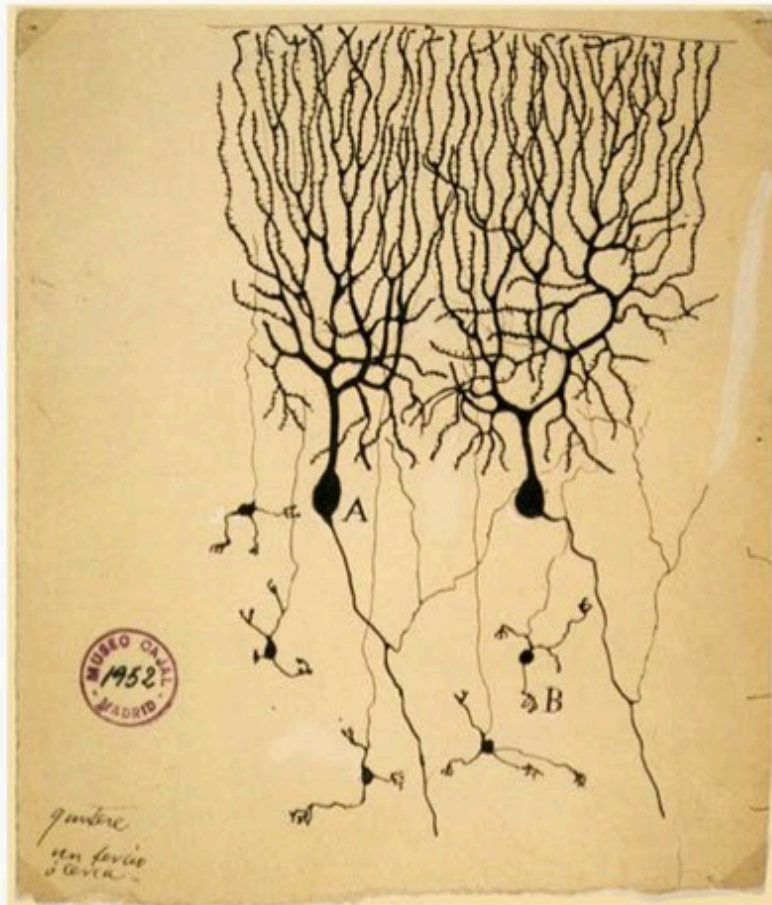Georgia Tech

Neural Networks
Forward Pass and Back Propagation

Mahdi Roozbahani
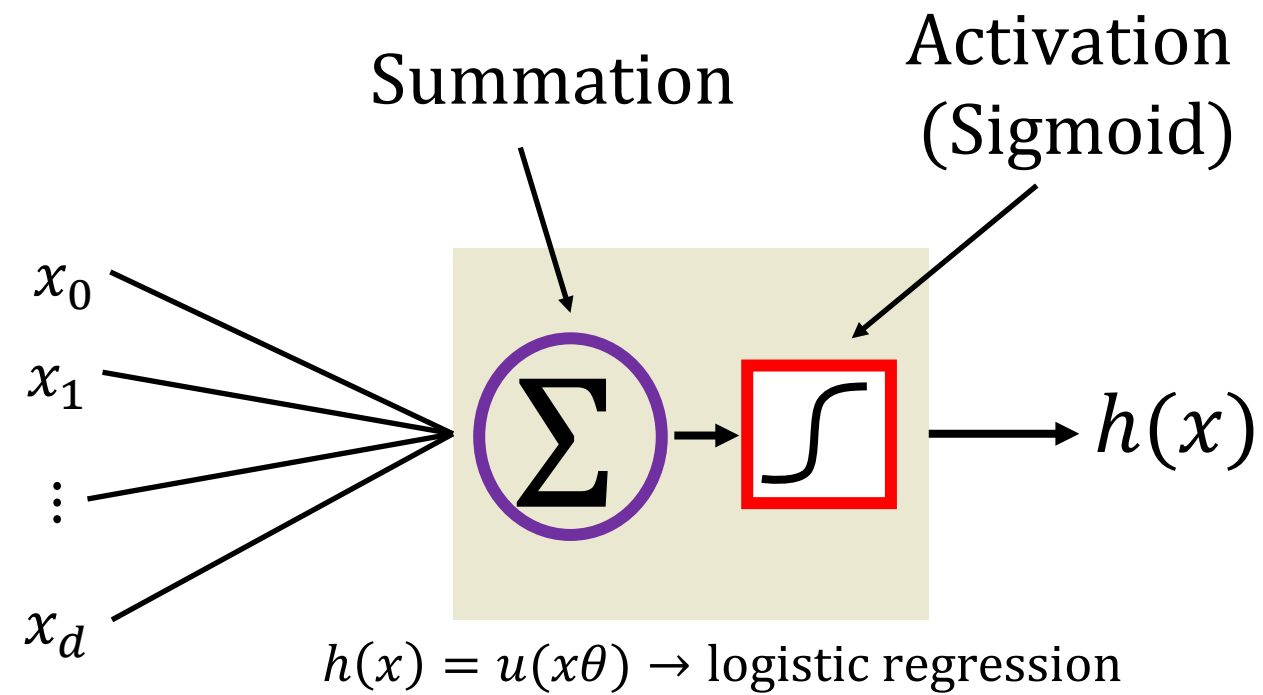
Georgia Tech

Inspiration from Biological Neurons

