


Applied Text Analytics & Natural Language Processing



with Dr. Mahdi Roozbahani
& Wafa Louhichi

*Neural Networks
Forward Pass and Back Propagation*



Learning Objectives

In this lesson, you will learn another linear text classifier

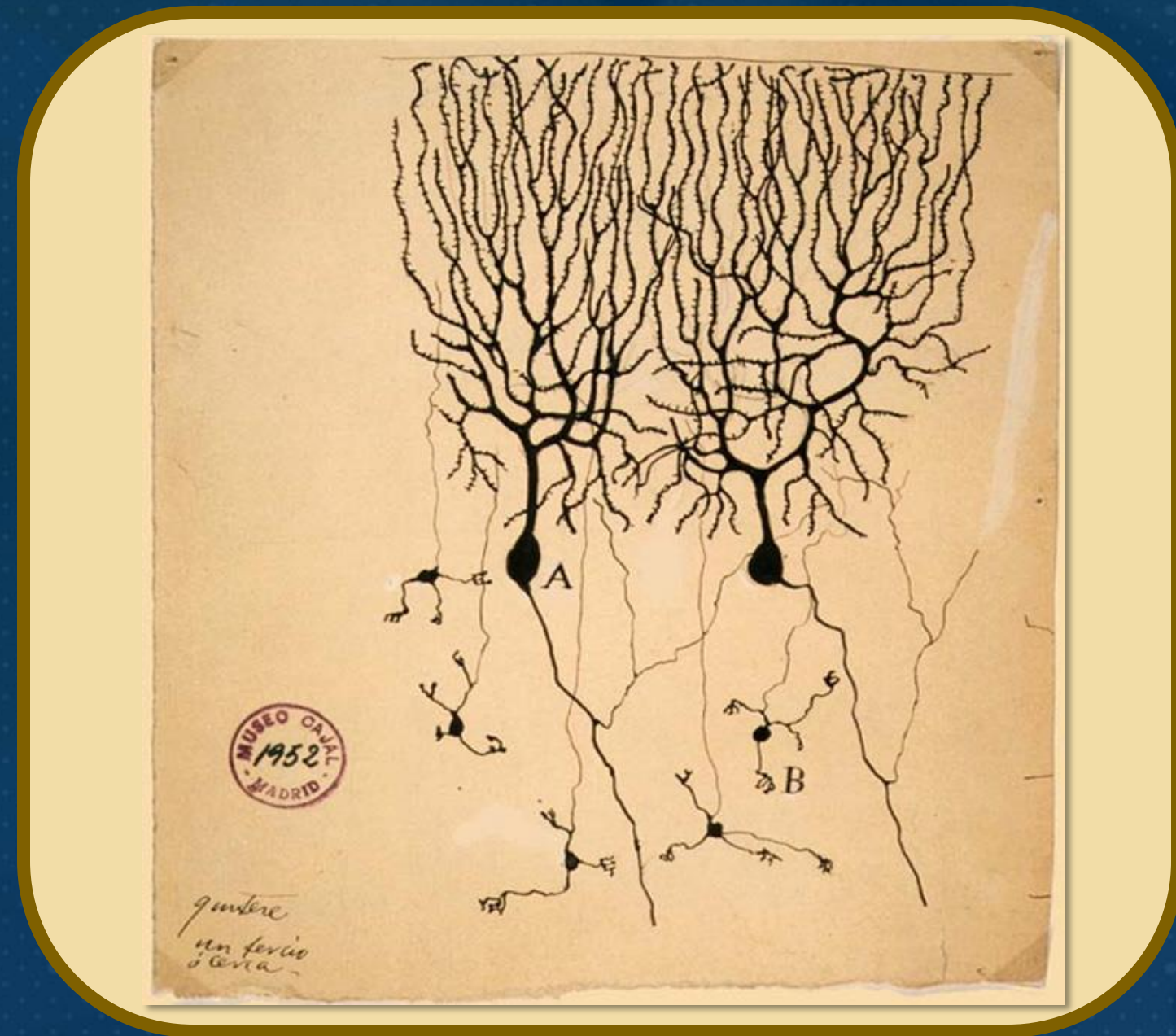
- Neural Network
- Activation Functions
- Forward Pass
- Backpropagation



Inspiration from Biological Neurons

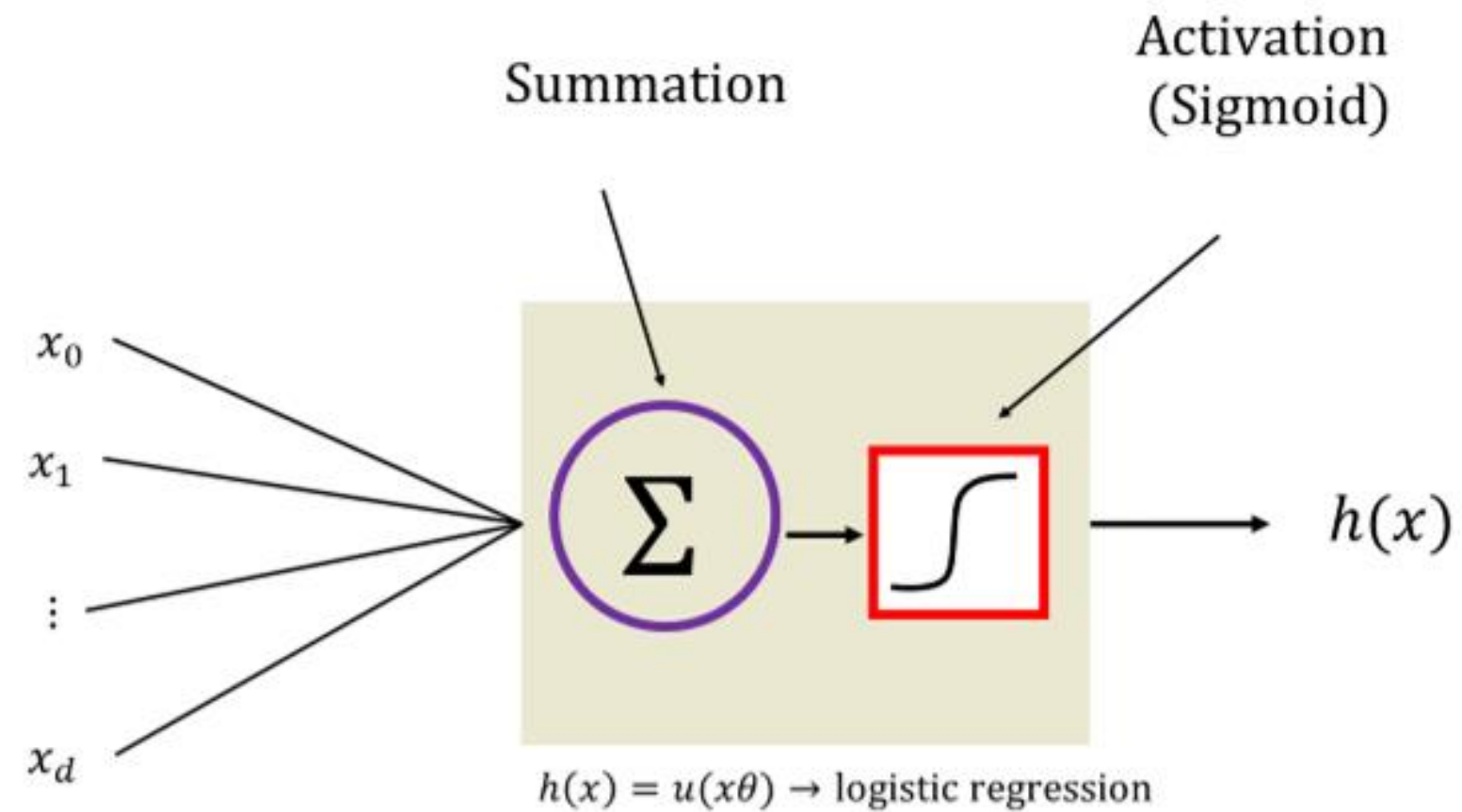
Neurons: core components of the brain and the nervous system consisting of:

