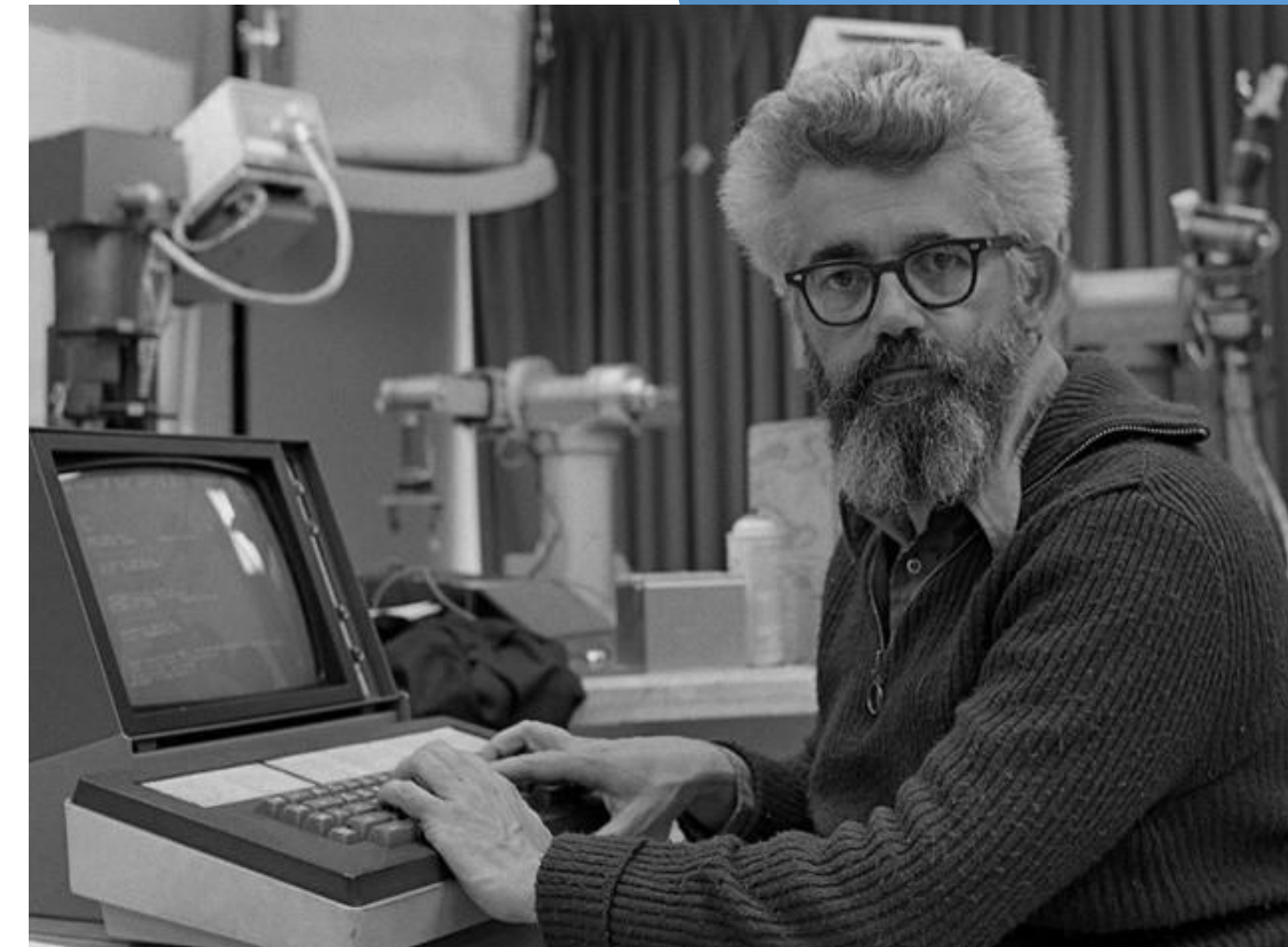


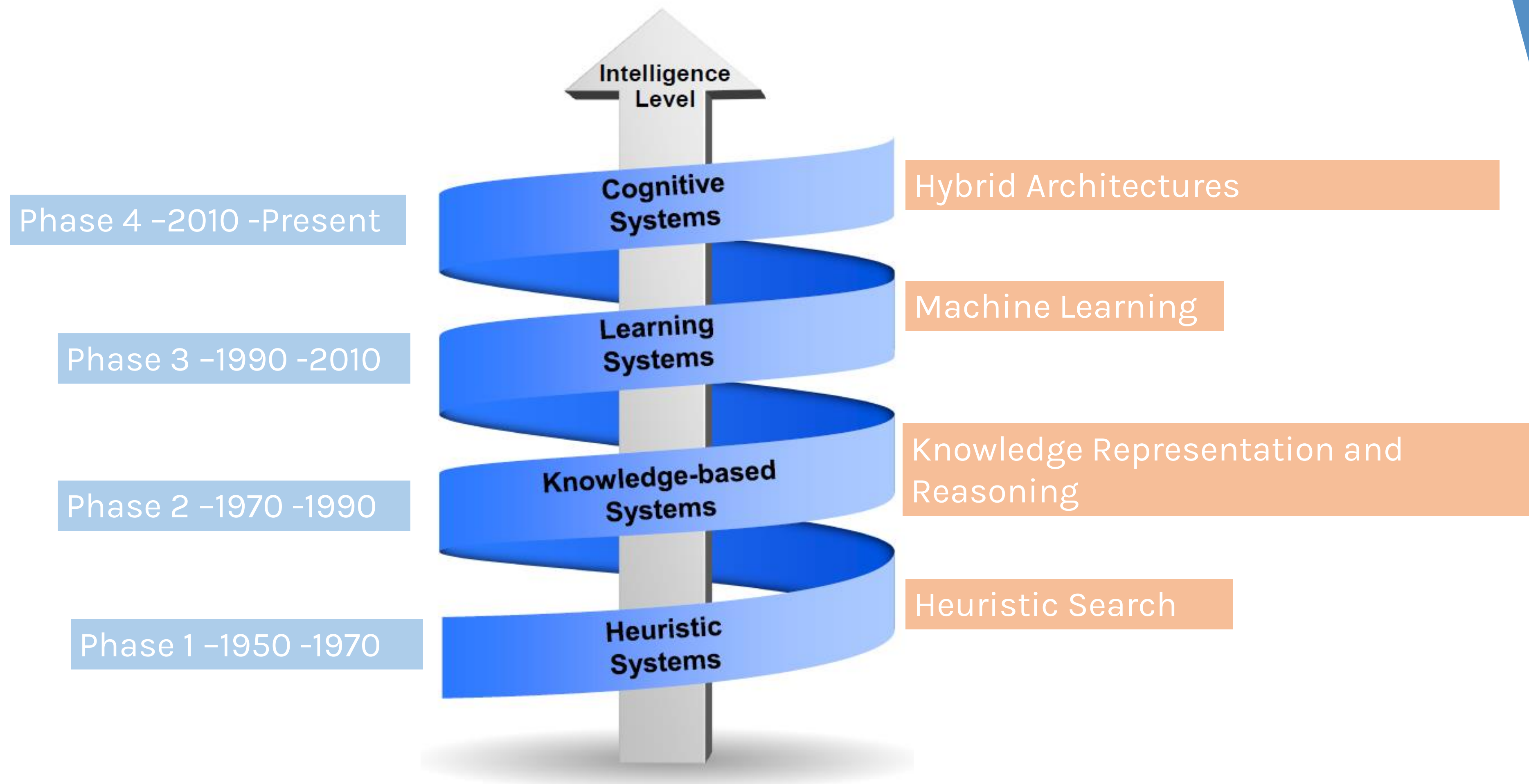
Introduction to AI and Machine Learning

What is Artificial Intelligence ?

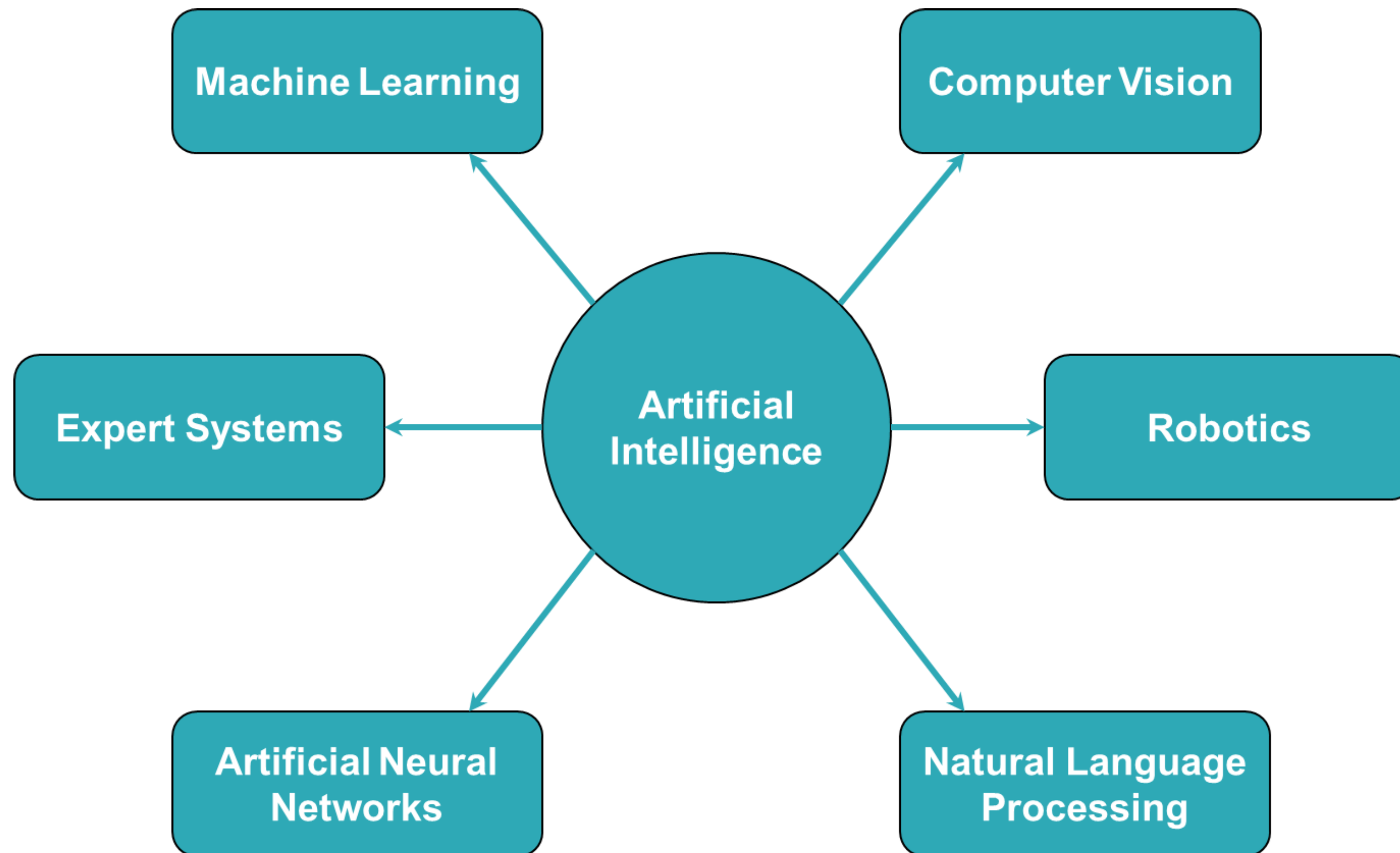
- “The science and engineering of making intelligent machines, especially intelligent computer programs”.
 - John McCarthy