The first drawing of a brain cells by Santiago Ramón y Cajal in 1899
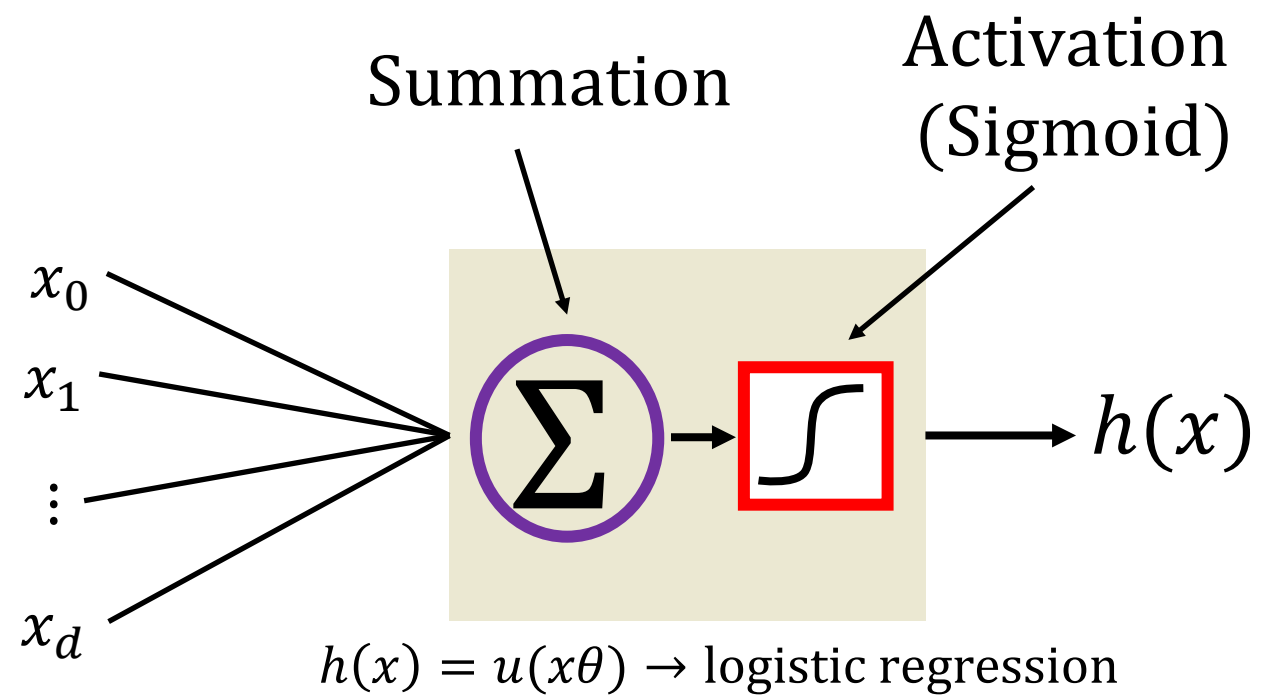
Neurons: core components of brain and the nervous system consisting of

