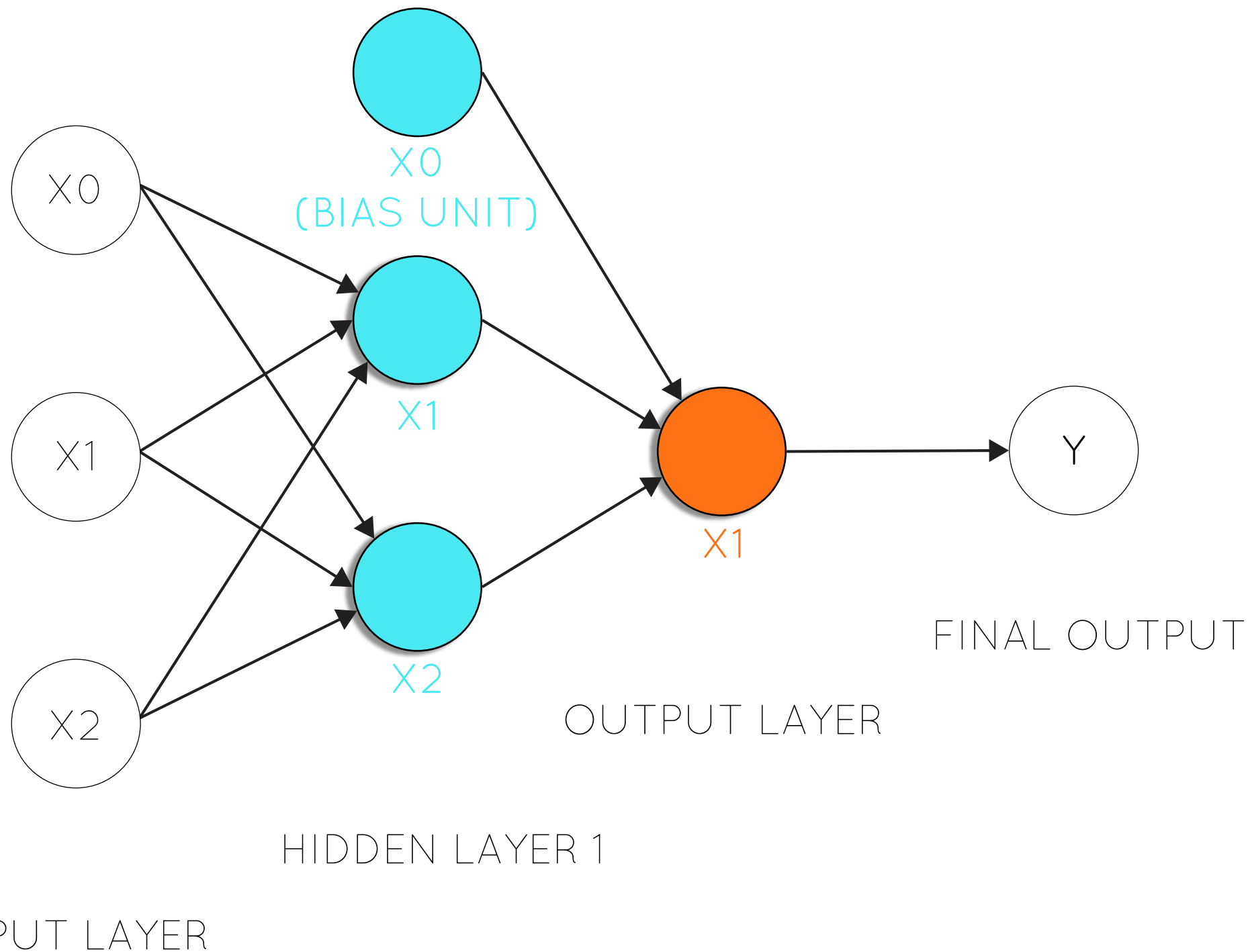
$\begin{bmatrix} 1 \\ -2 \\ -2 \end{bmatrix}$