Four Phases of AI Research

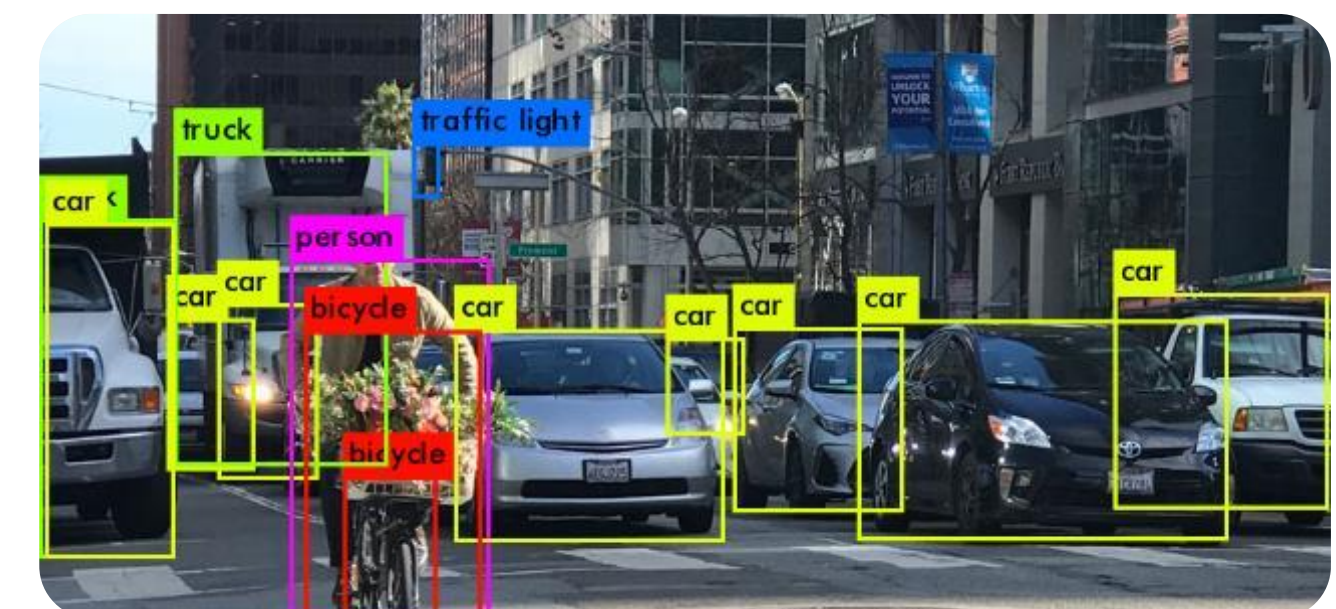
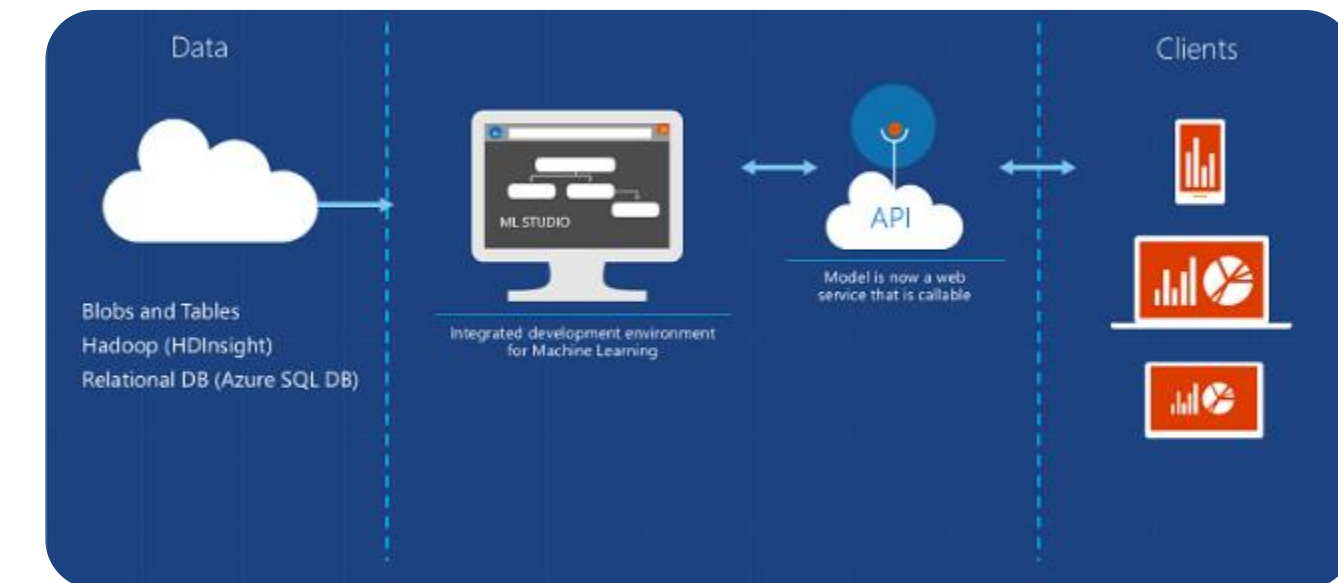
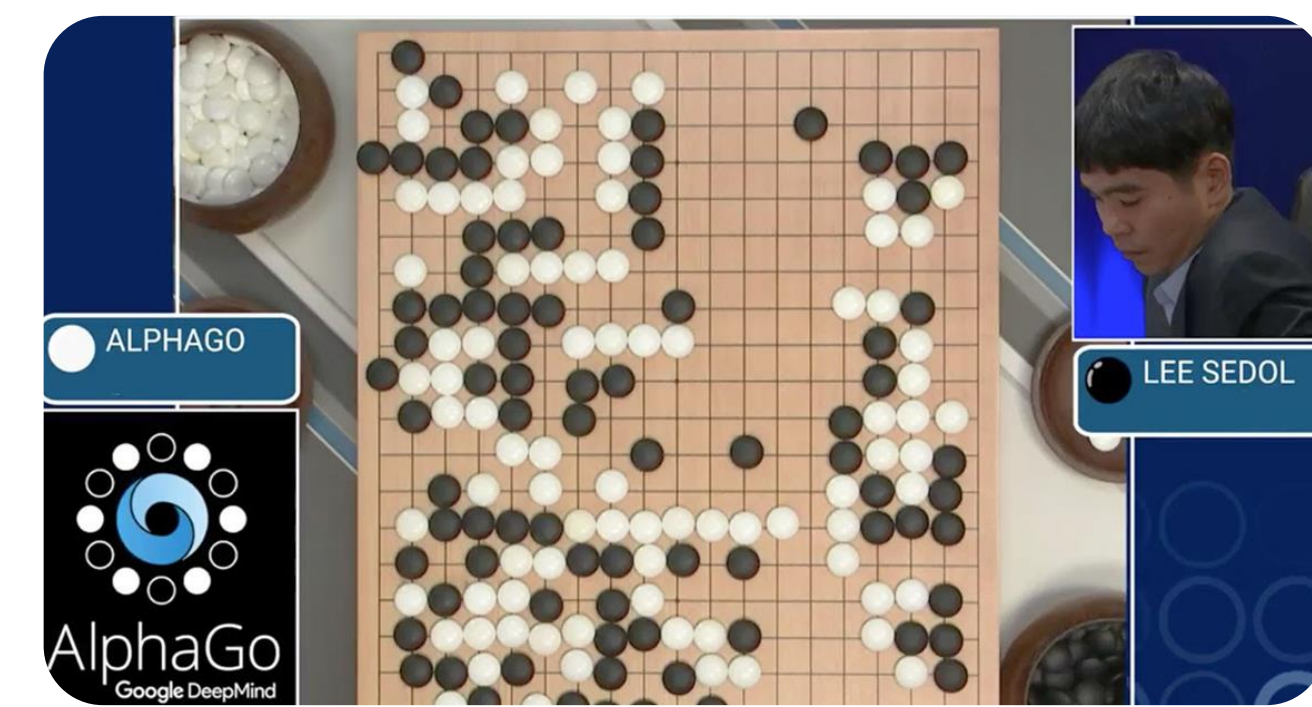


Branches of Artificial Intelligence



Applications of AI

- Game Playing
- Expert Systems
 - Chatbot
 - Personal Assistant
- Data Analytics
- Object Detection
- Self-Driving Cars



Machine Learning

What is Machine Learning?