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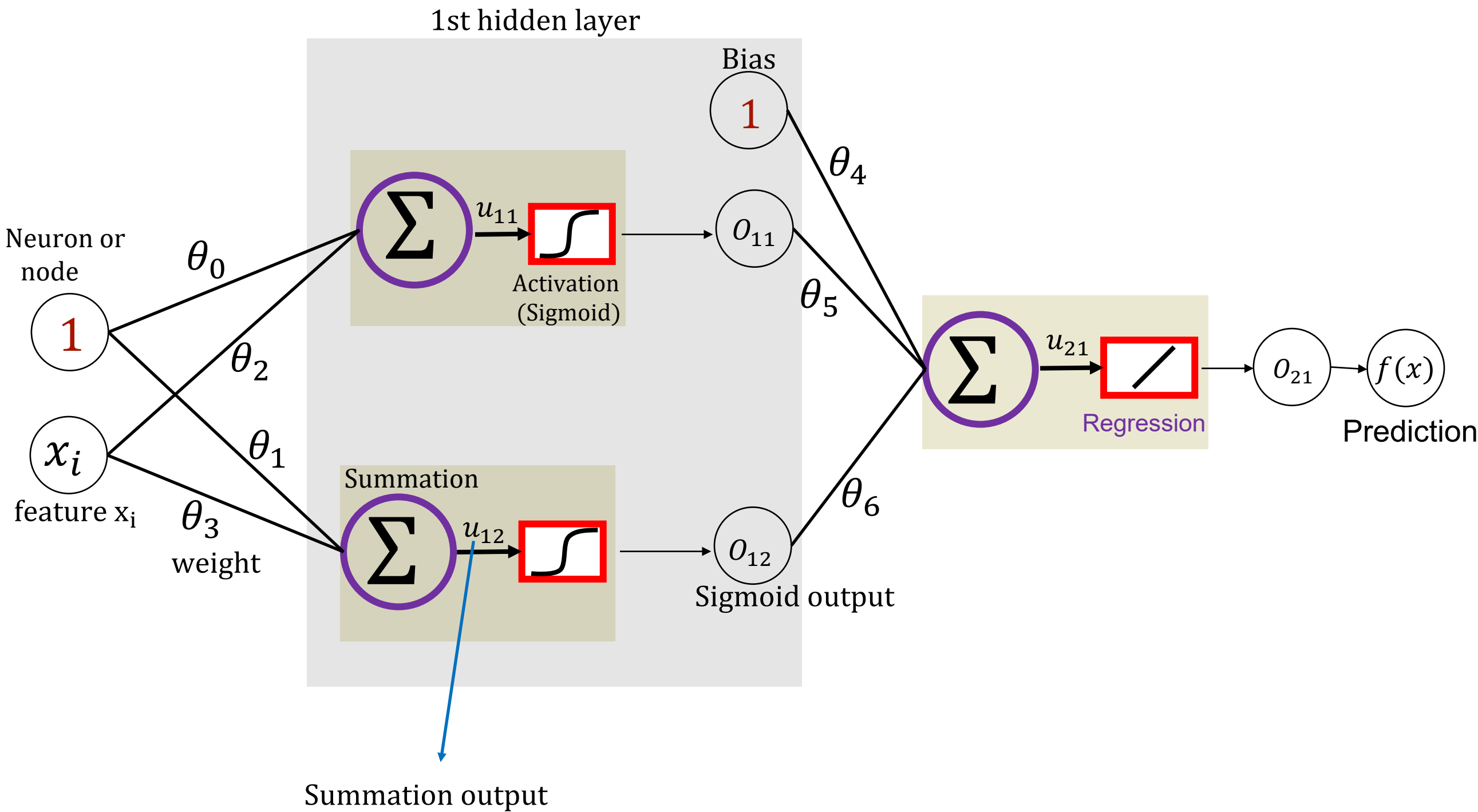2. An axon that generates outgoing spikes

Summation

Activation (Sigmoid)

