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DLI Accelerated Data Science Teaching Kit

# Module 16.1 - Introduction to Artificial Neural Networks



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# A Brief History of Artificial Neural Networks

Perceptron: a single neuron that can learn for classification. (1958)

Backpropagation for neural networks (1988): Learning representations by back-propagation errors

- Successful applications such as character recognition
- Limitations: overfitting, challenging hyper-parameter tuning such as number of neuron numbers, number of layers, and so on.

Deep Learning(2006)

- Autoencoder
- Convolutional Neural Networks
- Recurrent Neural Networks

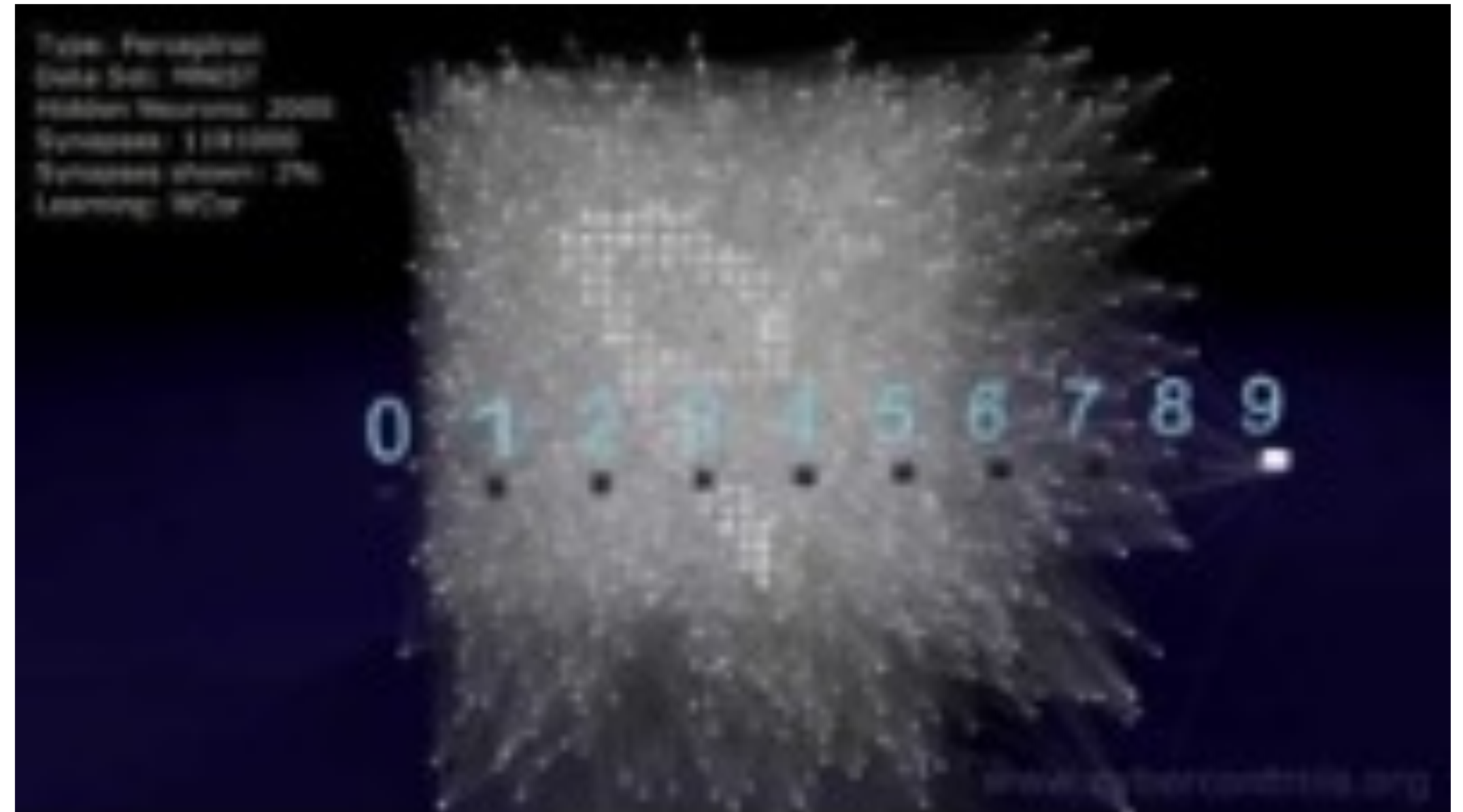
# Neural Network 3D Simulation

Perceptron

Multilayer Perceptron

Convolutional Neural Networks

Spiking Neural Networks

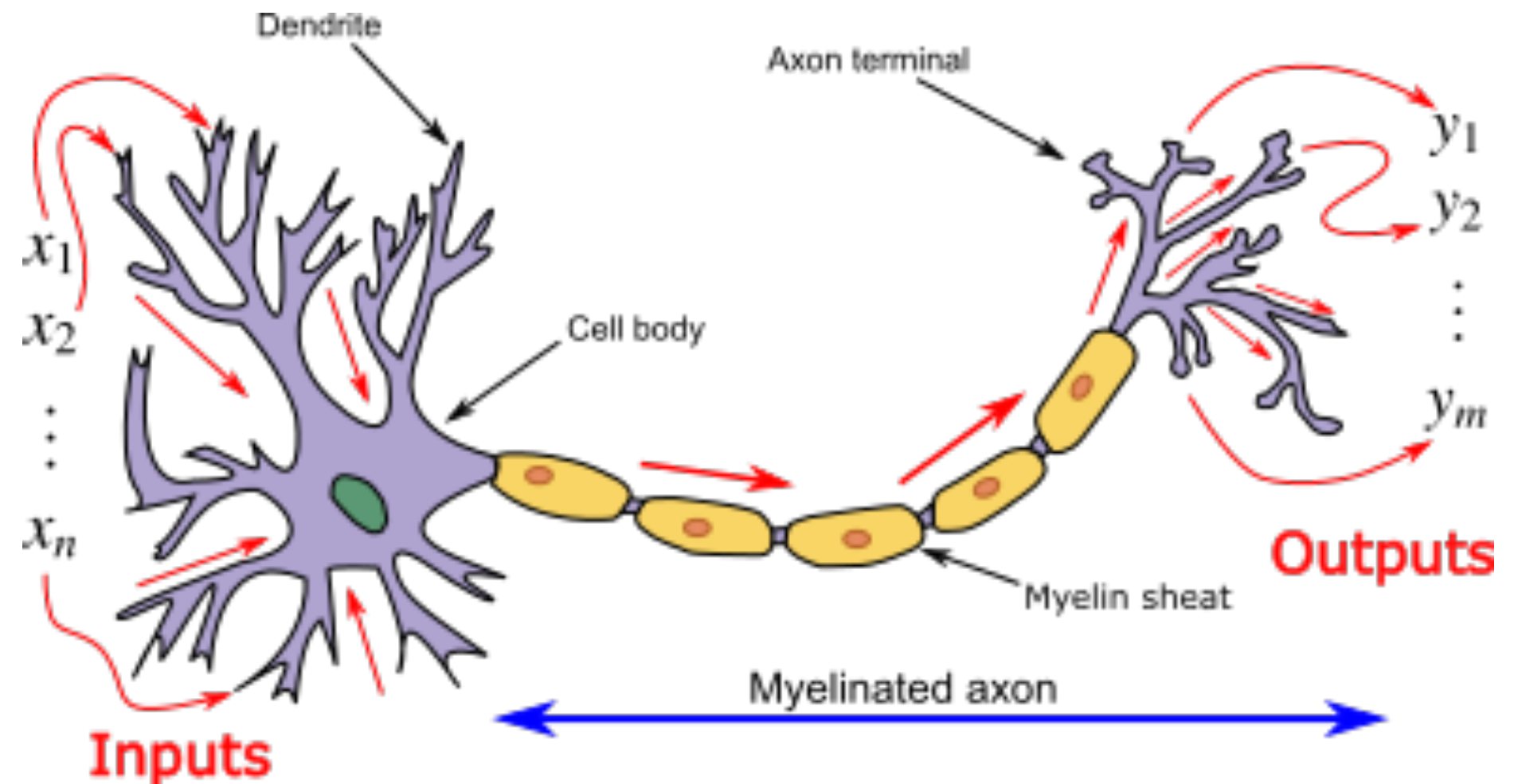


# Structure of Neurons in Human Brain

Dendrite: It receives signals from other neurons

Cell body: It sums all the incoming signals to generate input

Axon: When the sum reaches a threshold value, neuron fires and the signal travels down the axon to the other neurons