- Subfield of artificial intelligence
 - Concerned with techniques that allow computers to “learn”.
 - Without being explicitly programmed.

What is Machine Learning?

Data

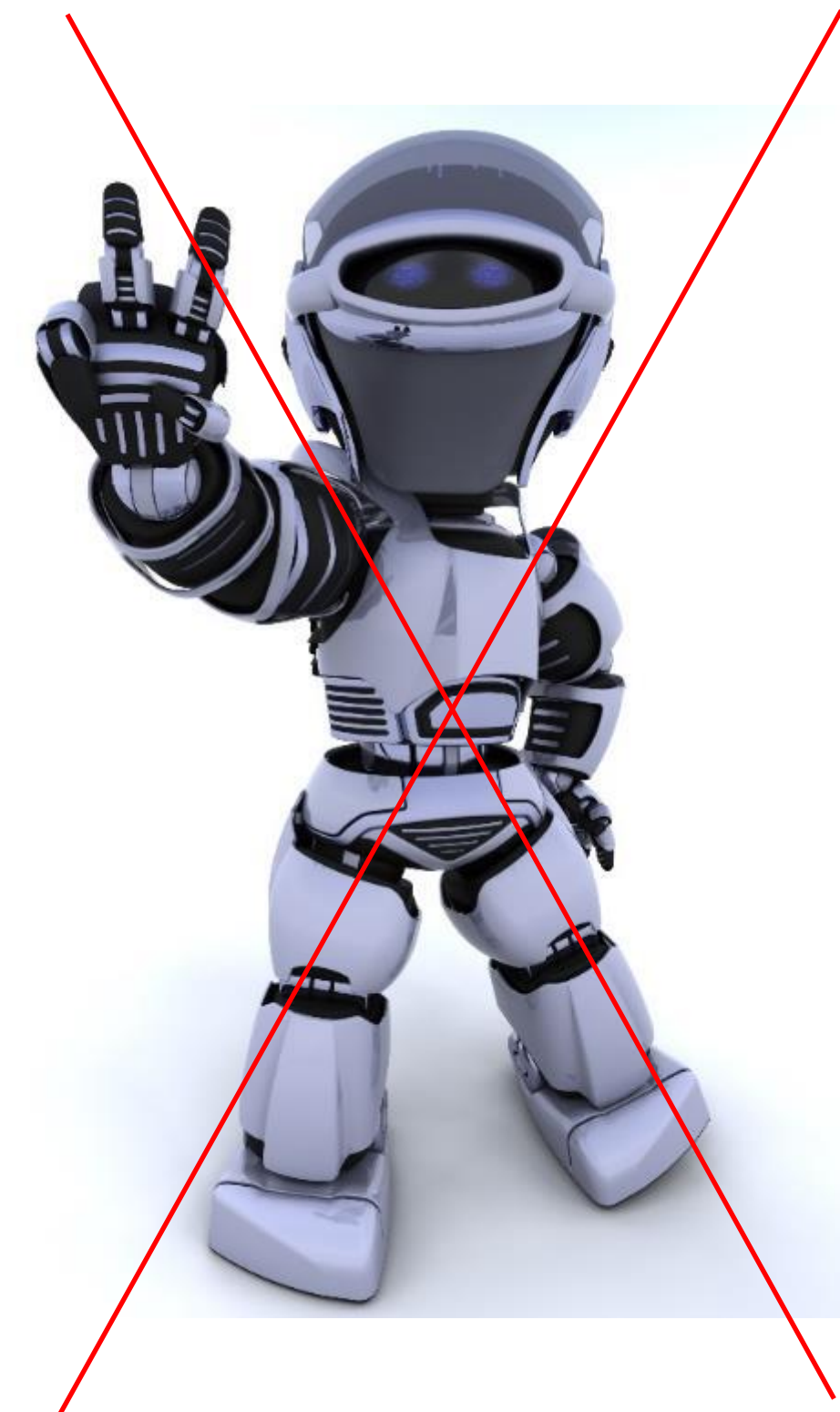
Learn from experience



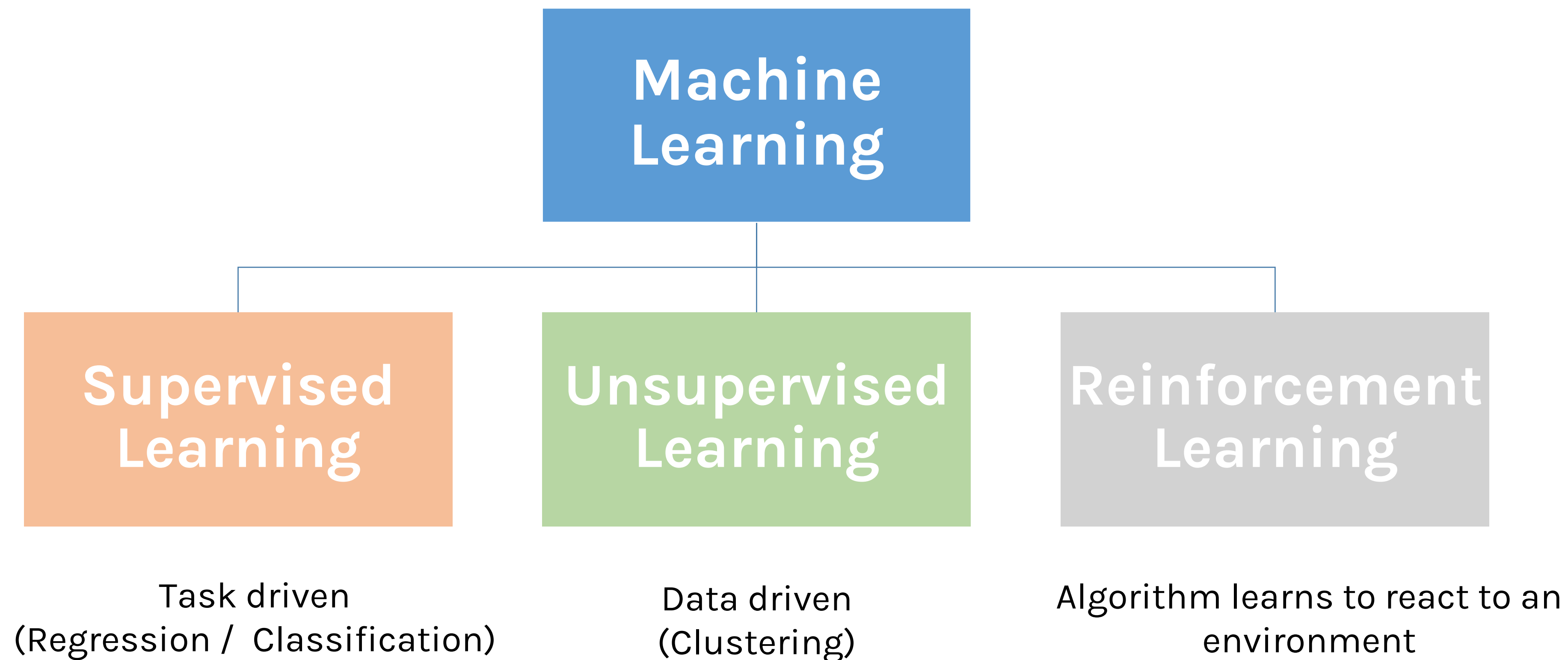
Learn from experience



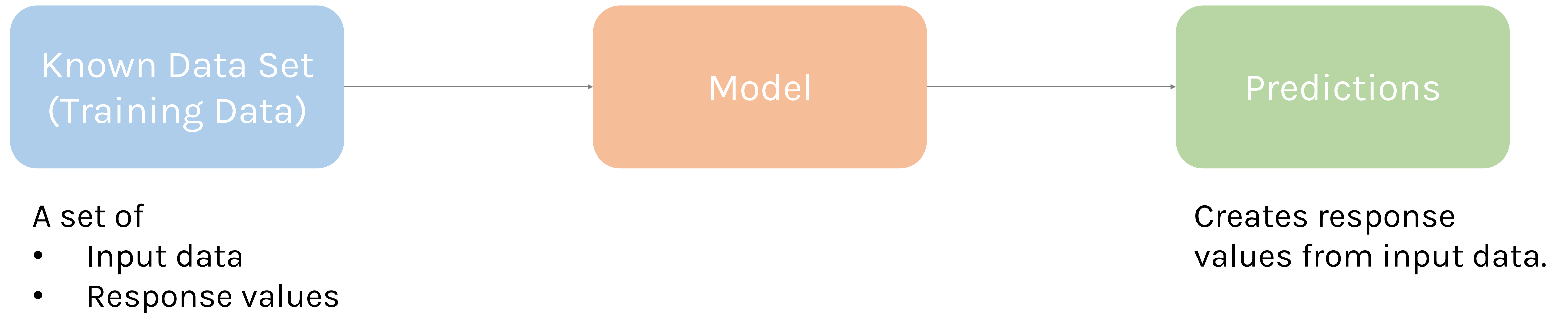
Follow instructions



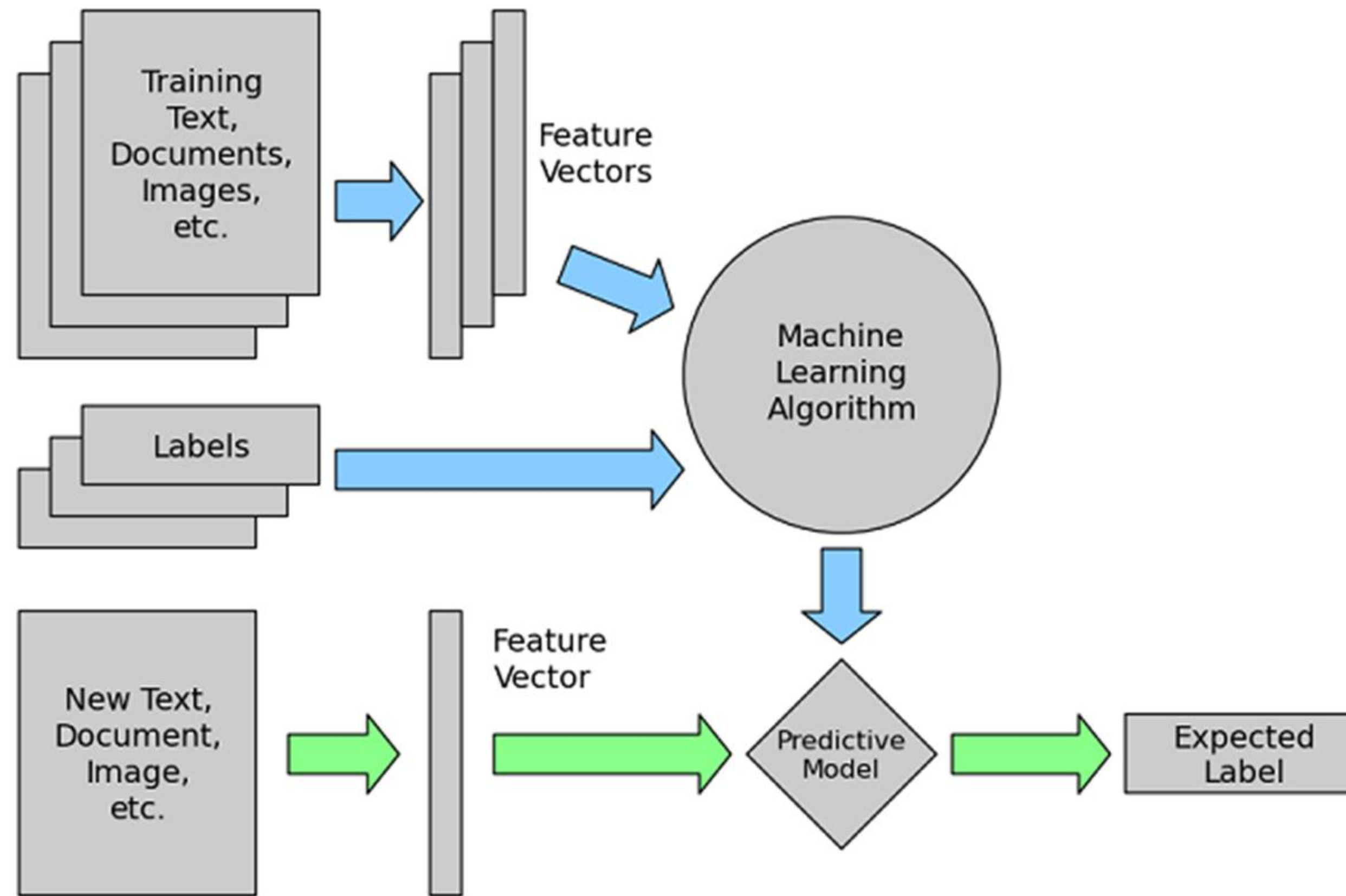
