Introduction to Deep Learning for Sequence-to-Sequence Forecasting in MATLAB

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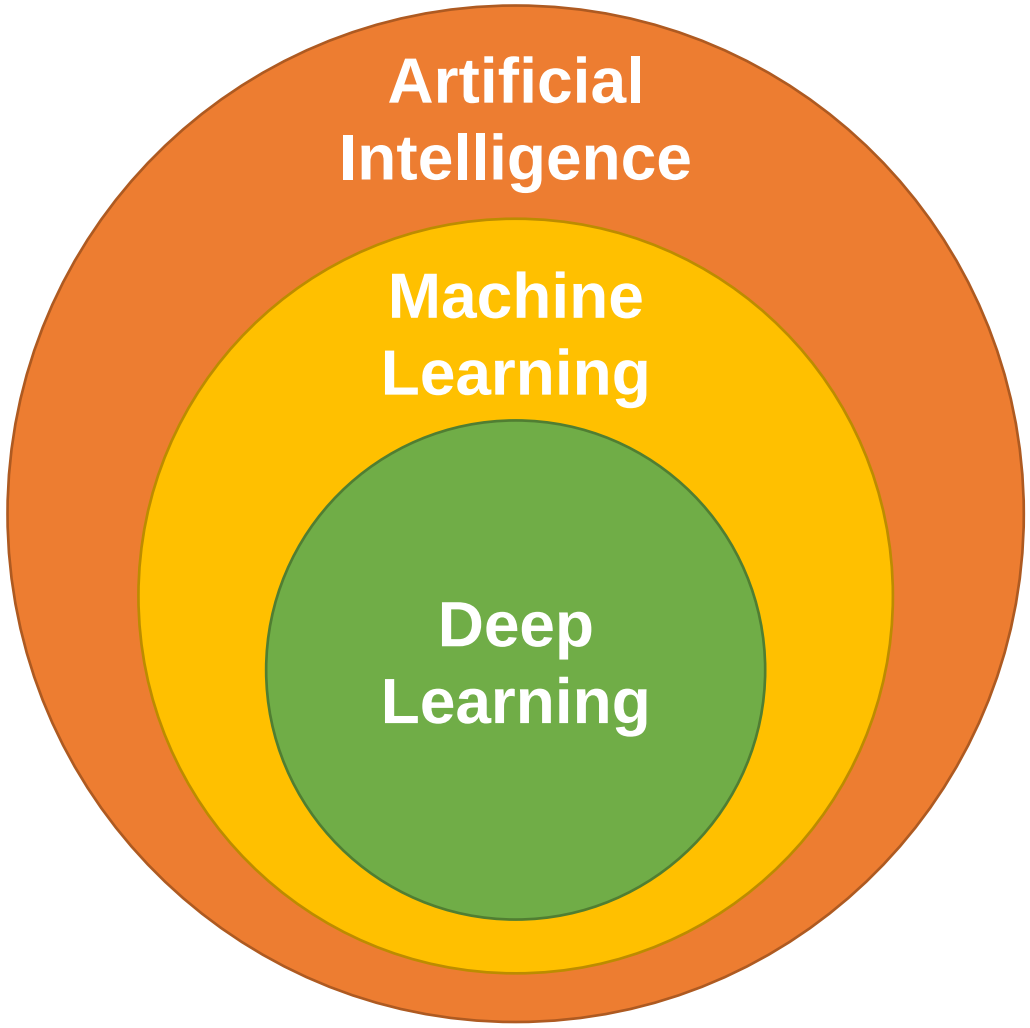
Machine Intelligence