1. Dendrites that collect information from other neurons
2. An axon that generates outgoing spikes



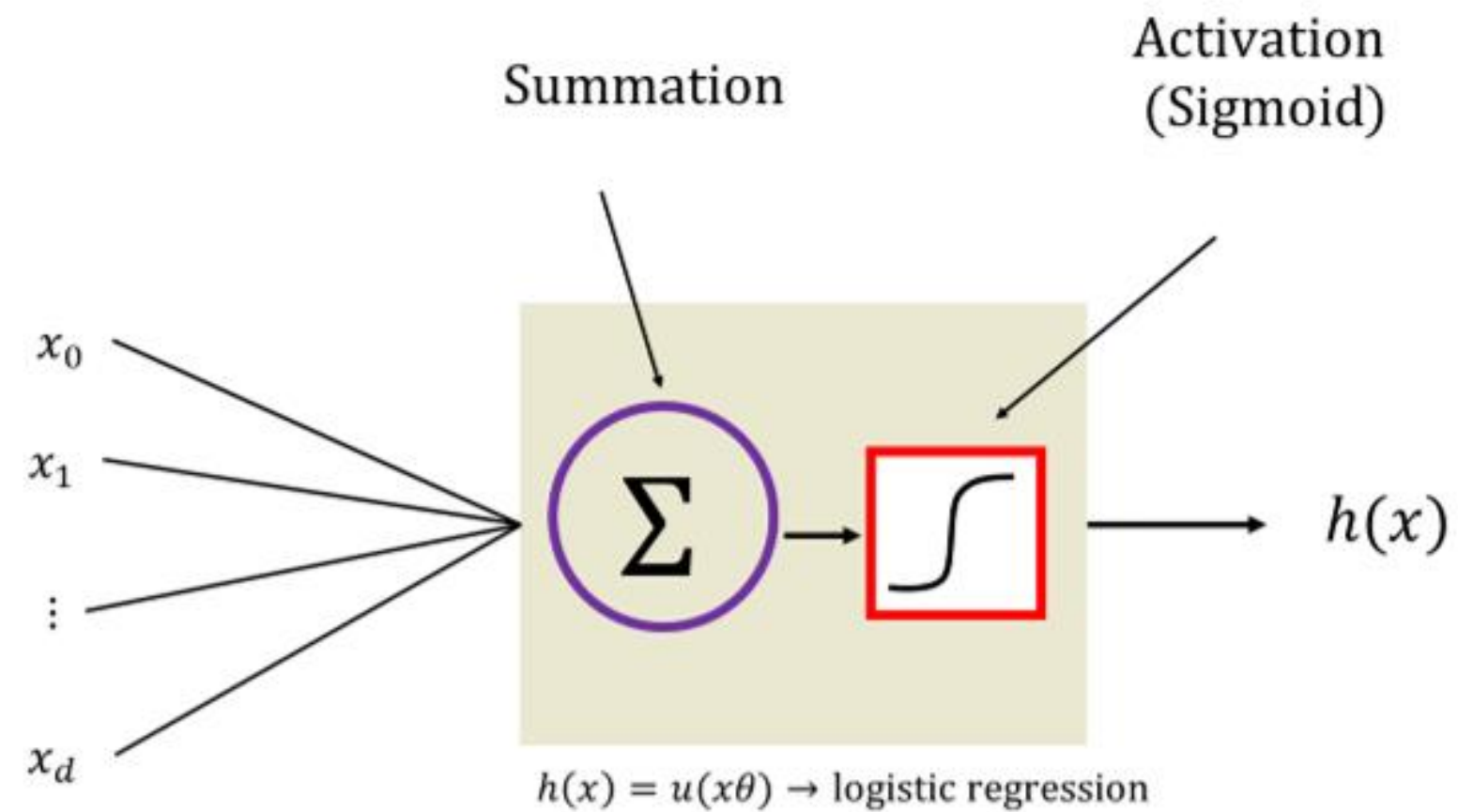
The first drawing of brain cells by Santiago Ramón y Cajal in 1899
Public Domain, <https://commons.wikimedia.org/w/index.php?curid=612581>

Logistic Regression Block



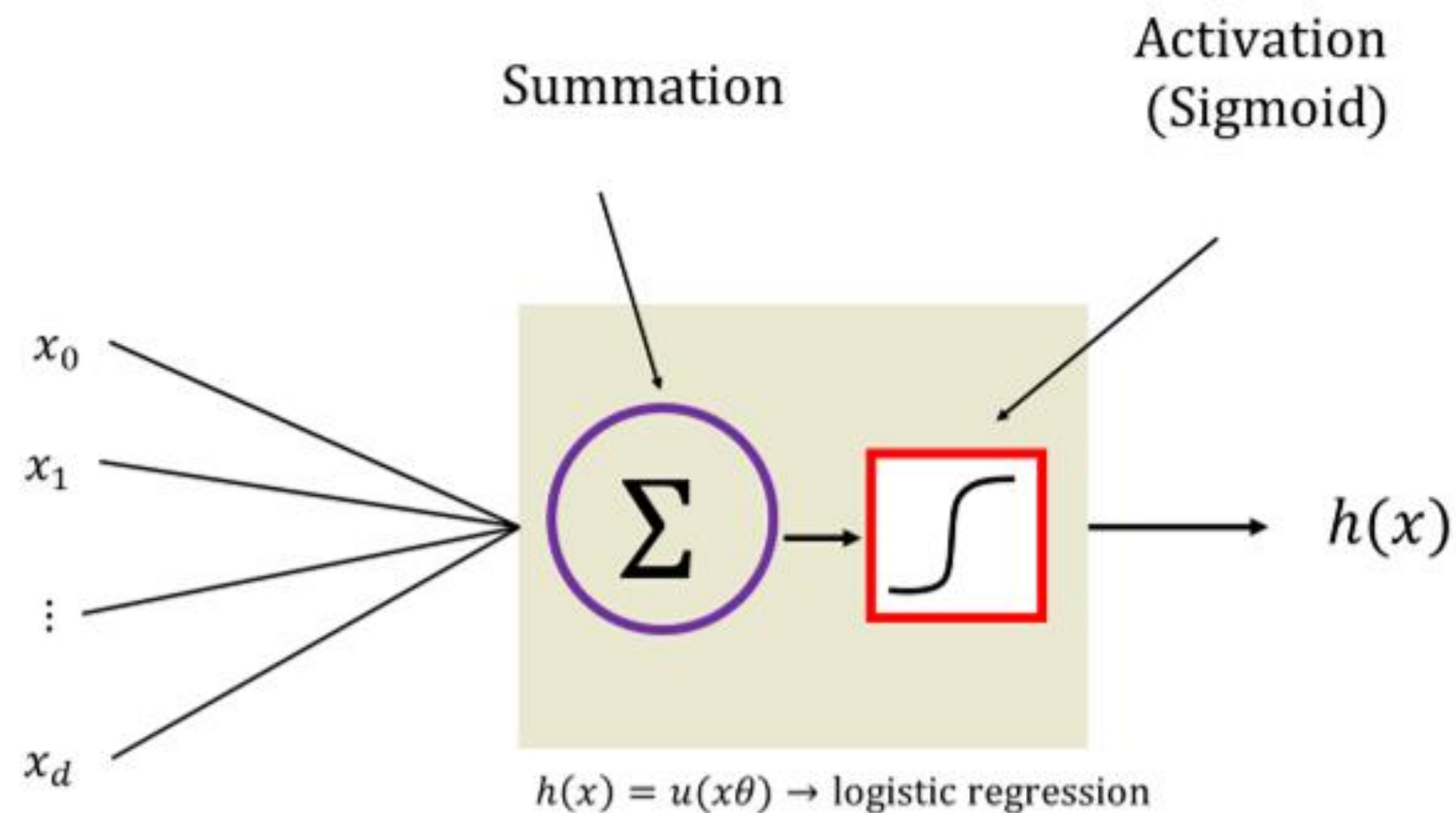
$$\textcircled{\Sigma} = \sum_{i=0}^d x_i \theta_i = \theta_0 + \theta_1 x_1 + \dots + \theta_d x_d$$