Types of Machine Learning



Supervised Learning Concept



Detailed Concept



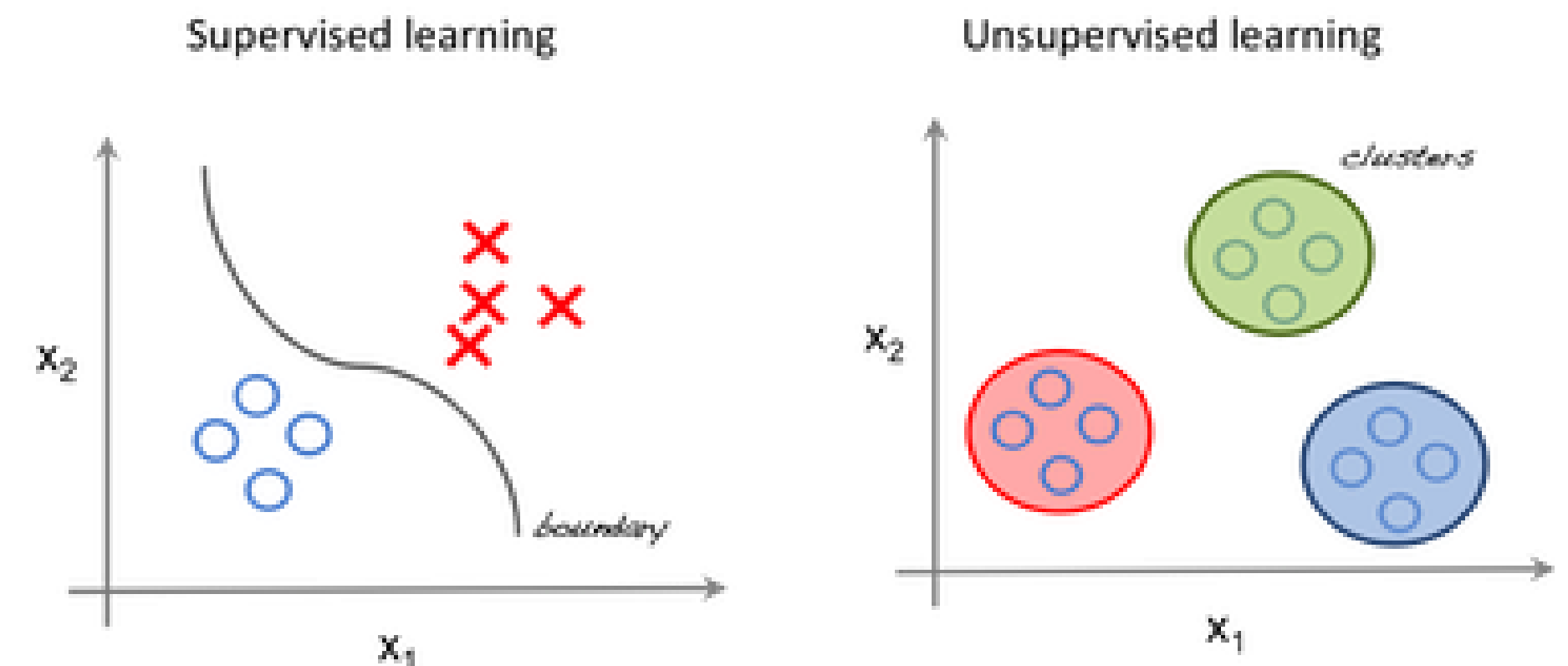
Types of Supervised Learning

Supervised learning can be separated into two general categories of algorithms:

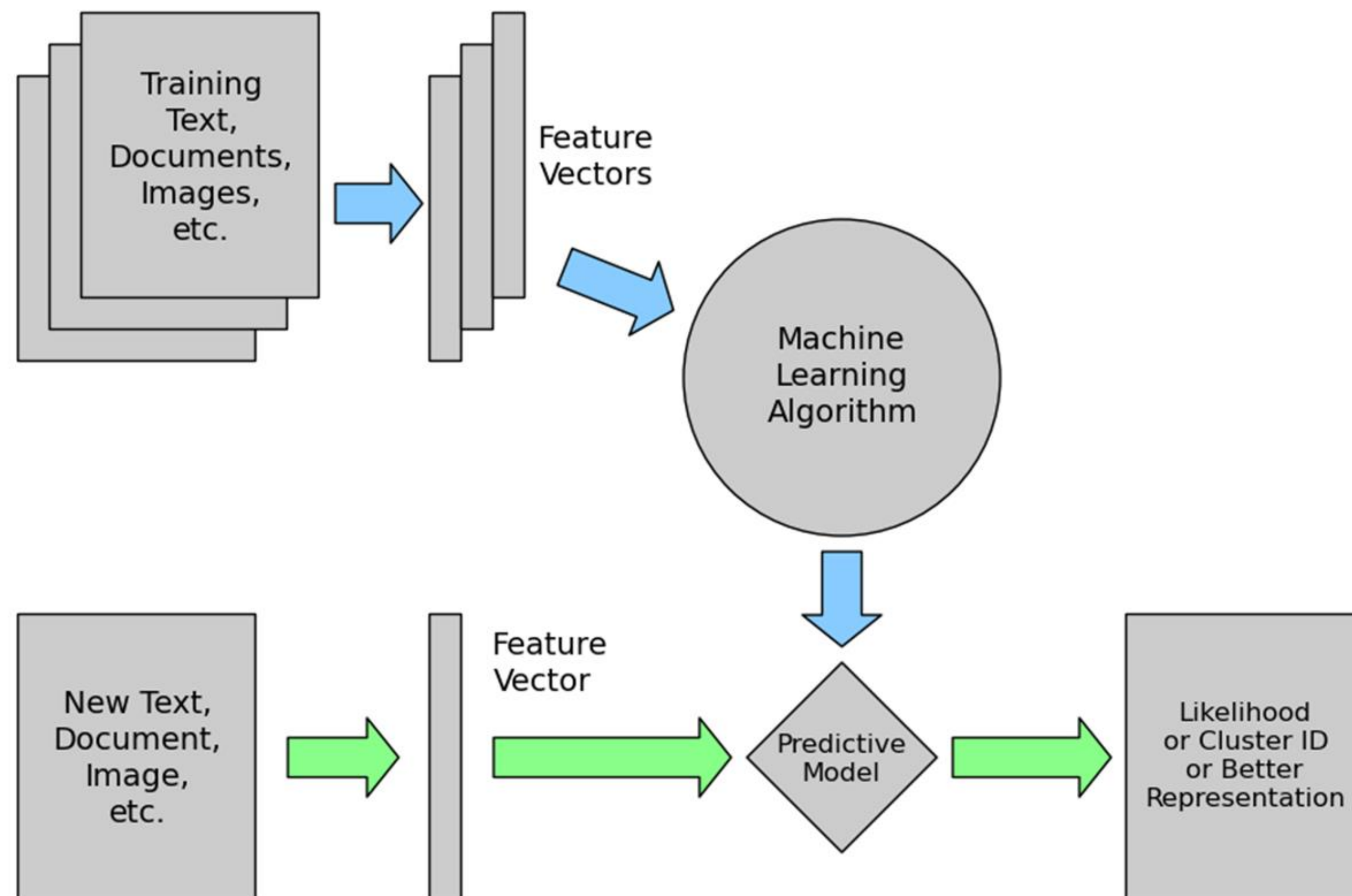
- **Classification:**
 - Categorical response values, where the data can be separated into specific “classes”
- **Regression**
 - Continuous-response values