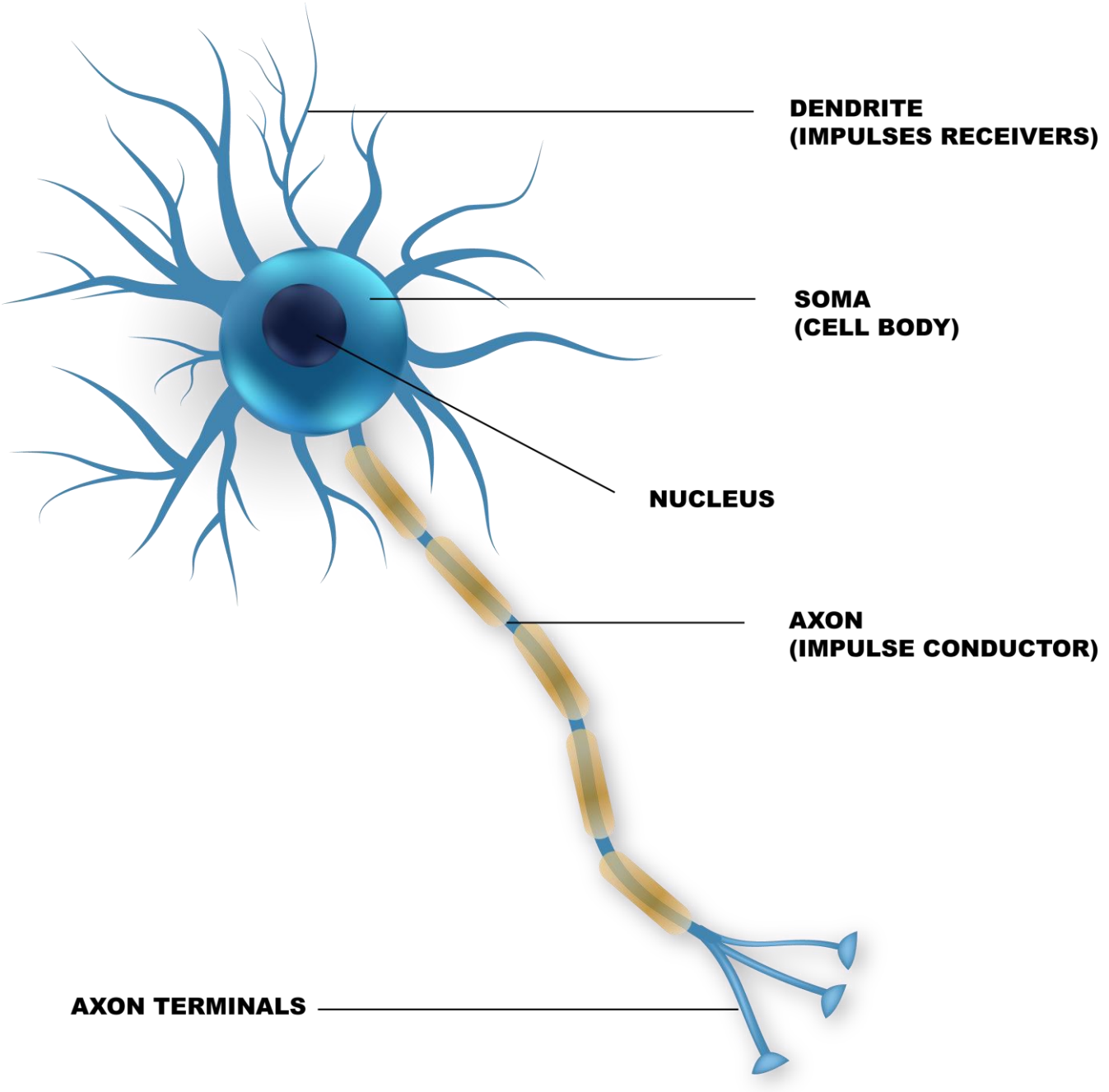


Intelligence demonstrated by **machines**.

