

# Deep Learning

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Twitter: @streamingnology

# What is Deep Learning?

## ARTIFICIAL INTELLIGENCE

Any technique that enables computers to mimic human behavior



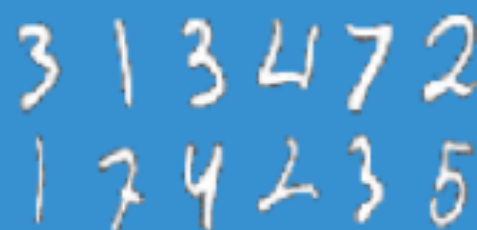
## MACHINE LEARNING

Ability to learn without explicitly being programmed



## DEEP LEARNING

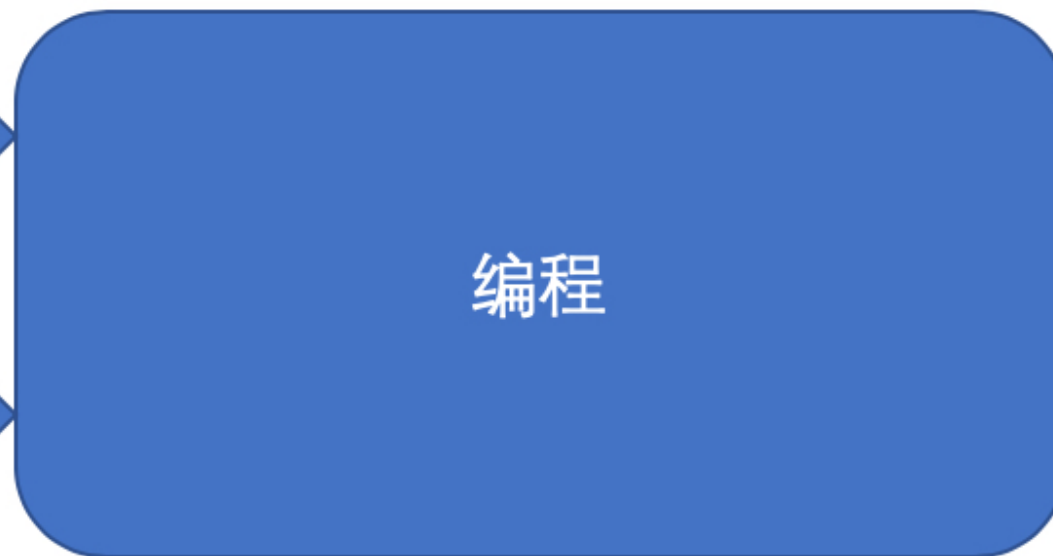
Extract patterns from data using neural networks



[0 1 2 3 4 5 6 7]