X_1	X_2	$(\theta_0 * X_0) + (\theta_1 * X_1) + (\theta_2 * X_2)$	Y
0	0	1	1
0	1	-1	0
1	0	-1	0
1	1	-3	0

the **xor** function

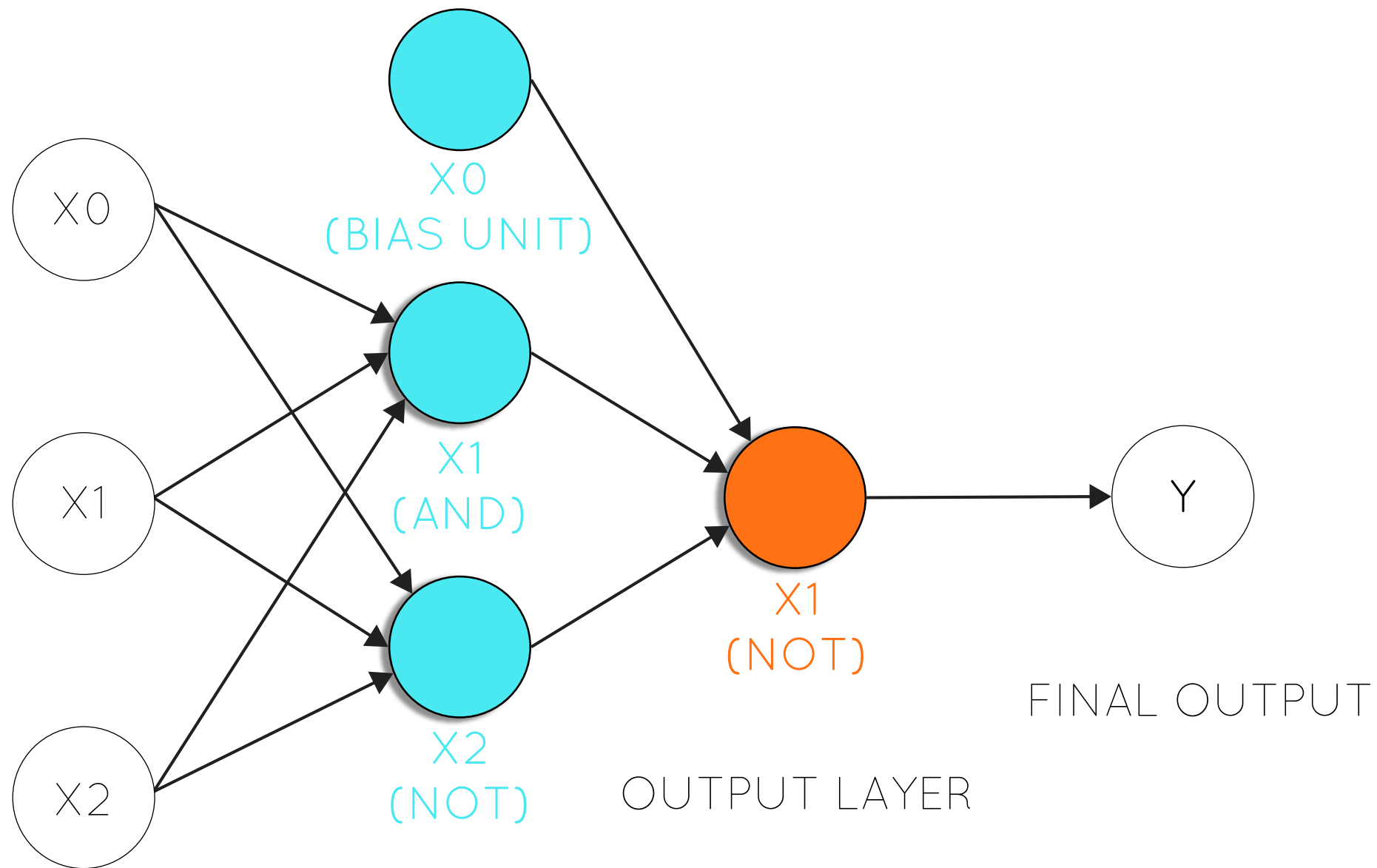
X1	X2	Y
0	0	0
0	1	1
1	0	1
1	1	0

the **xor** function



X1	X2	Y
0	0	0
0	1	1
1	0	1
1	1	0

the **xor** function



X1	X2	Y
0	0	0
0	1	1
1	0	1
1	1	0

a deeper dive:

INPUT LAYER:

HIDDEN LAYER:

OUTPUT LAYER:

X1	X2	X1	X2	X1 = Y	
0	0	0	1	0	0
0	1	0	0	1	1
1	0	0	0	1	1
1	1	1	0	0	0