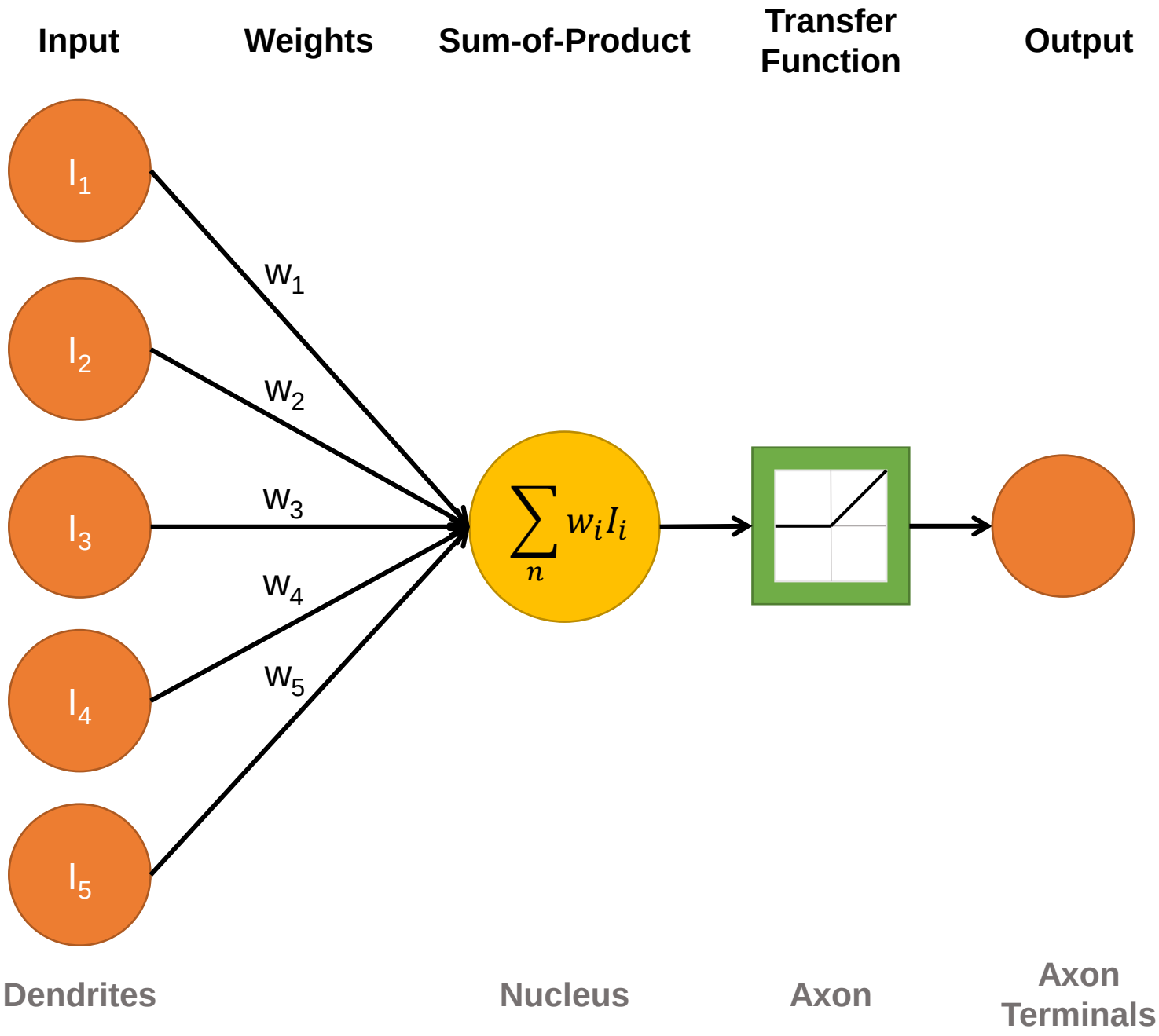
The **study of algorithms and statistical models** that machines use for specific tasks relying on patterns.

Machine learning methods based on artificial neural networks with knowledge representation learning.