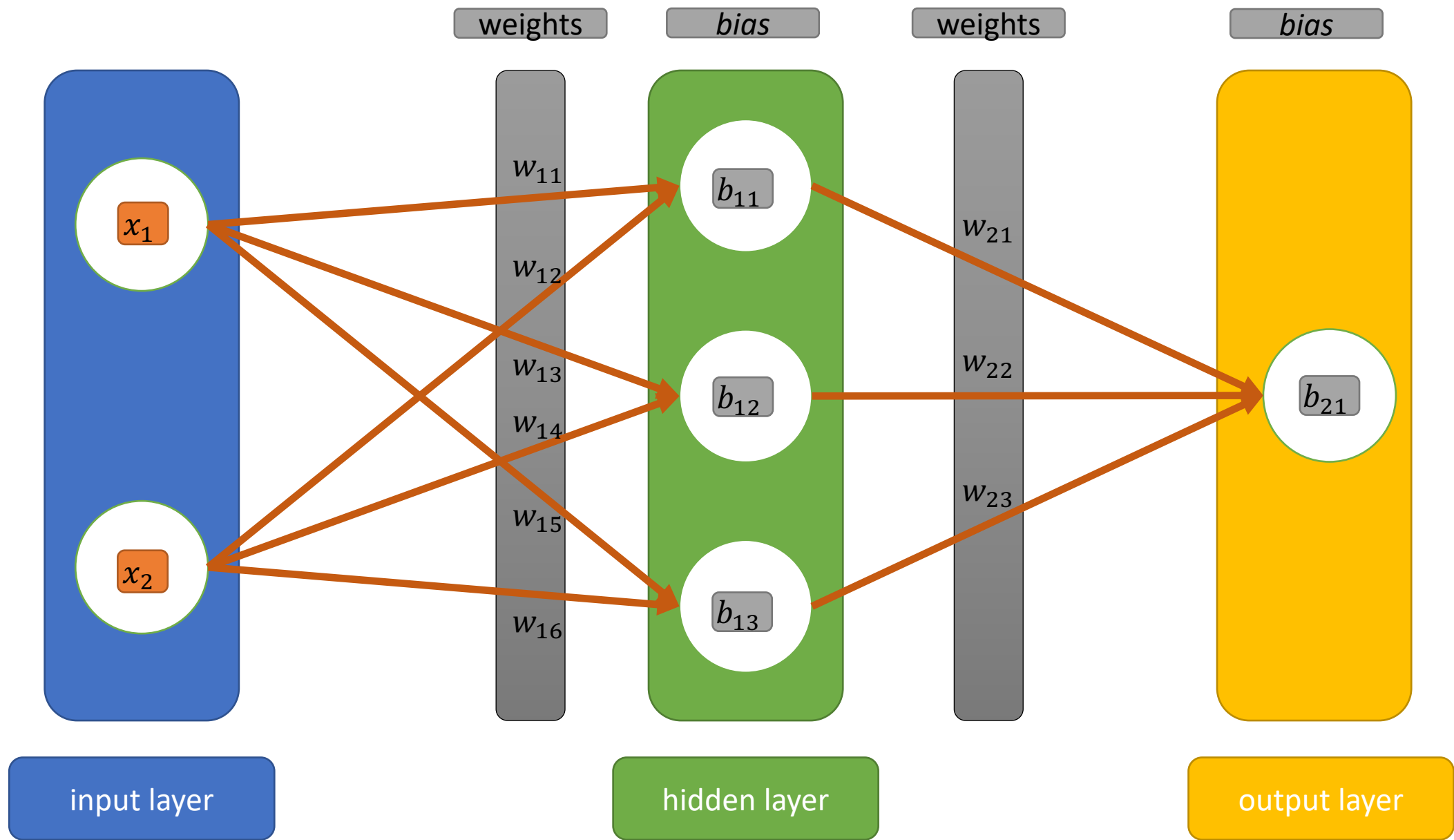
$$f(x) = 2x + 1$$