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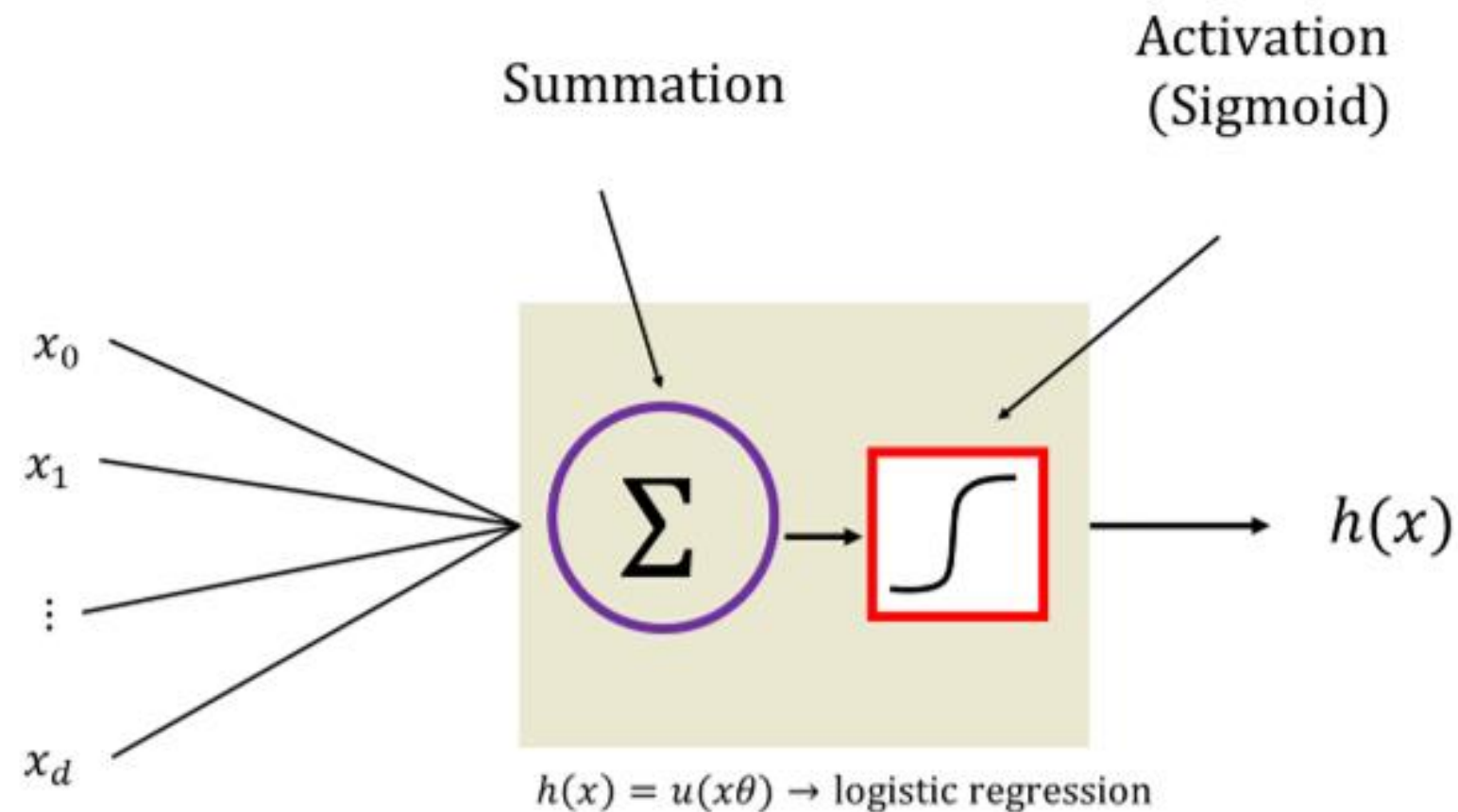
Different Activation Function



$$\text{output} = \text{activation}(x\theta + b)$$

Name of the neuron	Activation function: $\text{activation}(z)$
Linear unit	z
Threshold/sign unit	$\text{sgn}(z)$
Sigmoid unit	$\frac{1}{1 + \exp(-z)}$
Rectified linear unit (ReLU)	$\max(0, z)$
Tanh unit	$\tanh(z)$

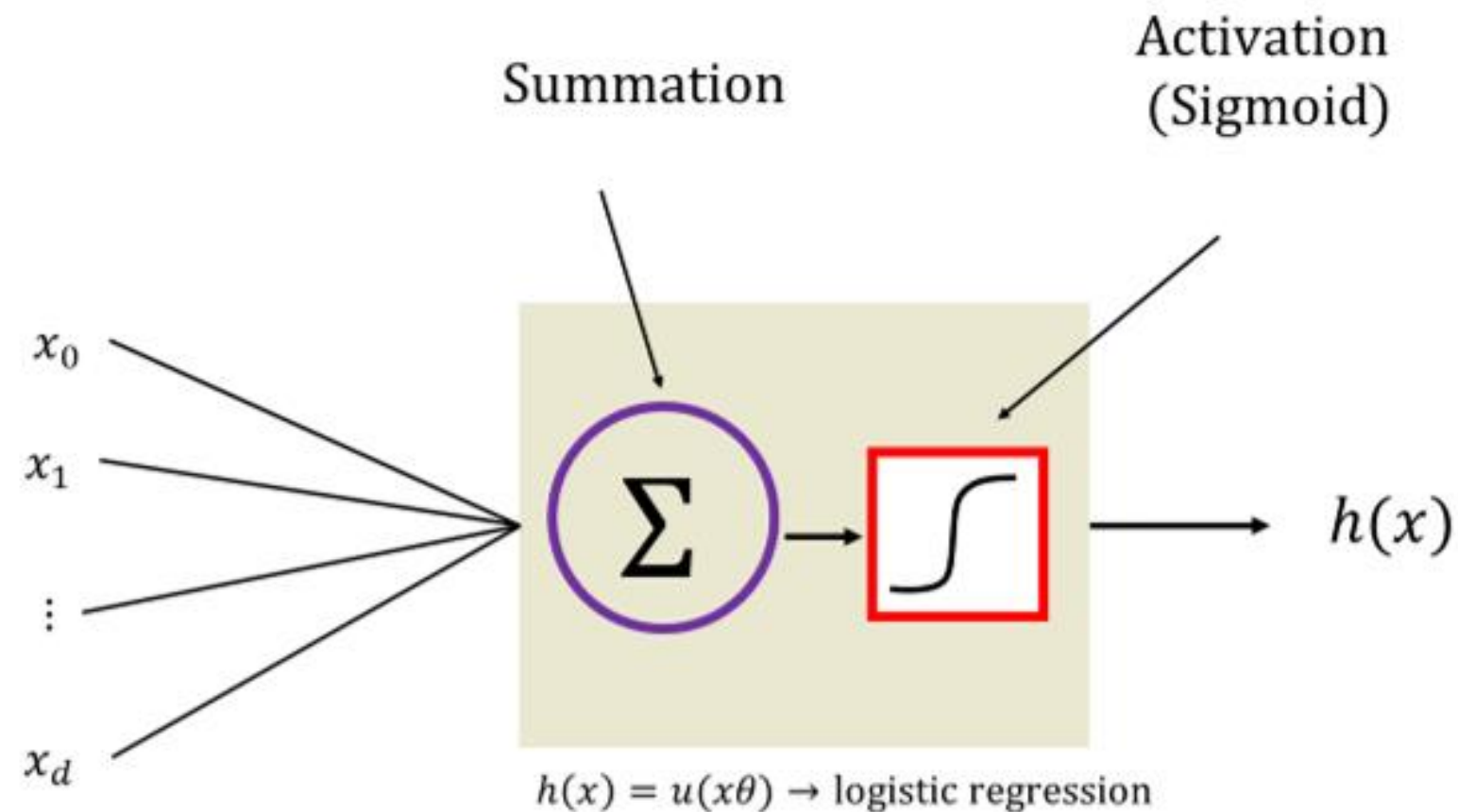
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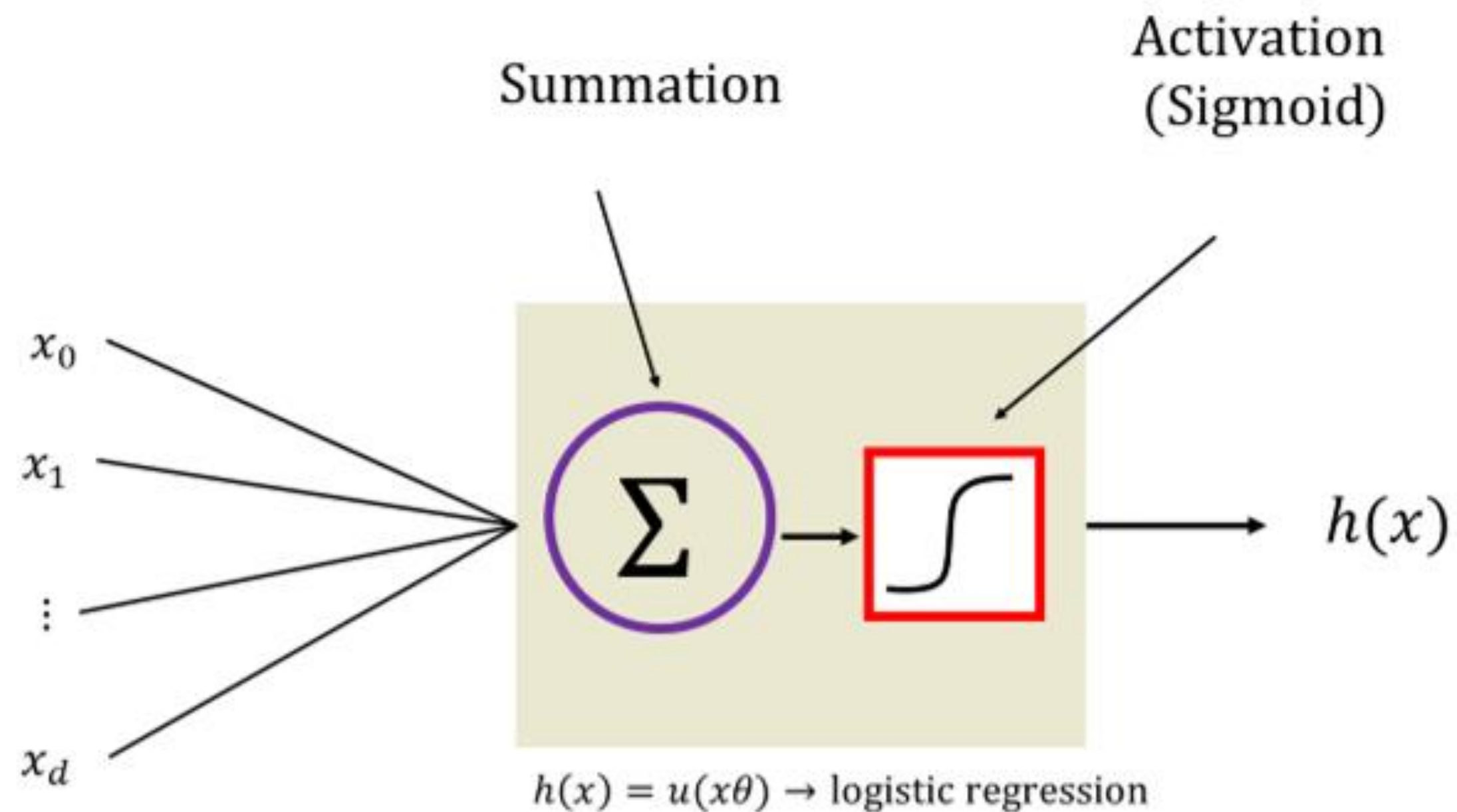
Different Activation Function