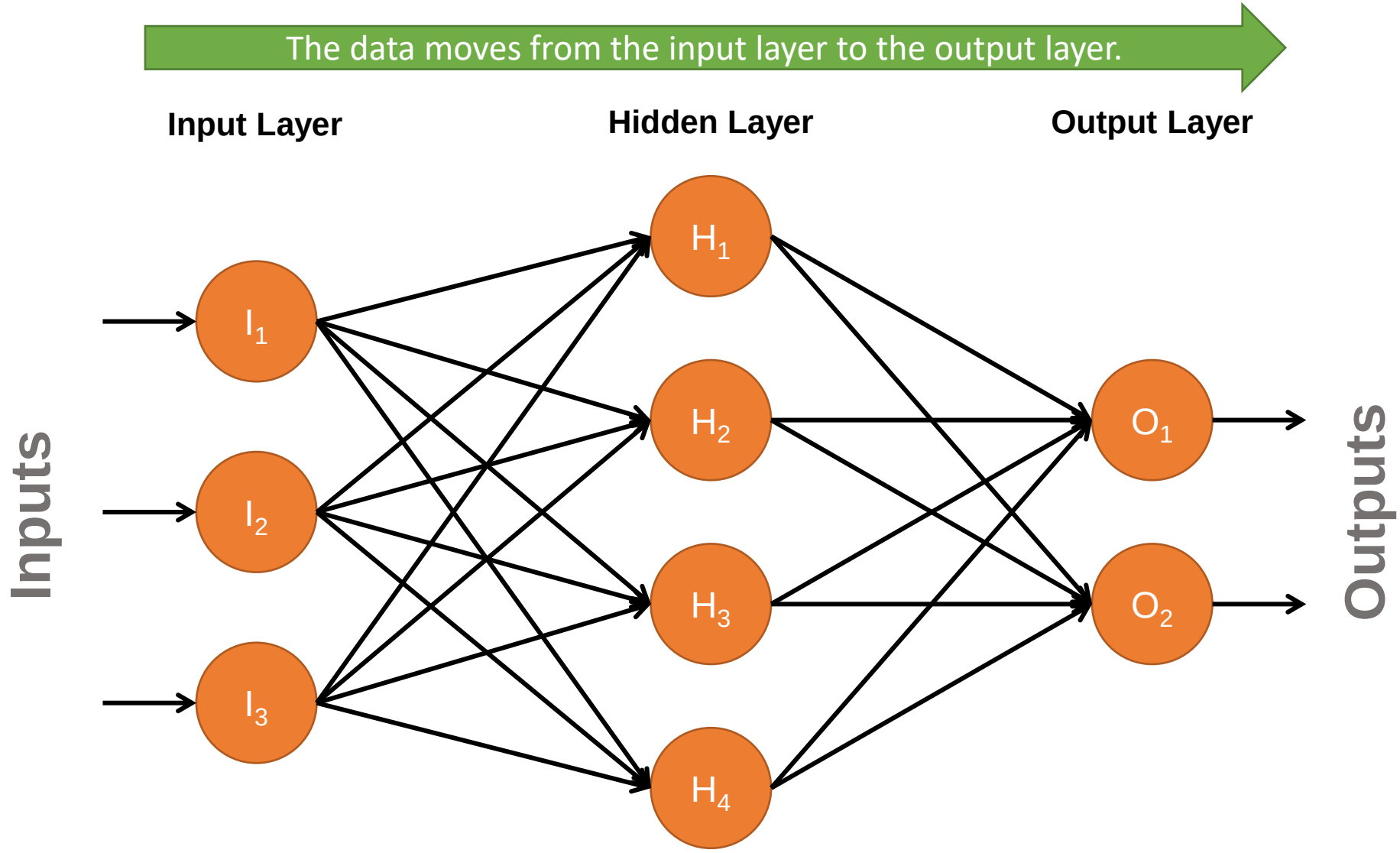
The Animal Neuron



The Artificial Neuron Model



Feedforward Neural Network



Backpropagation

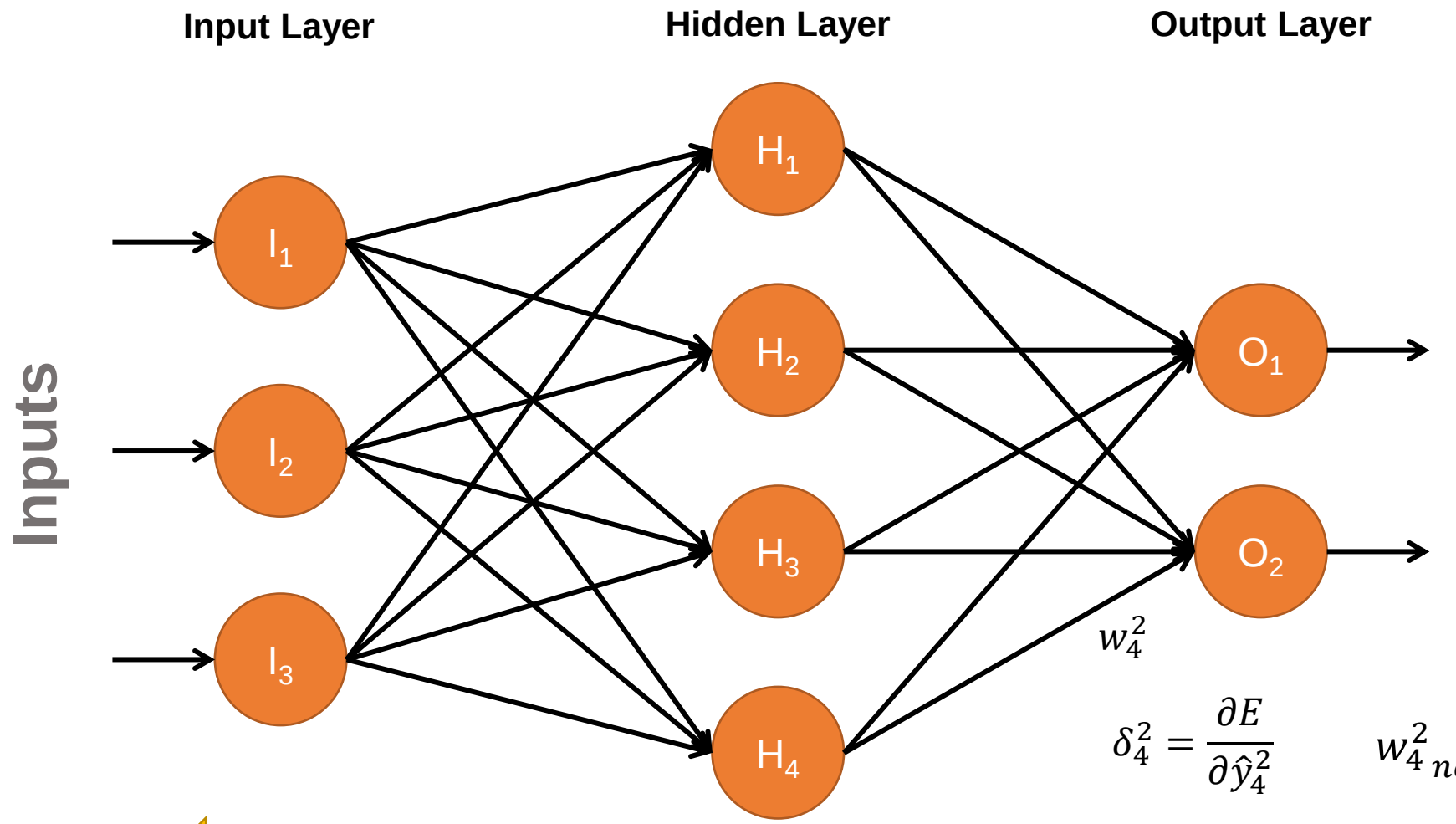
Backpropagation algorithm is the most fundamental building block of neural networks.

The algorithm is used to effectively train a neural network through a method called **chain rule**.

Backpropagation aims to **minimize the loss function** by adjusting the network's weights.

The level of adjustment is **determined by the gradients** of the loss function with respect to those parameters.