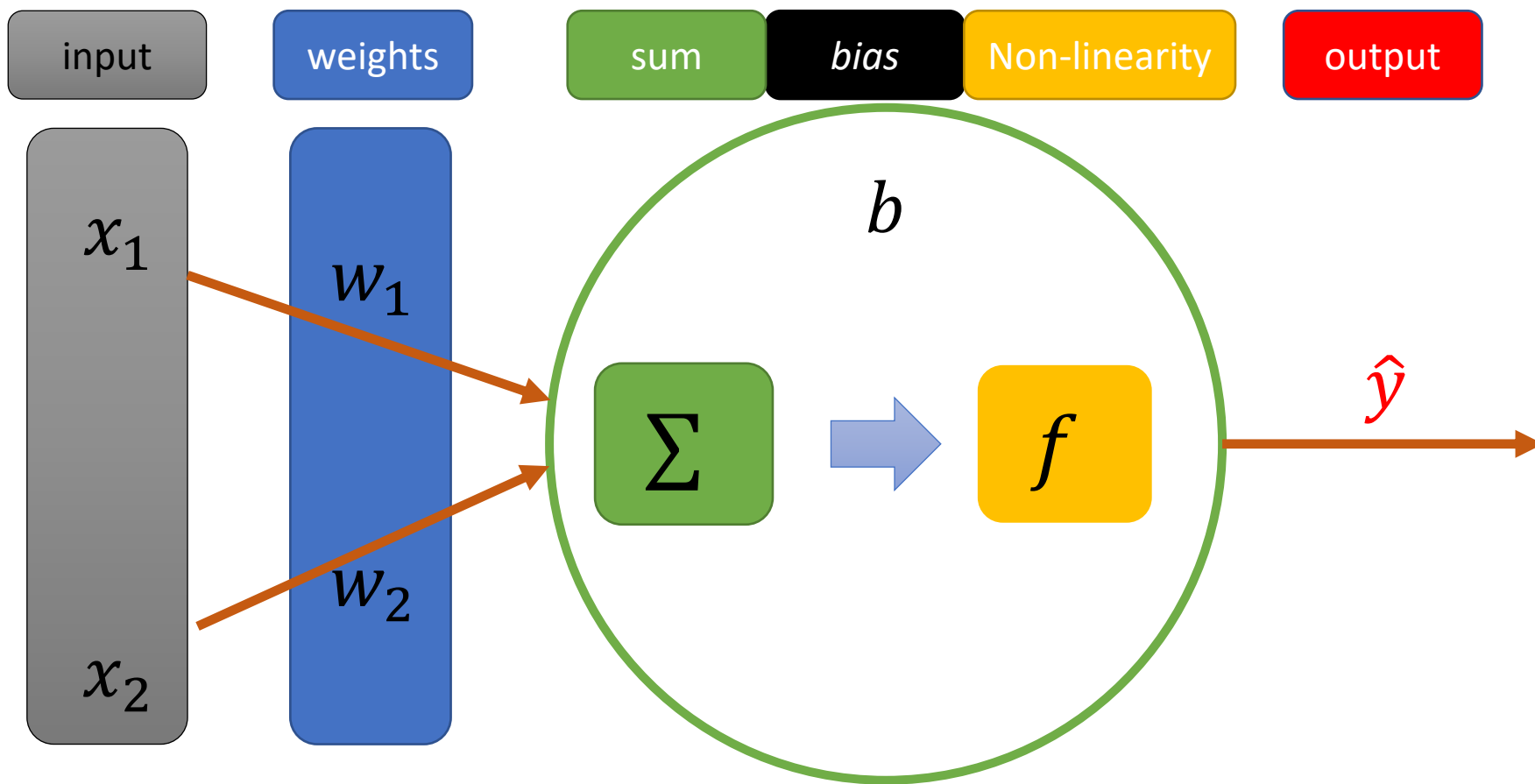


[1 3 5 7 9 11 13 15 17]