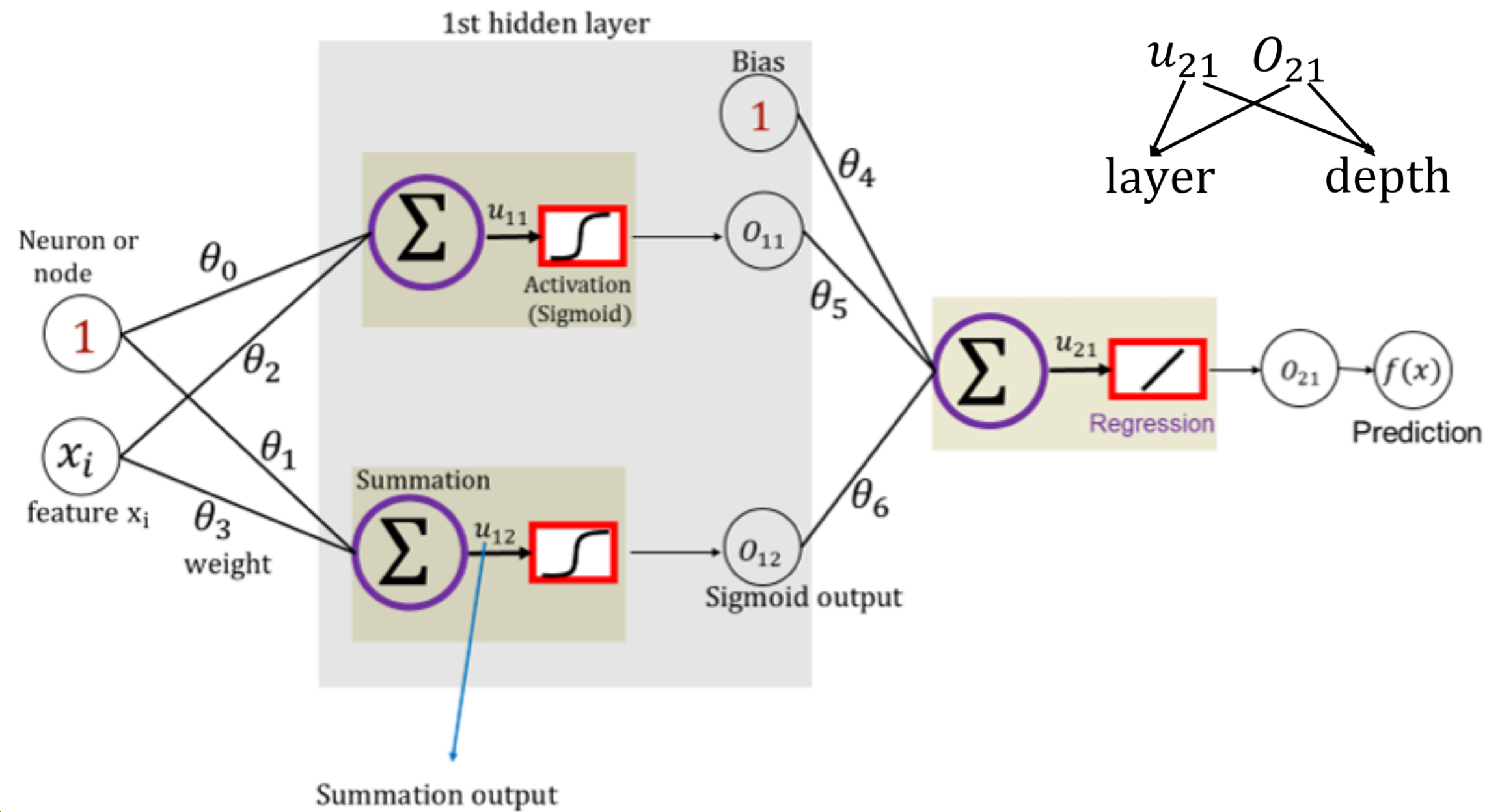
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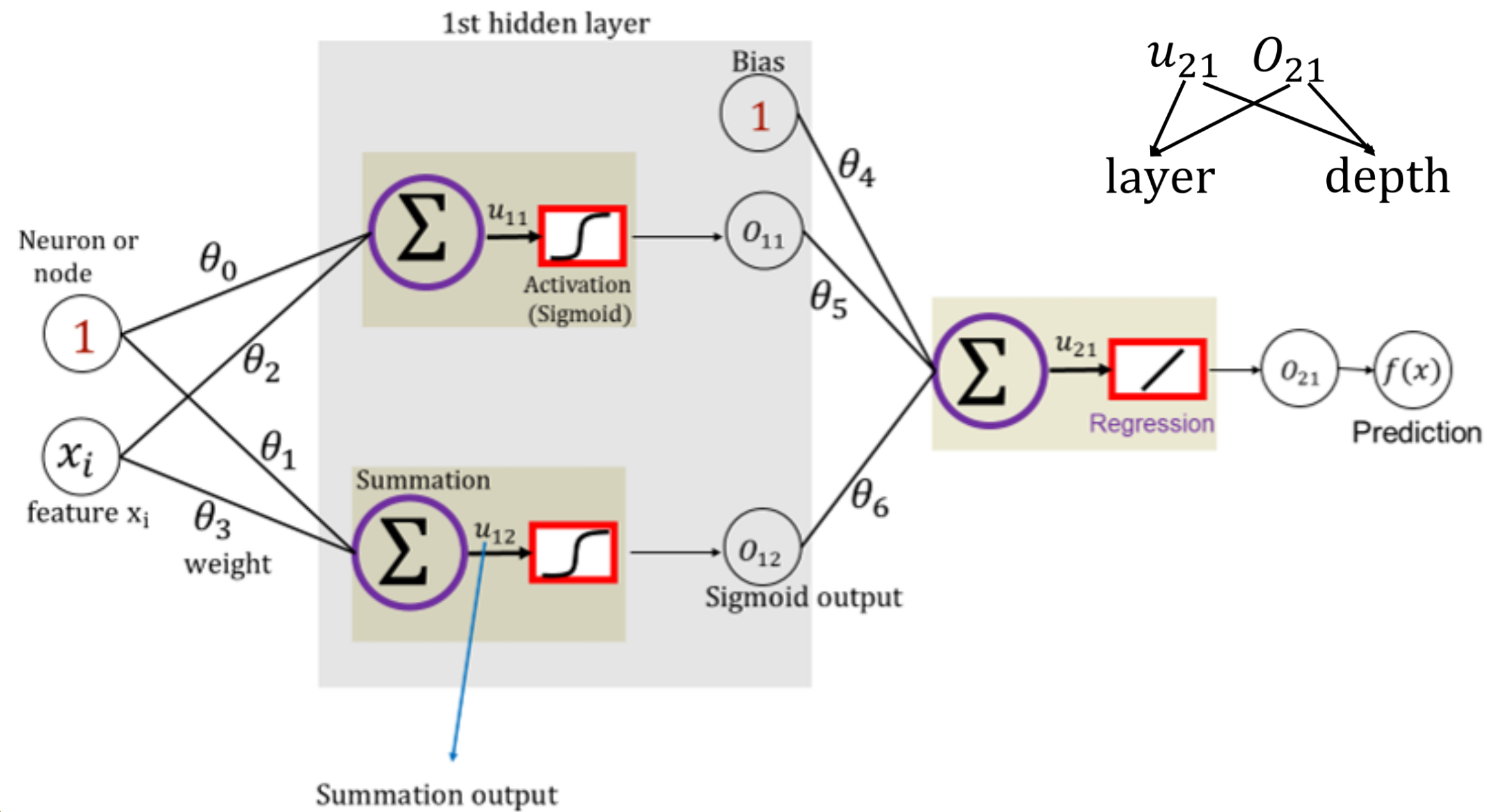
Can We Connect a Bunch of These Blocks Together?