Backpropagation *(Cont.)*



$$E = \overbrace{(y - \hat{y}_j^l)}^{e}{}^2$$

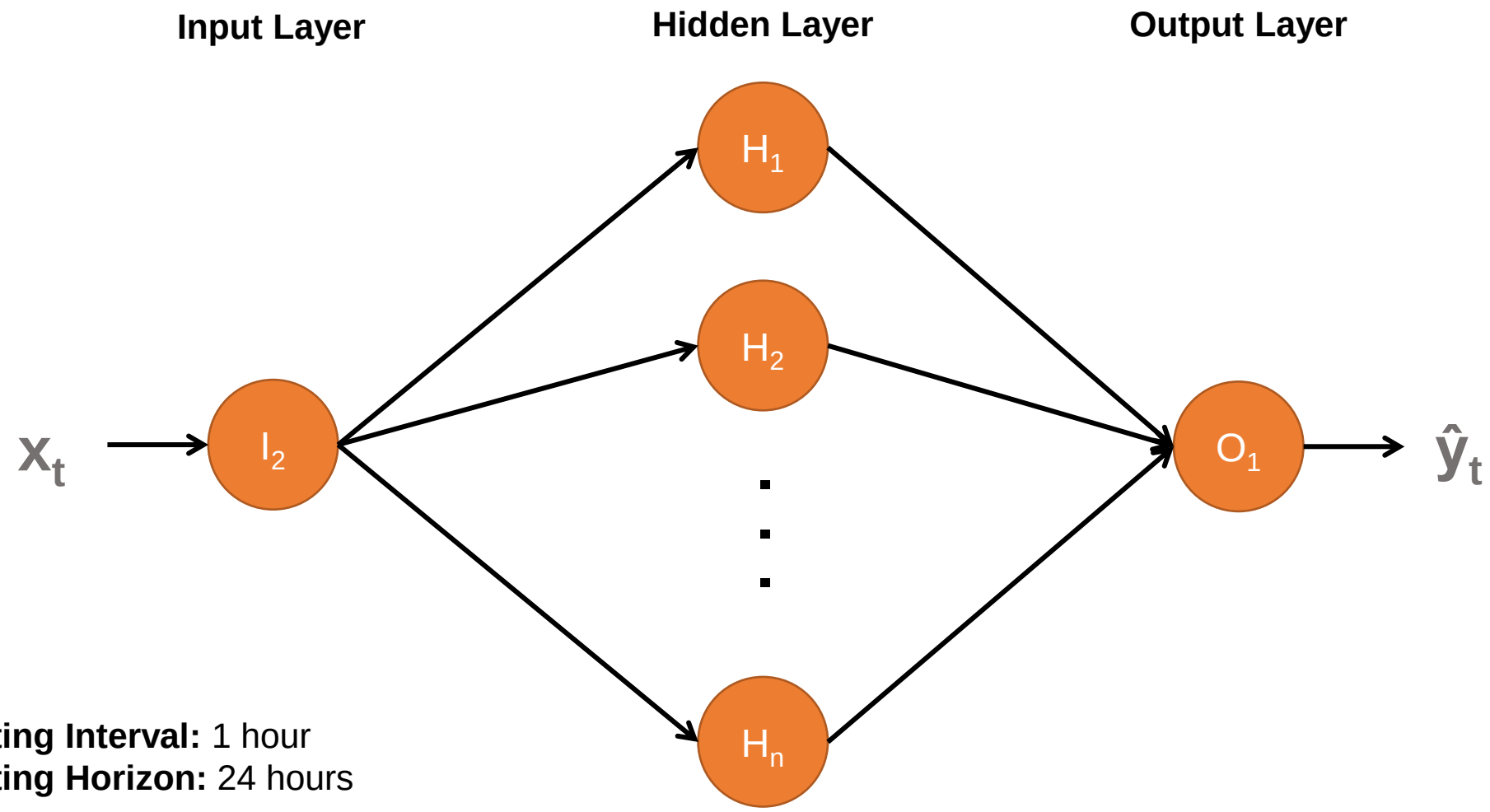
w_4^2

$$\delta_4^2 = \frac{\partial E}{\partial \hat{y}_4^2}$$

$$w_{4\,new}^2 = w_{4\,old}^2 - \alpha\delta_4^2$$

The errors moves from the output layer to the input layer.

Fully-Connected Neural Network Architecture



Forecasting Interval: 1 hour
Forecasting Horizon: 24 hours

MATLAB Example

- **Collect historical data**
  - Global Solar Radiation (Input) and Photovoltaic Power (Output)
- **Pre-process historical data**
  - Standardization
- **Build models**
  - Fully-Connected Neural Network
- **Identify parameters**
  - Epochs, learning rate and its drop factor, and batch size
- **Forecast load**
- **Analyze performance**
  - MAPE, RMSE, MAE, Plot Actual and Forecasted Curves