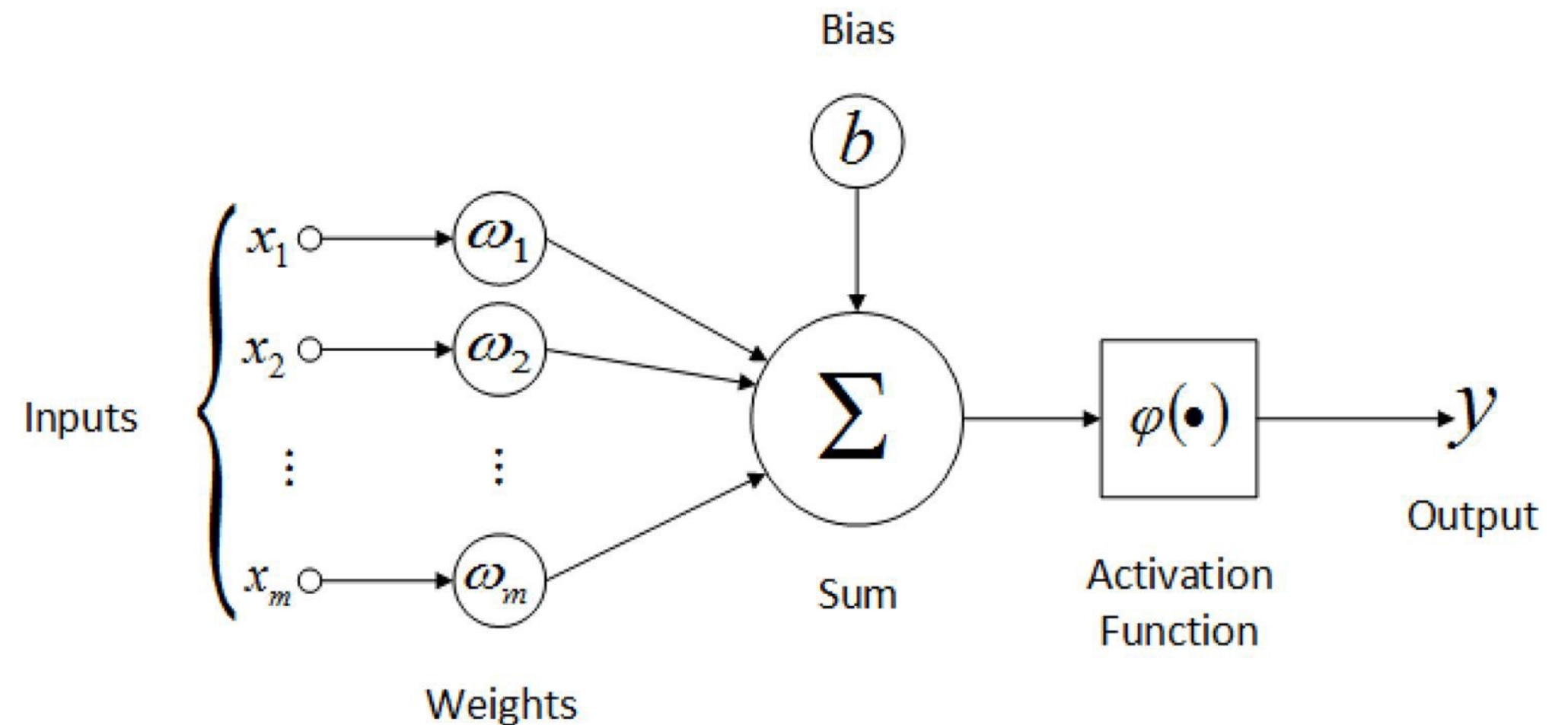


# Basic Computational Unit

Artificial neuron, often called a node or unit, receives input from some other neurons, or from an external source and computes an output.

Each input has an associated weight ( $w$ ), which is assigned on the basis of its relative importance to other inputs.

The node applies a function to the weighted sum of its inputs.



# Artificial neural network (ANN)

A network of artificial neurons (also known as "nodes")

These nodes are connected to each other.

The strength of their connections to one another is assigned a value based on their strength.

If the value of the connection is high, then it indicates that there is a strong connection.