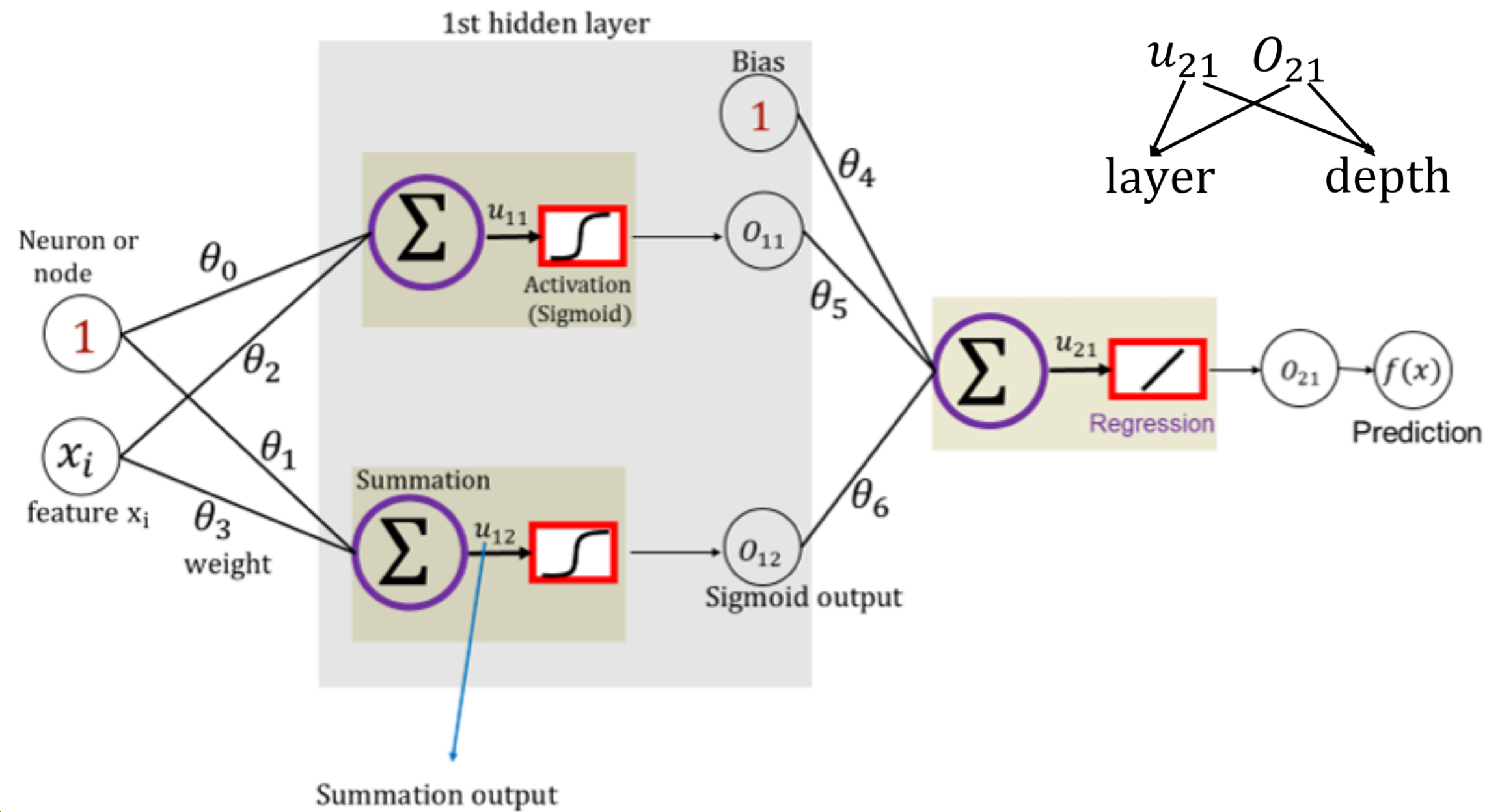
Neural Network Regression



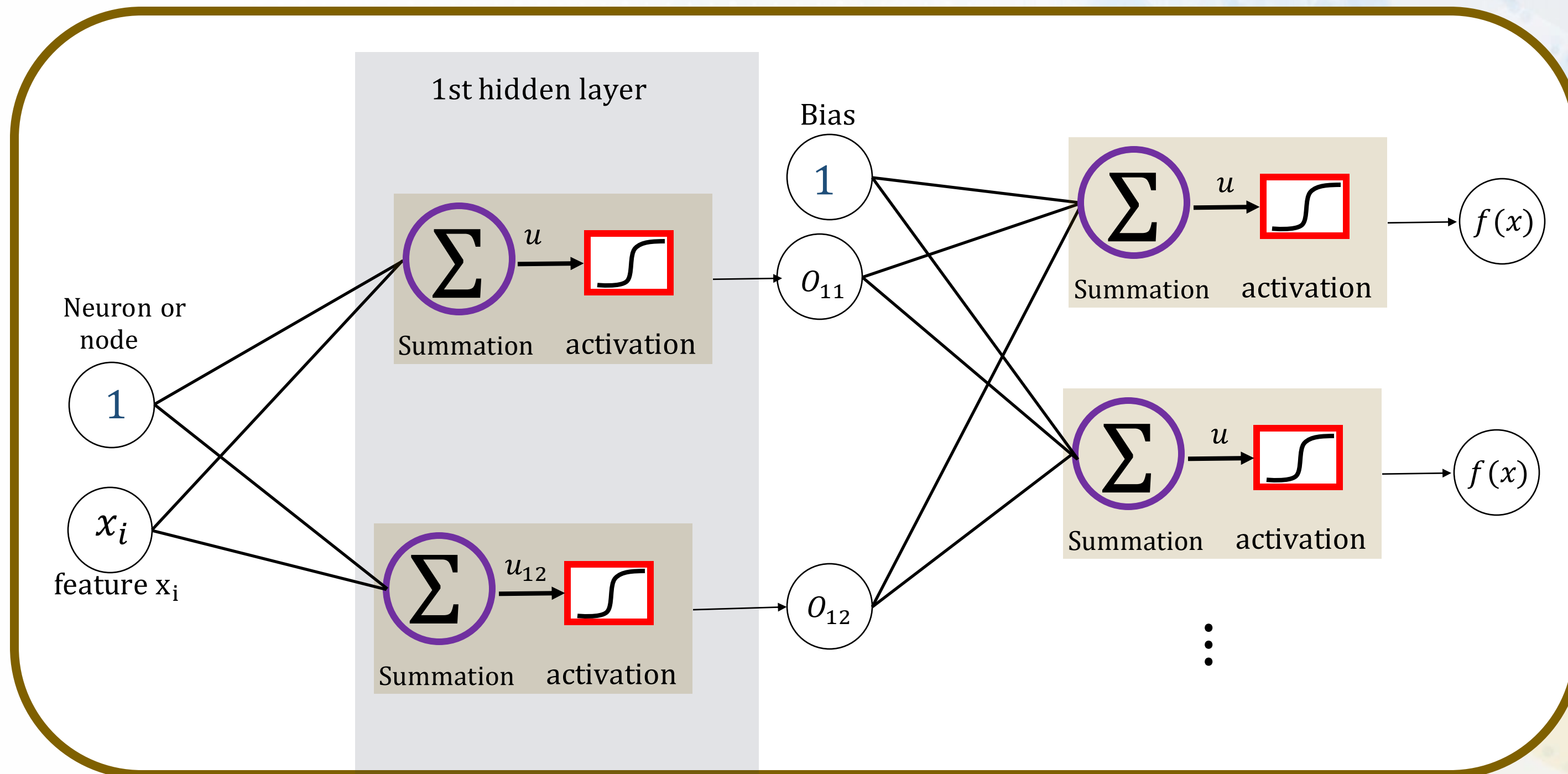
Neural Network Regression



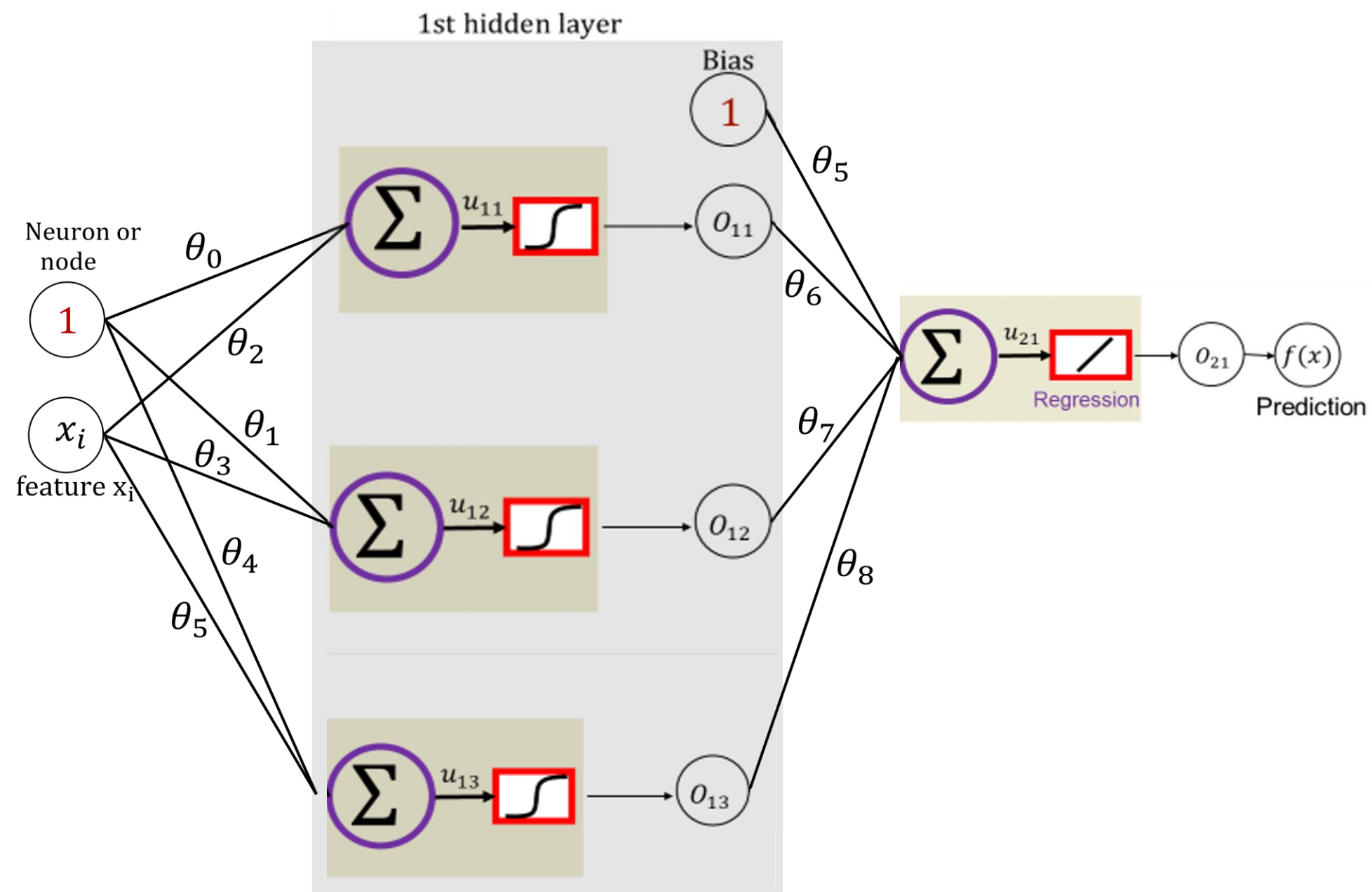
Neural Network Regression