Unsupervised Learning

- Operates on **unlabeled** examples.
 - Correct responses are not provided
- The algorithm tries to identify **similarities** between the inputs
 - Inputs that have something in common are categorized together.
- This is called **clustering**.



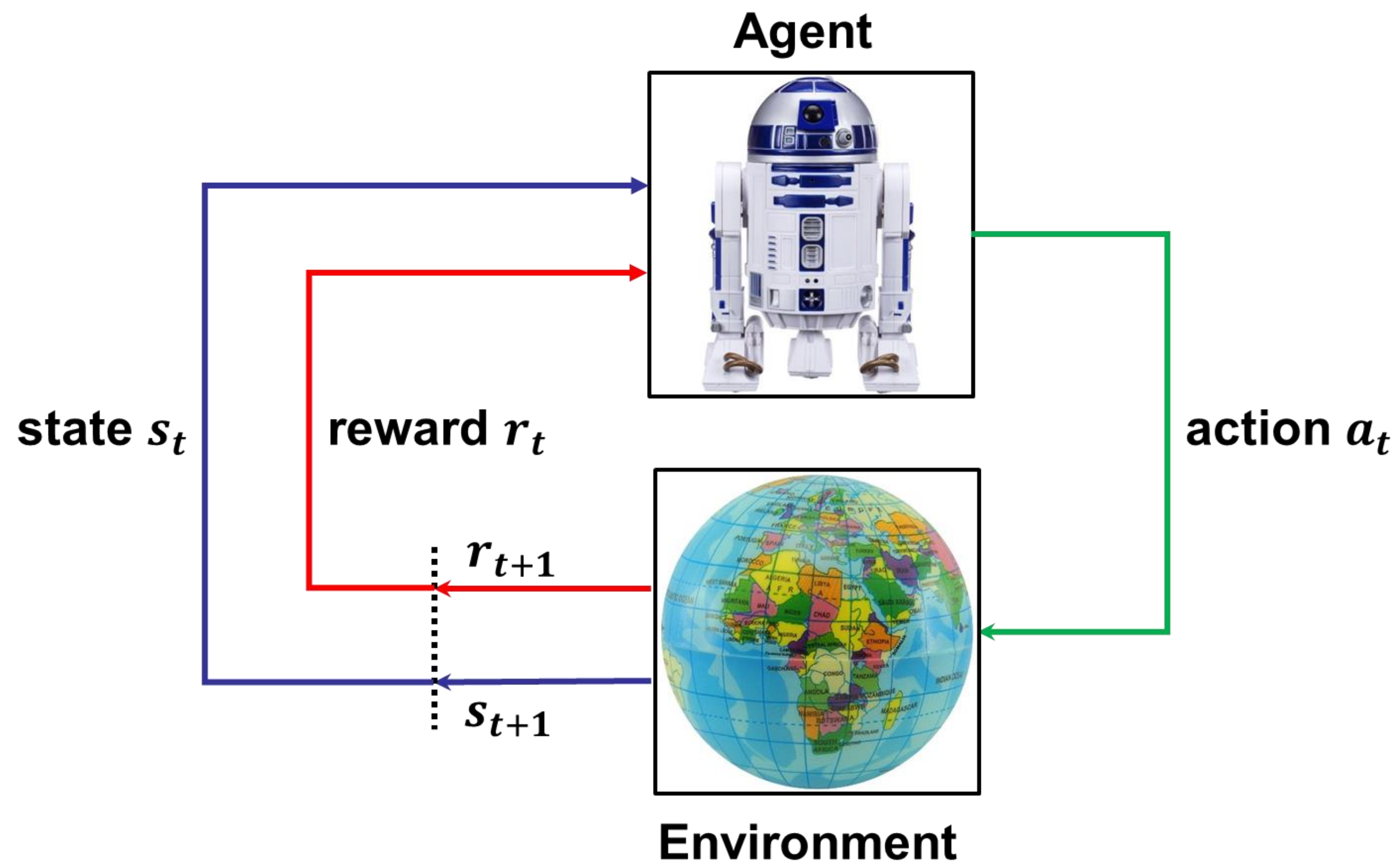
Unsupervised Learning



Reinforcement Learning

- Type of ML that interacts with the **environment**
 - Learns which sequence of actions yields the most favorable results.
- The learner is a decision-making **agent** that takes actions in an environment
 - Receives reward (or penalty) for its actions.
- After a set of trial-and-error runs, it should learn the best **policy**
 - The sequence of actions that maximize the total reward.