The network is trained by iteratively modifying the strengths of the connections so that given inputs map to the correct response

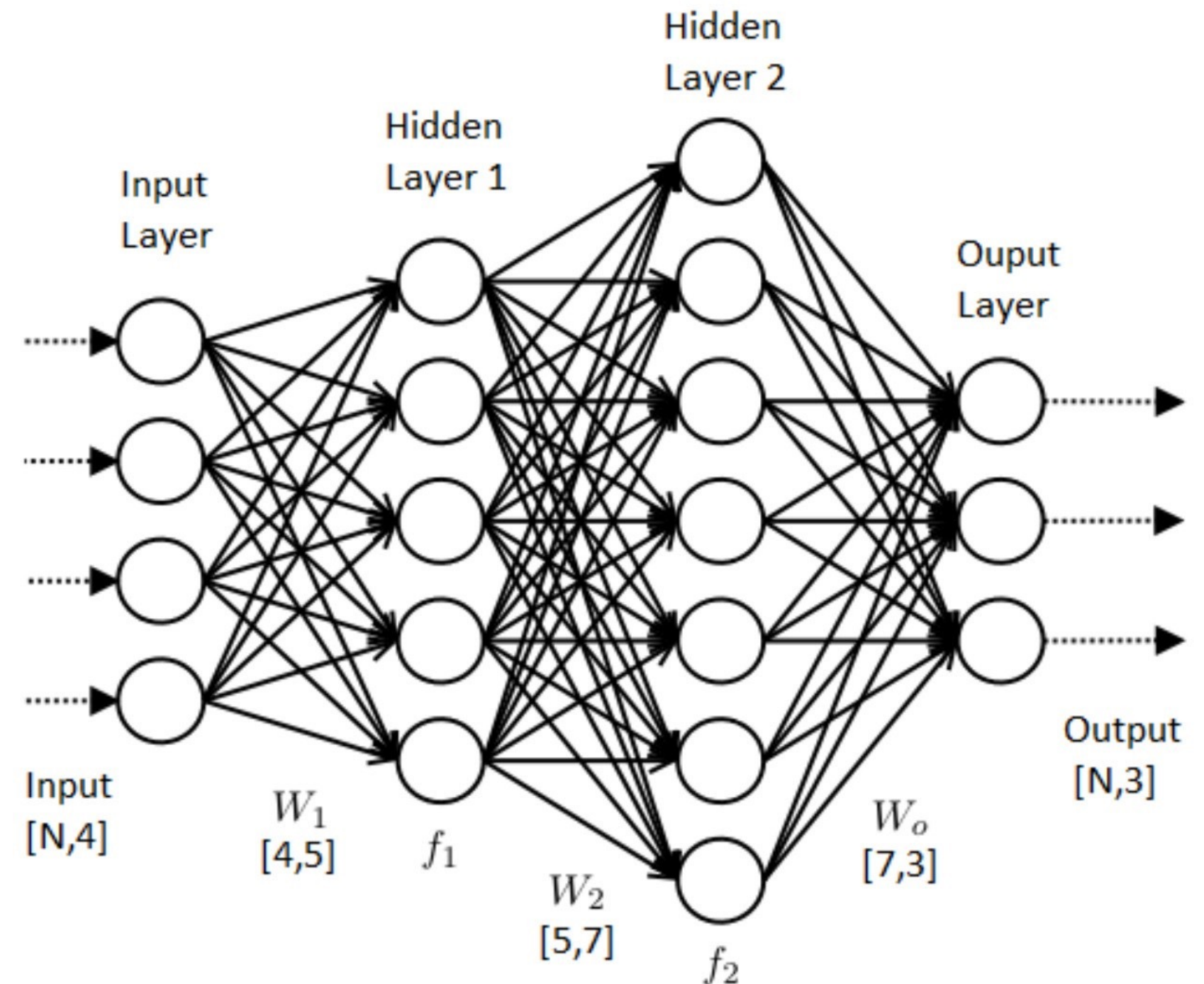


# Feedforward Neural Network

A feedforward neural network is an artificial neural network where connections between the units do not form a cycle.

In this network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) and to the output nodes.

No cycles or loops in the network.