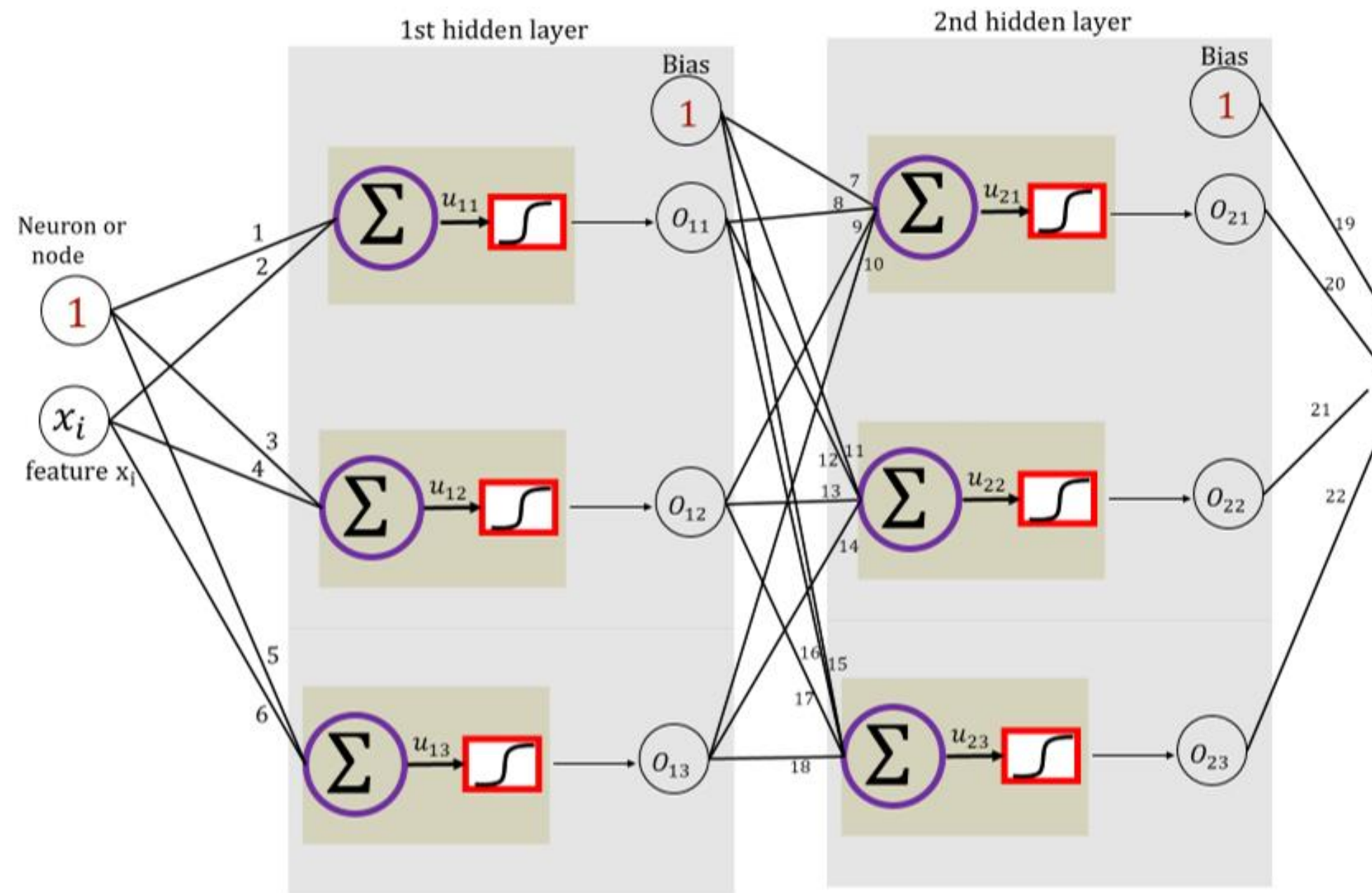
Neural Network Classification



Increasing the Depth of Each Layer



Adding More Hidden Layer

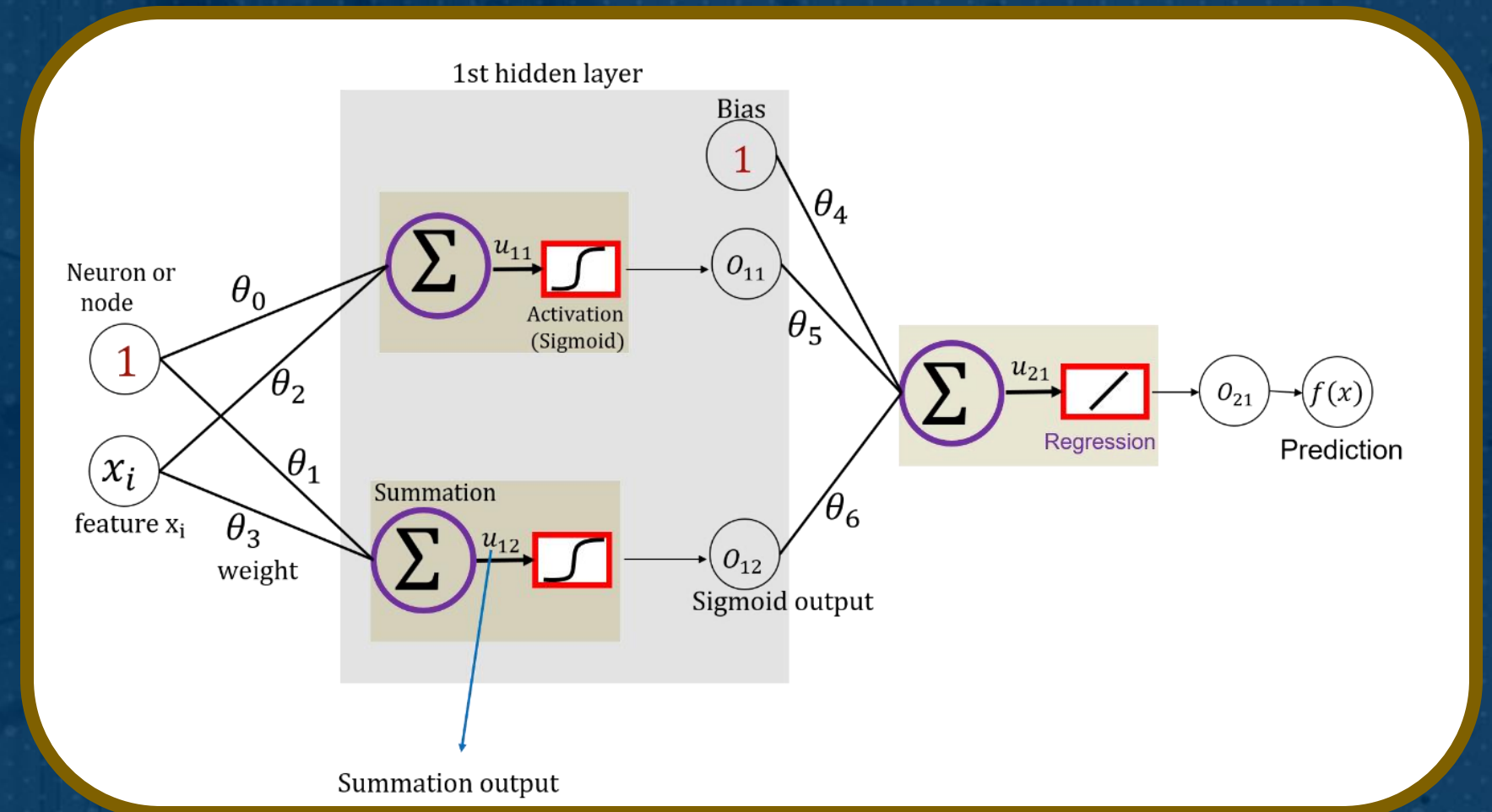


Forward Pass

$$u_{11} = \sum_{i=0}^d x_i \theta_i = \theta_0 + \theta_1 x_1 + \dots + \theta_d x_d$$

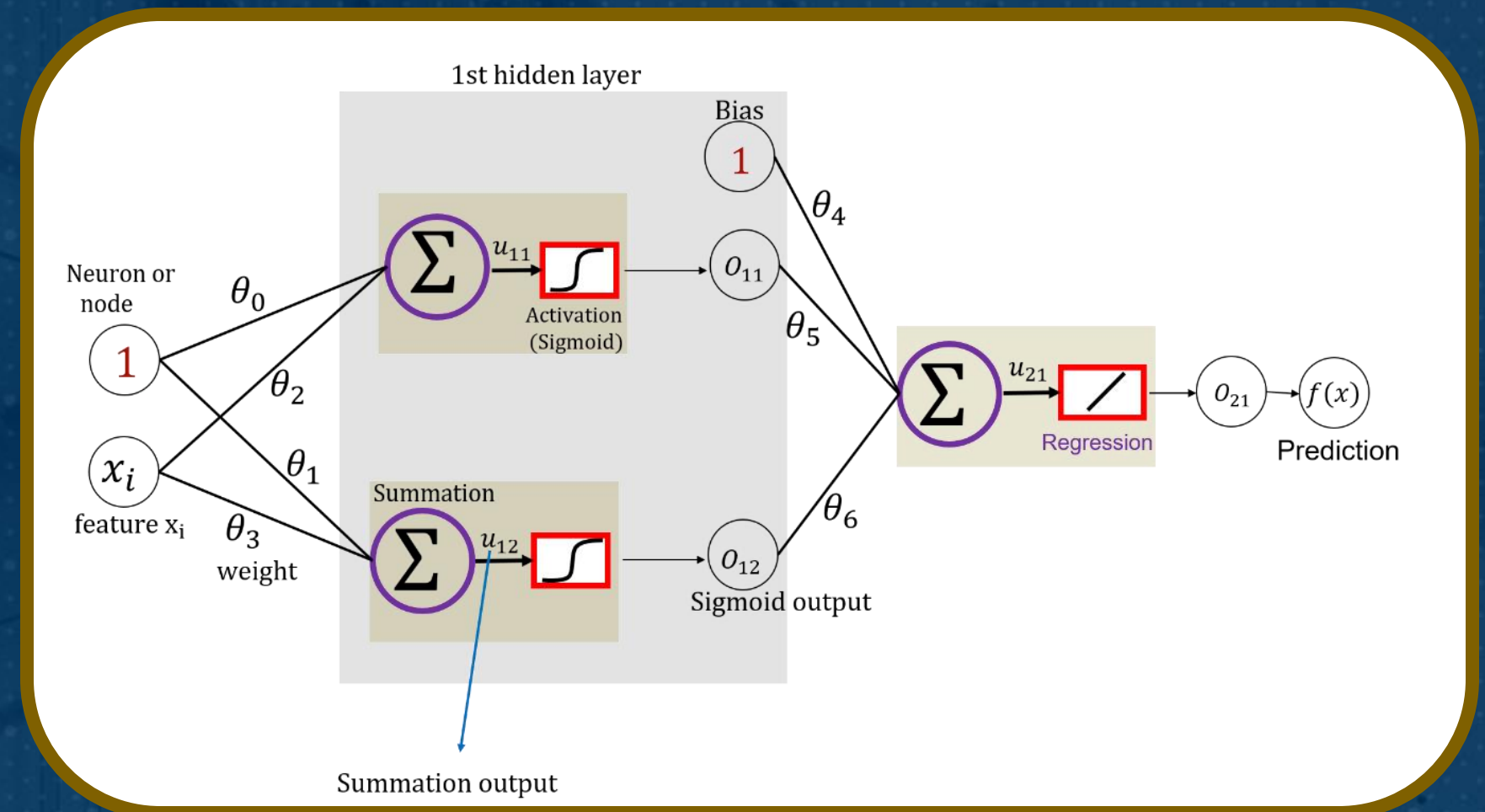
$$o_{11} = \frac{1}{1 + e^{-u_{11}}}$$

In forward pass, we calculate all u_{ij} and o_{ij} values from the left to the right of the network