$$\hat{y} = f(x_1 * w_1 + x_2 * w_2 + b) = f(X^T W + b)$$

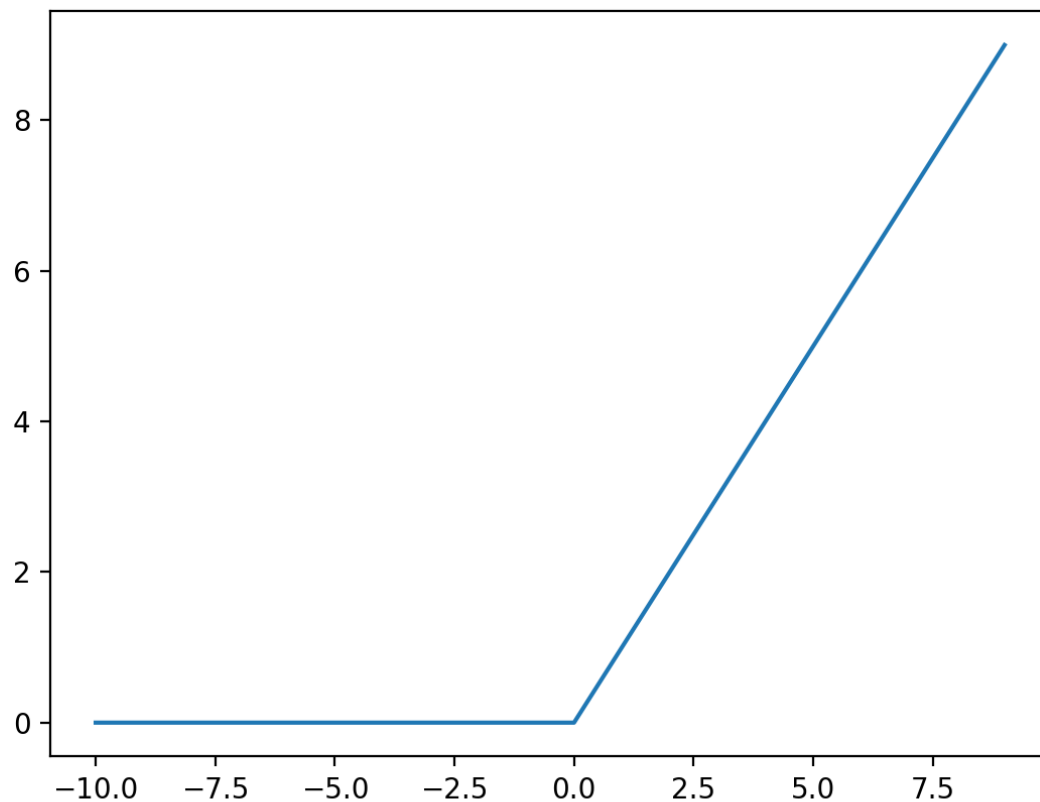
$$X = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \text{ and } W = \begin{bmatrix} w_1 \\ w_2 \end{bmatrix}$$