x_0
x_1
$\vdots$
x_d

$\Sigma \rightarrow \int \rightarrow h(x)$

$h(x) = u(x\theta) \rightarrow$ logistic regression

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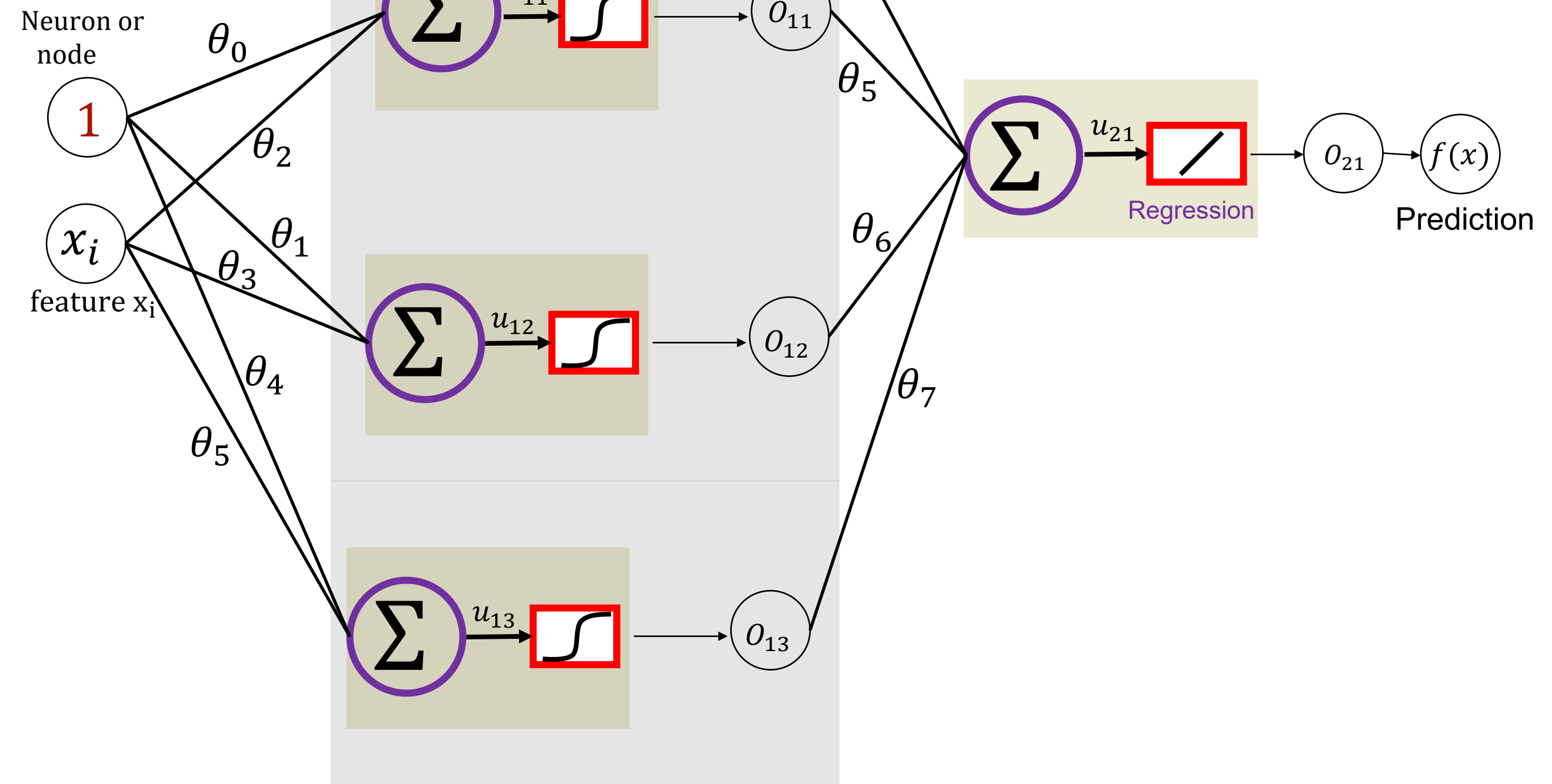
Name of the neuron	Activation function: $activation(z)$
Linear unit	z
Threshold/sign unit	$\text{sgn}(z)$
Sigmoid unit	$\dfrac{1}{1 + \exp(-z)}$
Rectified linear unit (ReLU)	$\max(0, z)$
Tanh unit	$\tanh(z)$

Summation

Activation
(Sigmoid)

x_0
x_1
$\vdots$
x_d

Σ → ∫ → $h(x)$

$h(x) = u(x\theta) \rightarrow$ logistic regression

NN Regression

u_{21} O_{21}

layer   depth

1st hidden layer

Bias

1

θ_4

Neuron or node

1

θ_0

θ_2

$\sum$ u_{11} Activation (Sigmoid) O_{11}

θ_5

$\sum$ u_{21} Regression O_{21} $f(x)$

Prediction

feature x_i

x_i

θ_1

θ_3

weight

Summation

$\sum$ u_{12} O_{12}

Sigmoid output

θ_6

Summation output
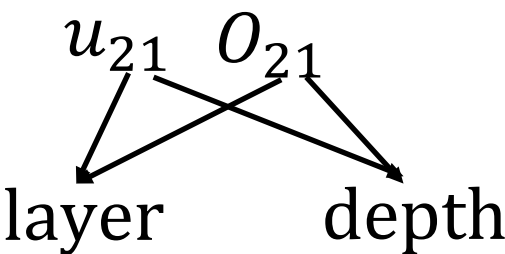
1st hidden layer

2nd hidden layer

Bias

1

Bias

1

Neuron or
node

1

feature x_i

Σ u_{11} O_{11}

Σ u_{12} O_{12}

Σ u_{13} O_{13}

Σ u_{21} O_{21}

Σ u_{22} O_{22}

Σ u_{23} O_{23}

1
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