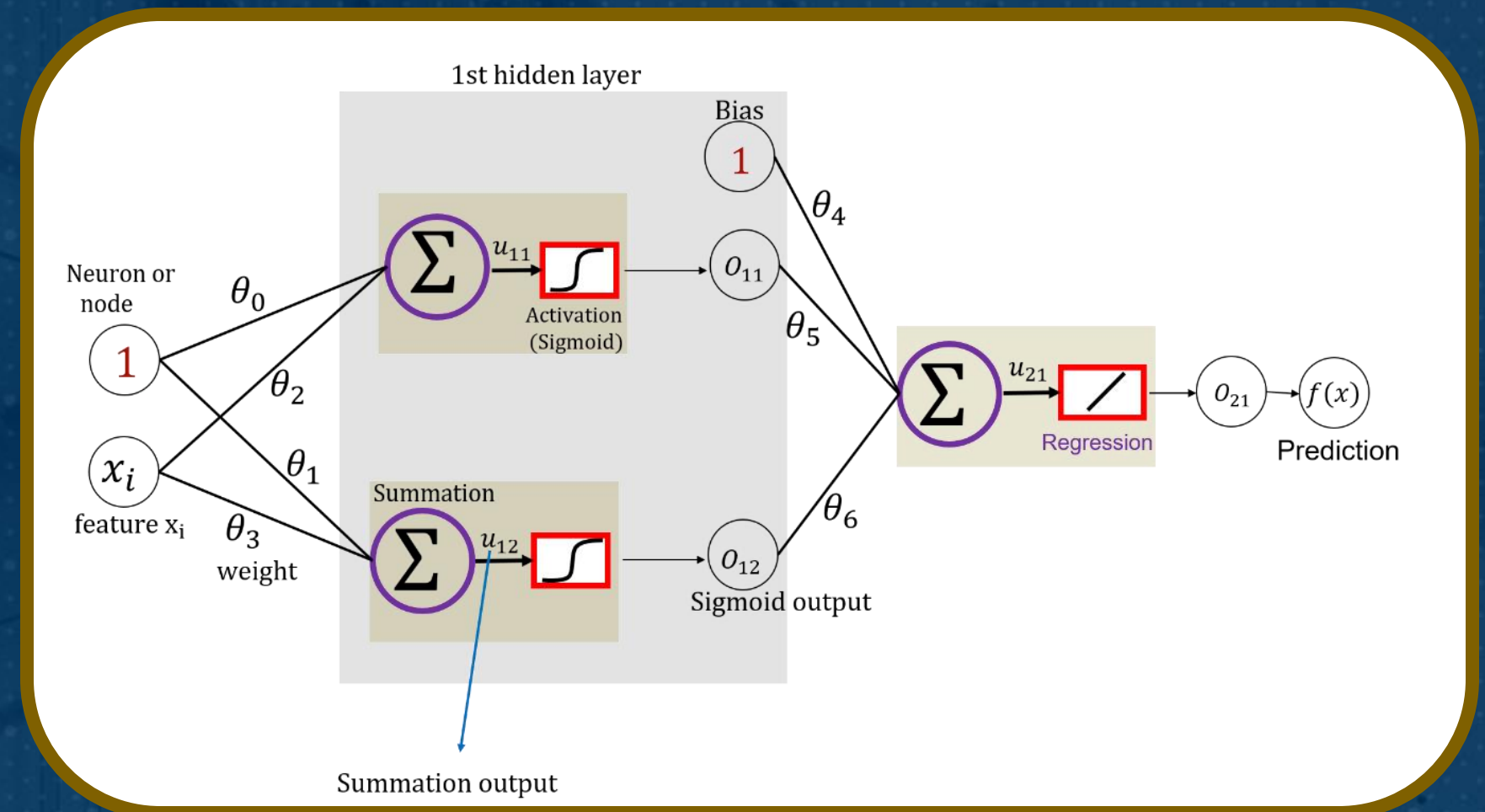
Backpropagation

- In backpropagation, we update all θ_i parameters from the right to the left of the network.
- Optimization can be done using iterative techniques such as gradient descent



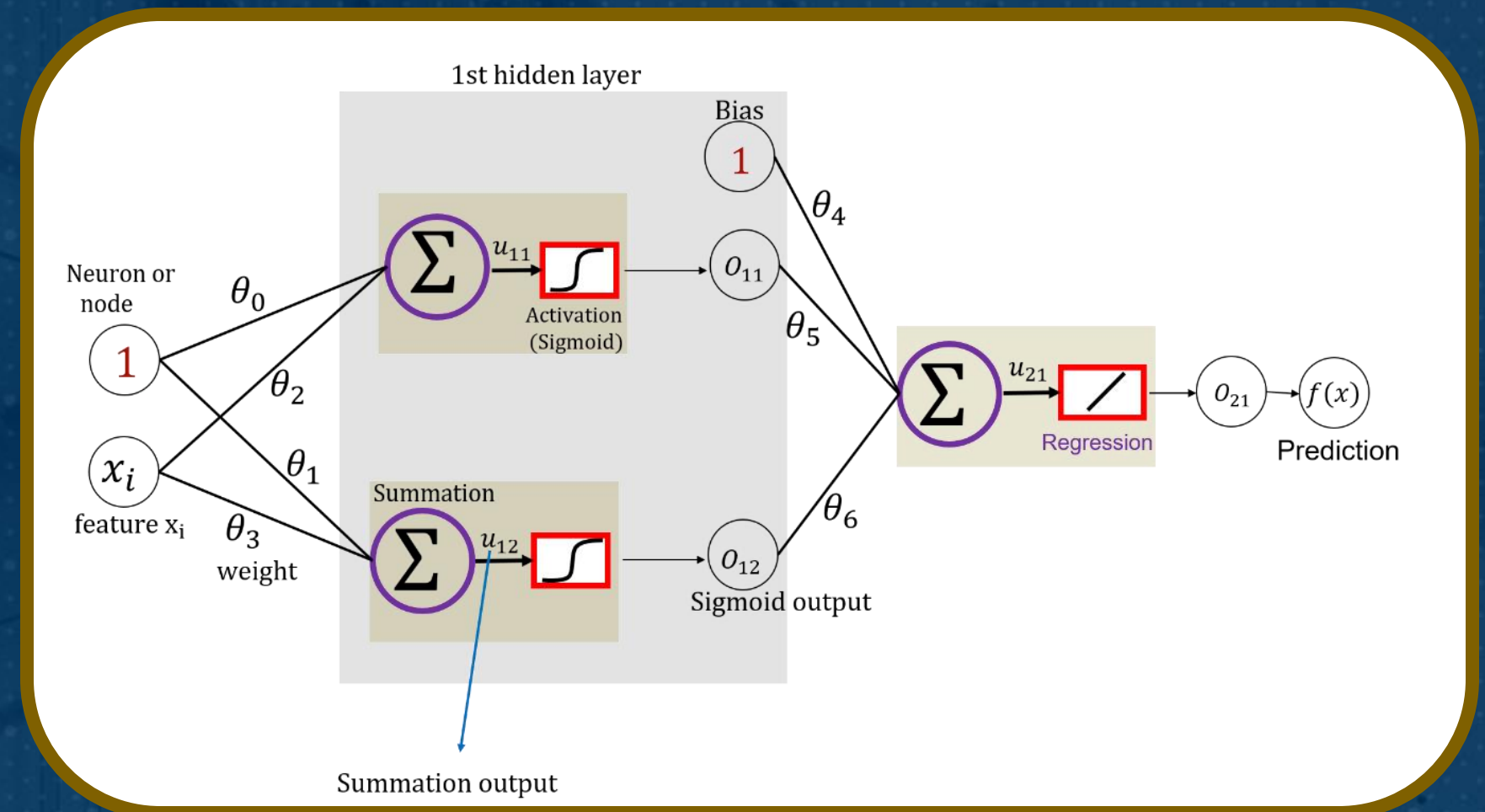
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Summary

- We learned about Neural Network
- We quickly went over Forward Pass and Backpropagation to optimize the model parameters