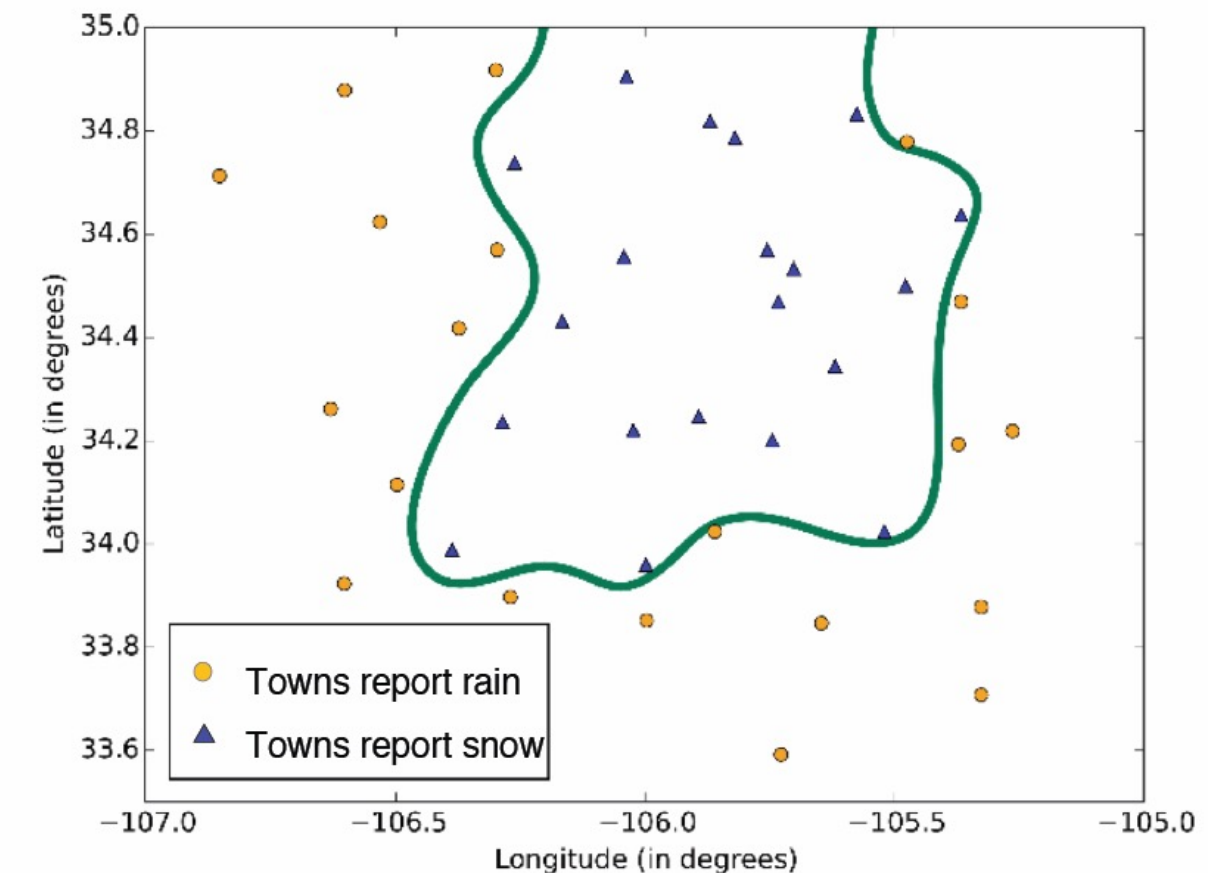
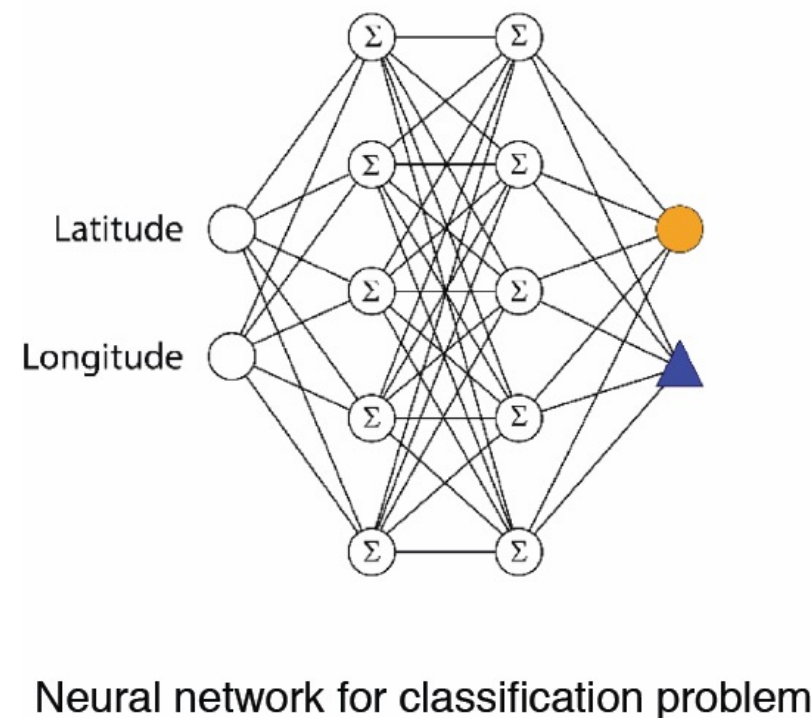
# Applications