Reinforcement Learning

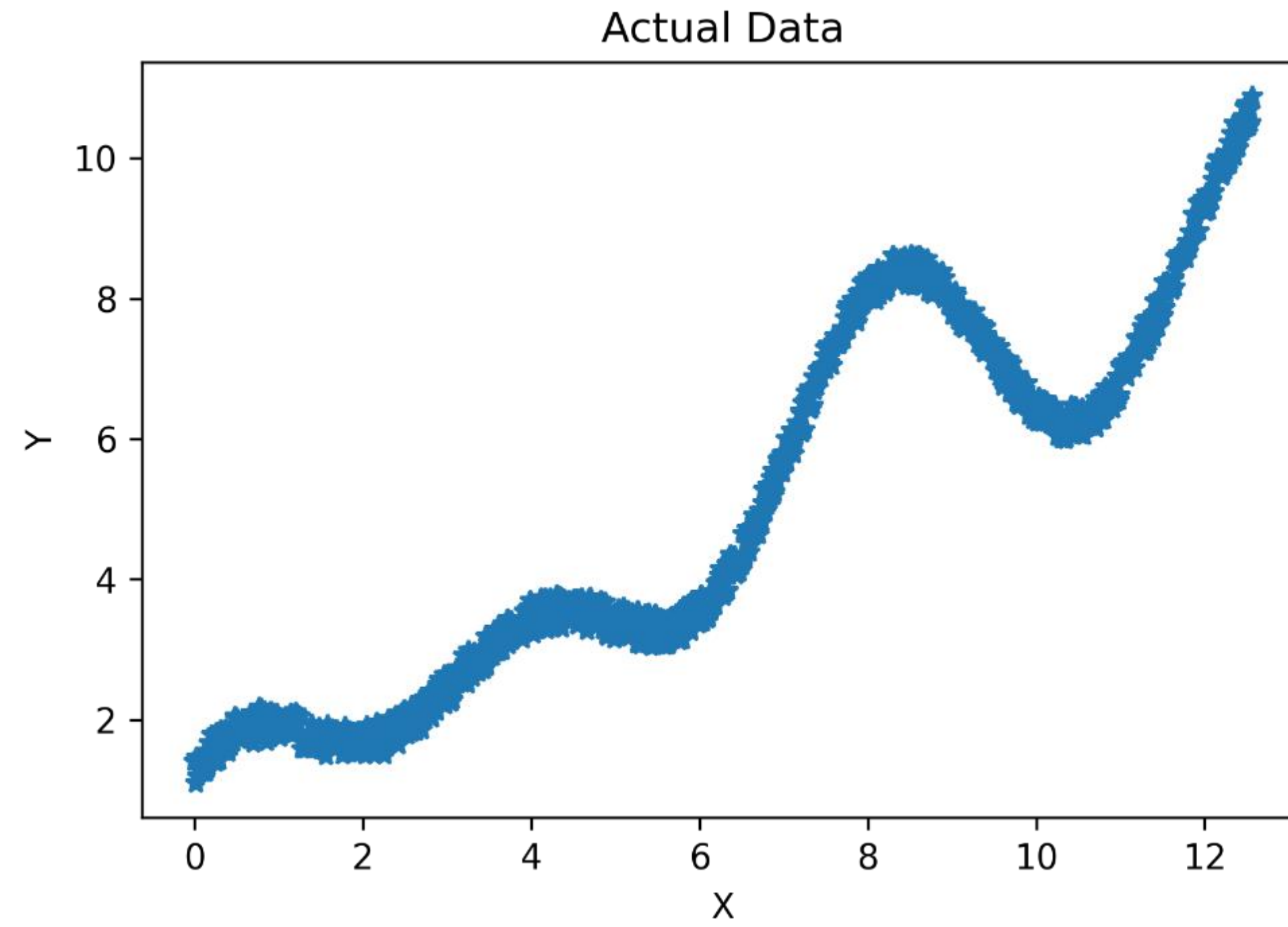


Mario Reinforcement Learning

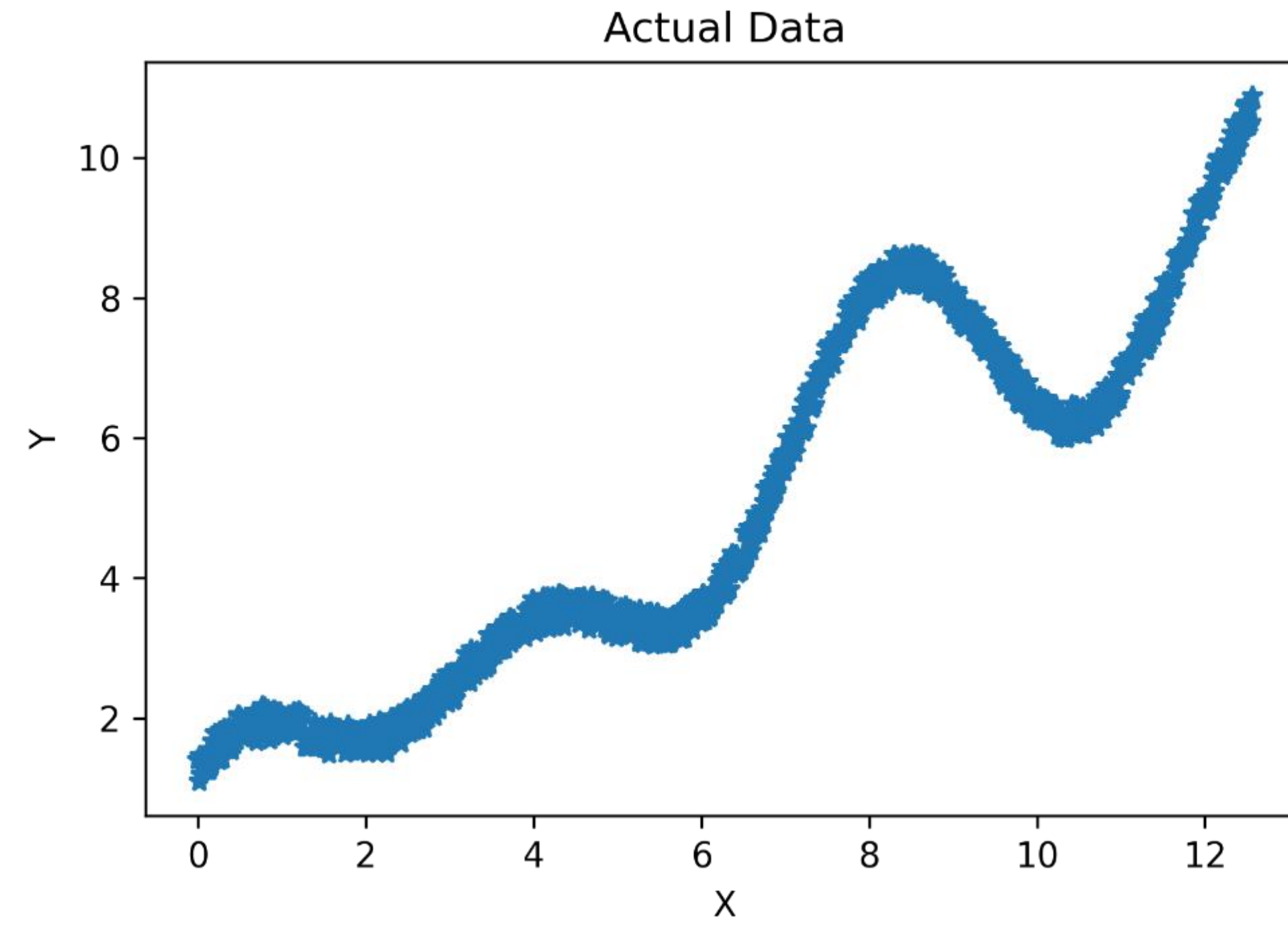
<https://youtu.be/qv6UV0Q0F44>



Artificial Neural Network

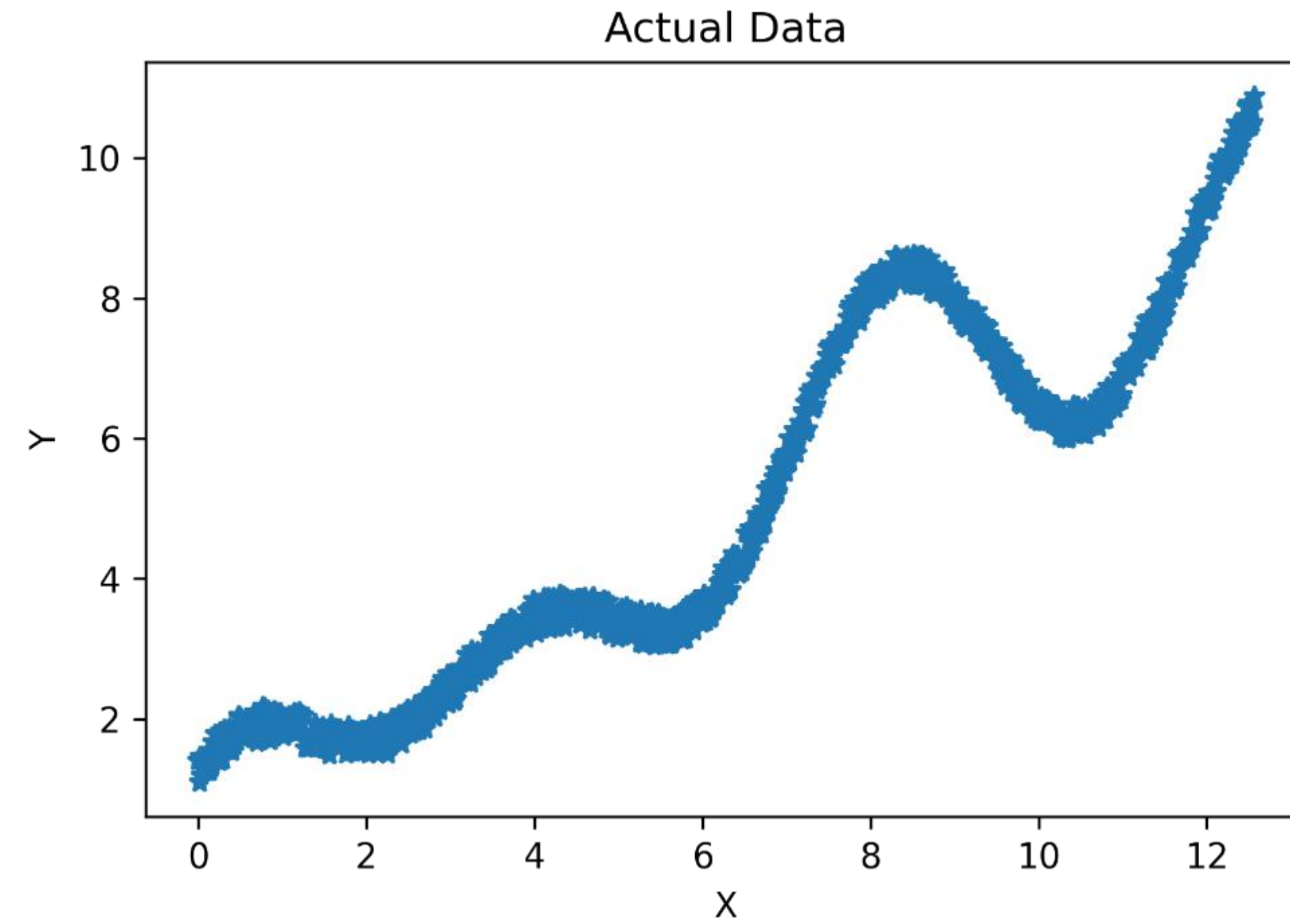


How do we fit a line to this data?