$f$

非线性函数

ReLU and sigmoid

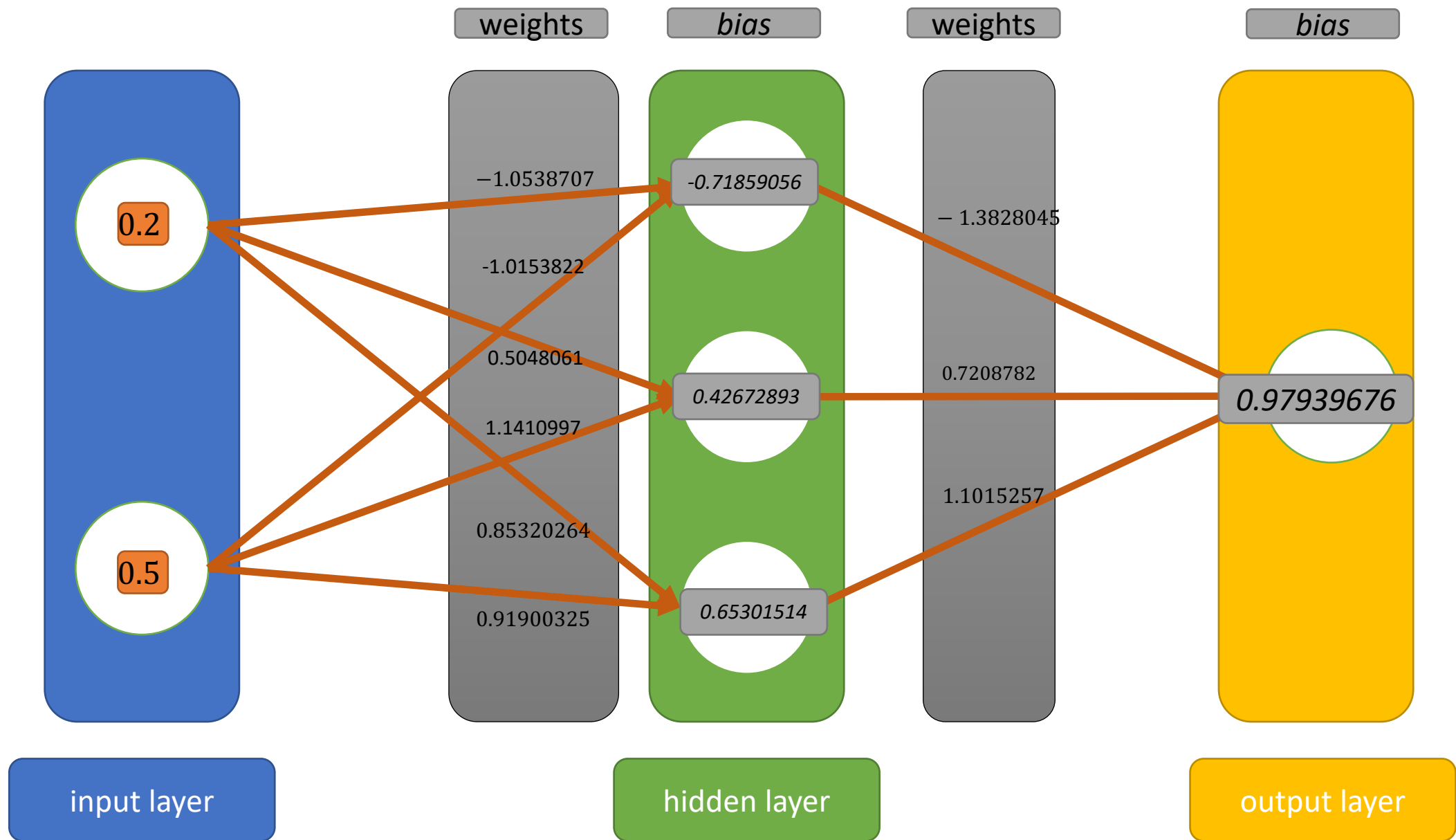
$$\text{ReLU}(x) = \max(0, x)$$



$$X = \begin{bmatrix} 0.1 \\ 0.2 \end{bmatrix} \quad W = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \quad b = 0.3 \quad f(x) = \text{ReLU}$$

$$\hat{y} = f(X^T W + b) = f(0.1 * 1 + 0.2 * 2 + 0.3) = f(0.8) = 0.8$$





$$f(x_1, x_2) = 2x_1 + 4x_2 + 3$$

$$X = \begin{bmatrix} 0.2 \\ 0.5 \end{bmatrix}$$

$$W1 = \begin{bmatrix} -1.0538707 & 0.5048061 & 0.85320264 \\ -1.0153822 & 1.1410997 & 0.91900325 \end{bmatrix}$$

$$b1 = [-0.71859056 \quad 0.42672893 \quad 0.65301514]$$

hidden layer

$$\begin{aligned} o1 &= X^T W1 + b \\ &= \begin{bmatrix} 0.2 \\ 0.5 \end{bmatrix}^T \begin{bmatrix} -1.0538707 & 0.5048061 & 0.85320264 \\ -1.0153822 & 1.1410997 & 0.91900325 \end{bmatrix} + [-0.71859056 \quad 0.42672893 \quad 0.65301514] \\ &= [-0.71846522 \quad 0.67151107 \quad 0.63014215] + [-0.71859056 \quad 0.42672893 \quad 0.65301514] \\ &= [-1.43705578 \quad 1.09824 \quad 1.28315729] \end{aligned}$$

$$o1 = \begin{bmatrix} -1.43705578 \\ 1.09824 \\ 1.28315729 \end{bmatrix}$$

$$W2 = \begin{bmatrix} -1.3828045 \\ 0.7208782 \\ 1.1015257 \end{bmatrix}$$

$$b2 = [0.97939676]$$

output layer

$$\begin{aligned} o2 &= o1^T W2 + b2 \\ &= \begin{bmatrix} -1.43705578 \\ 1.09824 \\ 1.28315729 \end{bmatrix}^T \begin{bmatrix} -1.3828045 \\ 0.7208782 \\ 1.1015257 \end{bmatrix} + [0.97939676] \\ &= [4.19229516] + [0.97939676] \\ &= [5.17169192] \end{aligned}$$

# END



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