For modeling highly nonlinear systems

When data is available incrementally and you wish to constantly update the model

When there could be unexpected changes in your input data

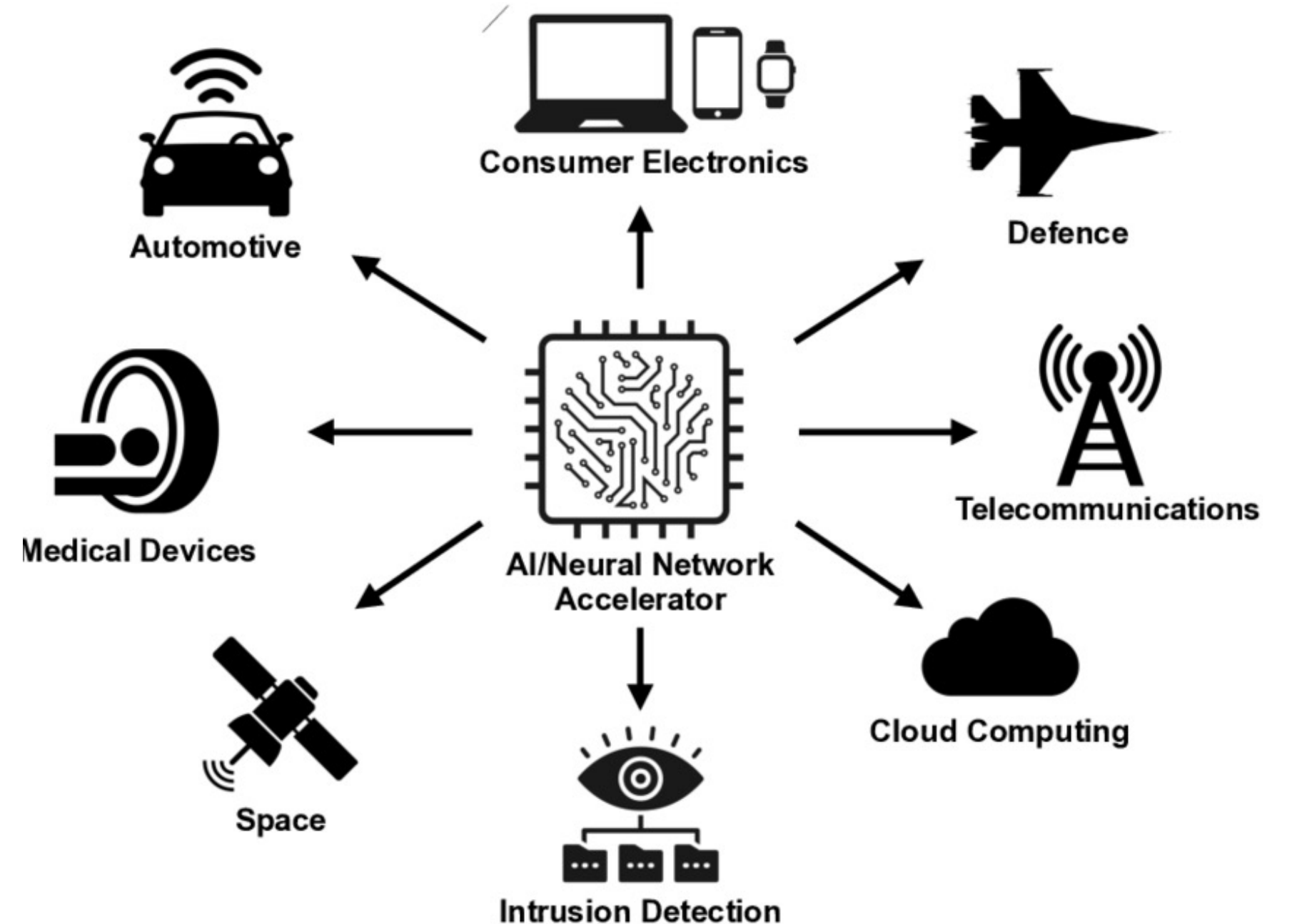
When model interpretability is not a key concern



# Applications

Applications in various domains and scenarios

- Auto-drive
- Communication
- Medicine
- ....





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# Thank You