$$y = f(x)$$

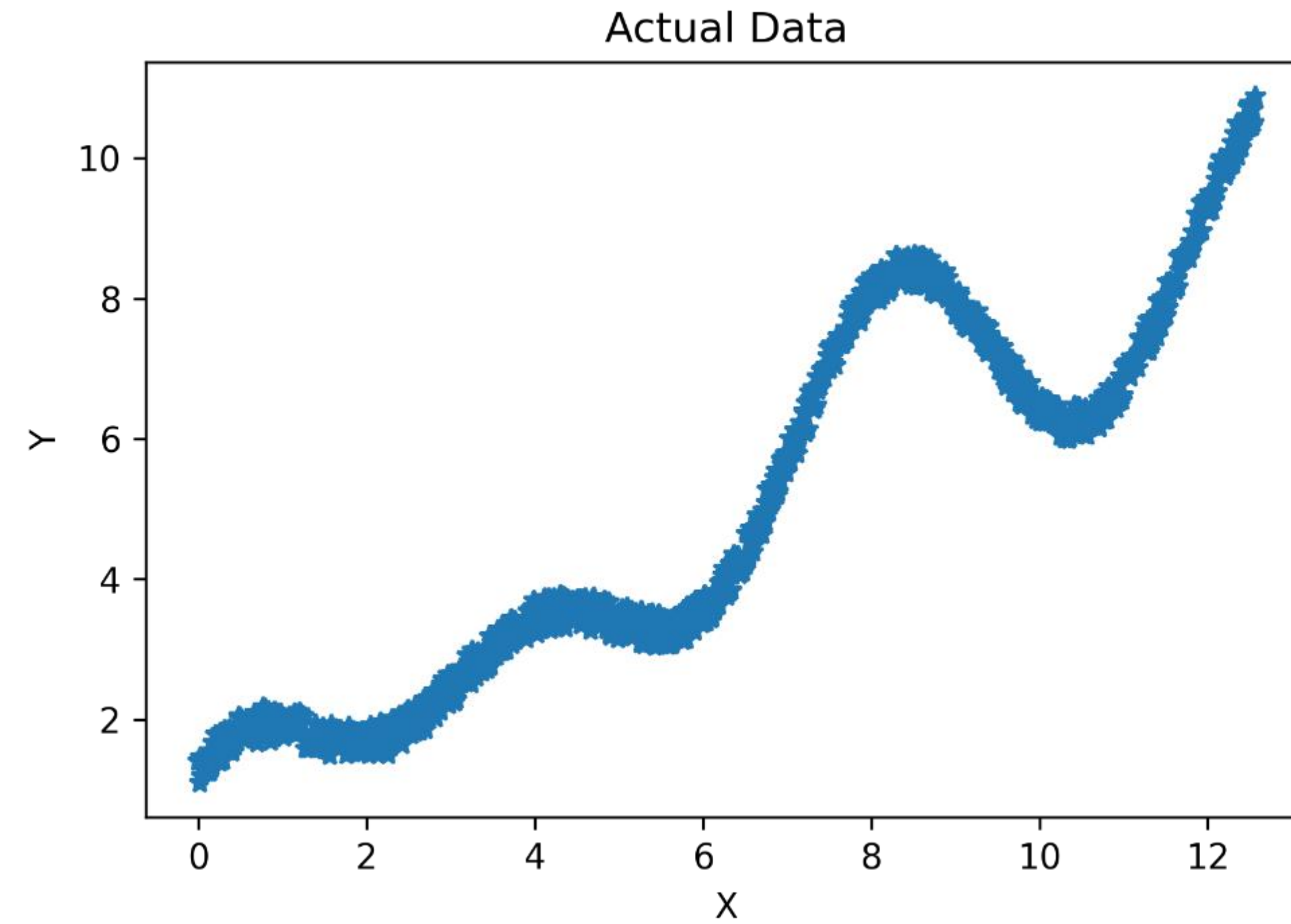
$$y = a_0 + a_1x + a_2x^2 + \dots$$



$$y = f(x)$$

$$y = a_0 + a_1x + a_2x^2 + \dots$$

$$y = a_0 + a_1 \sin(x) + a_2 \sin(2x) + \dots$$



$$y = f(x)$$

$$y = a_0 + a_1x + a_2x^2 + \dots$$

$$y = a_0 + a_1 \sin(x) + a_2 \sin(2x) + \dots$$

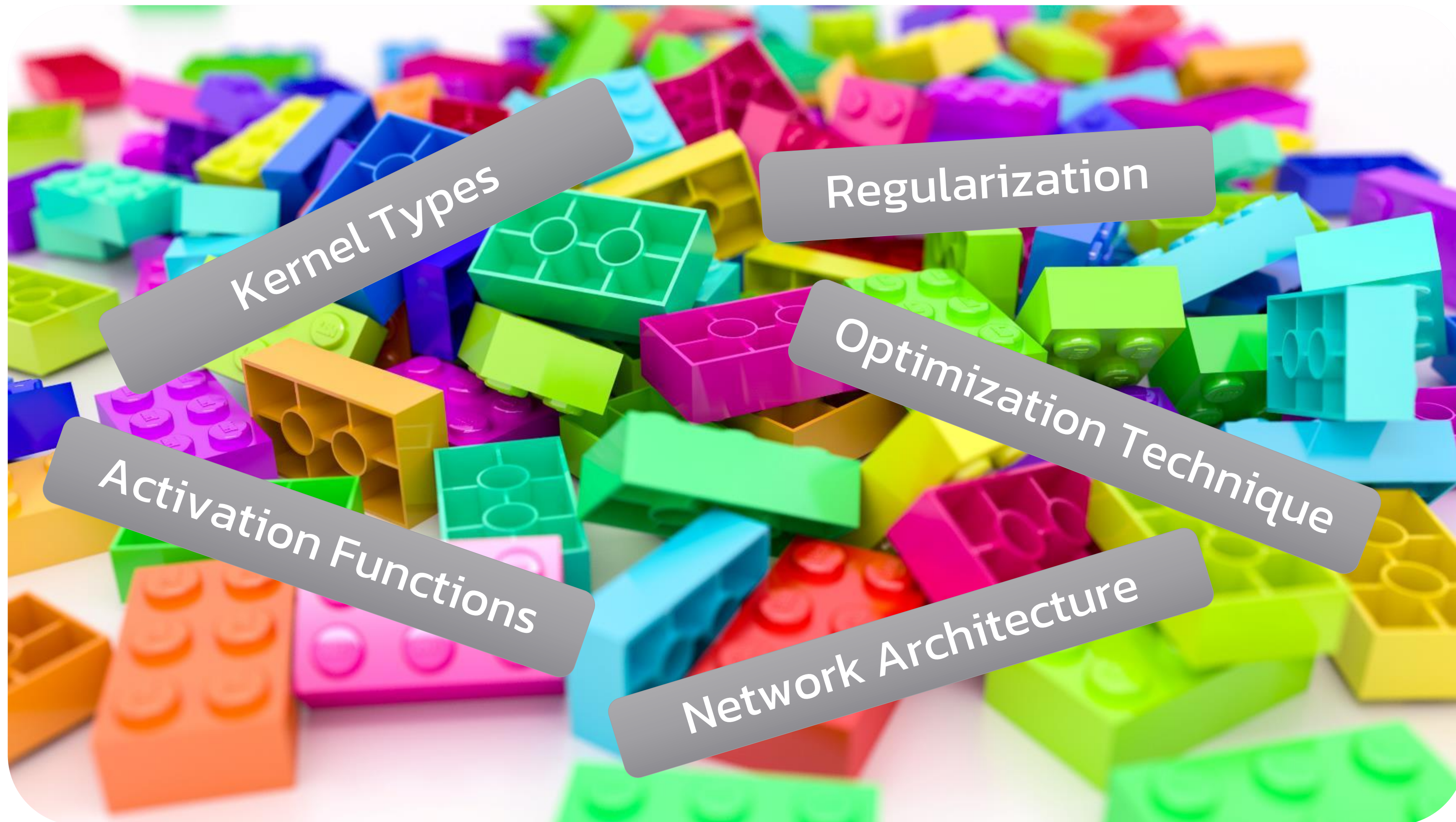
Artificial Neural Network

Universal Approximator

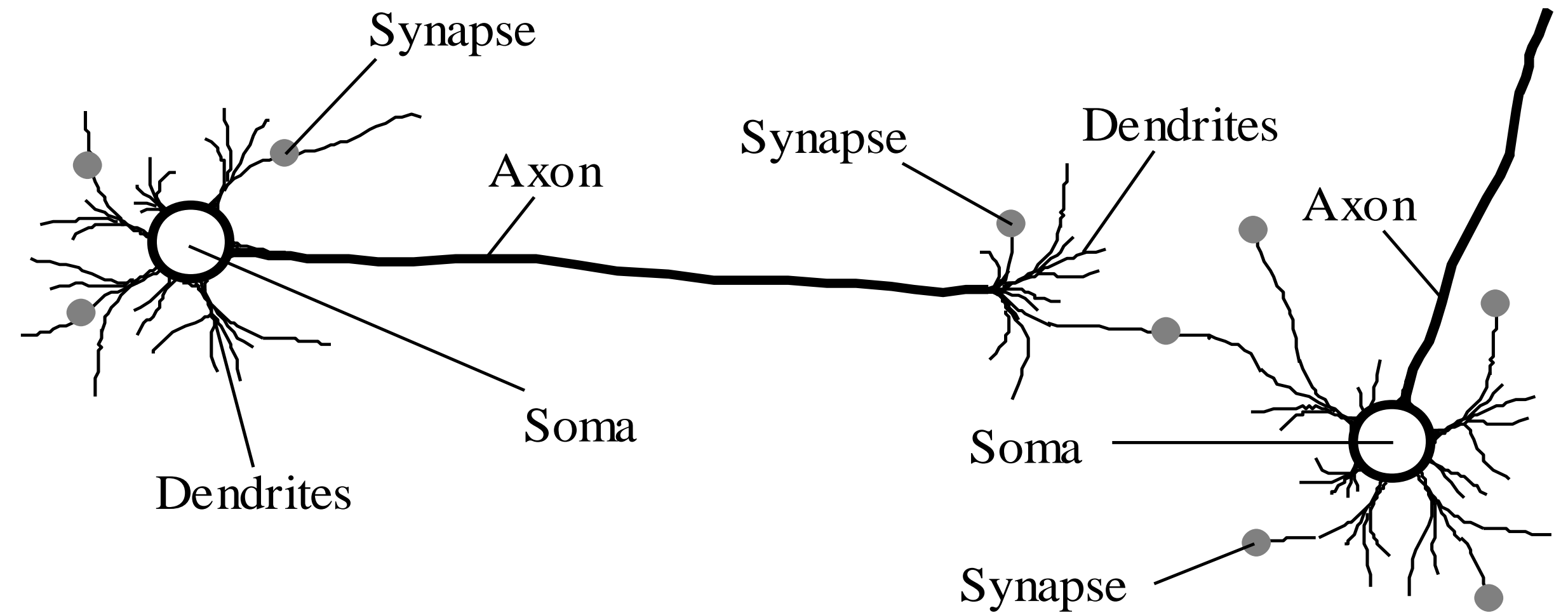
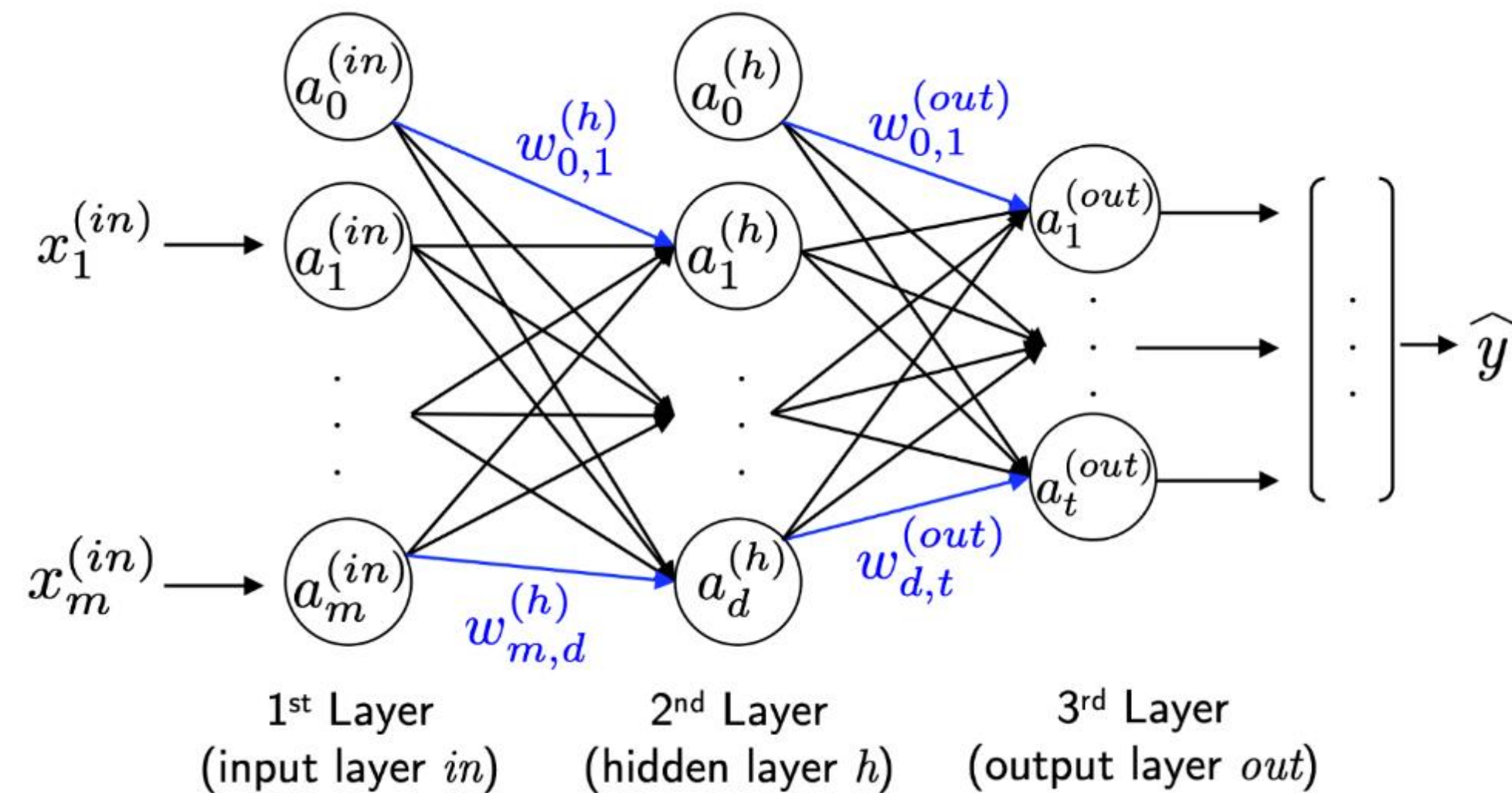
Artificial Neural Network



Artificial Neural Network

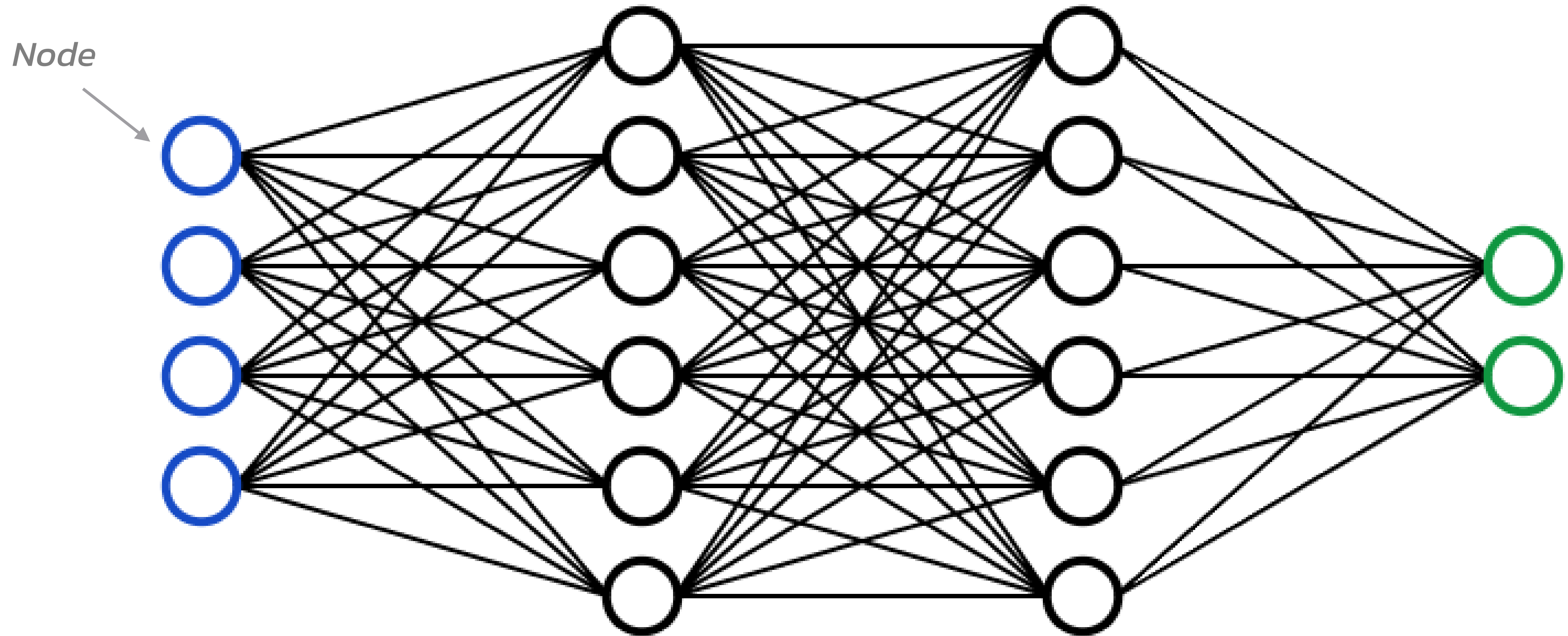


Connection to Biological Neural Networks



This connection is not relevant nowadays.

Architecture



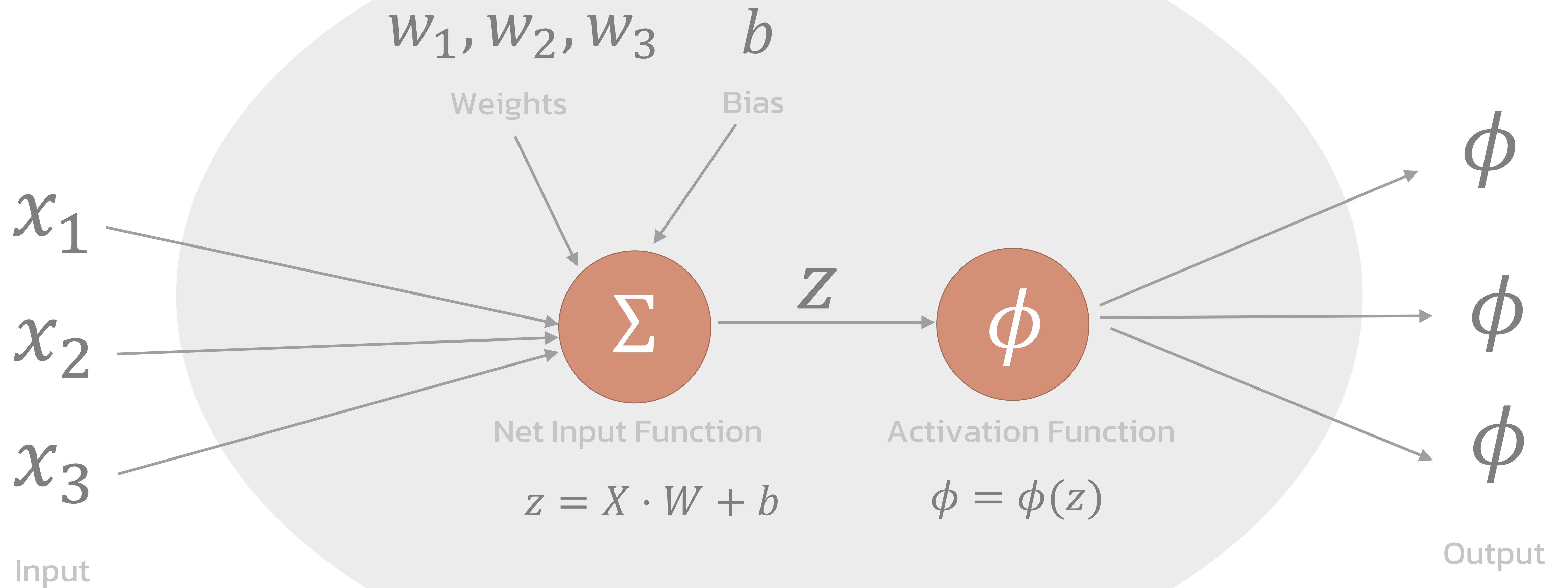
Input Layer

1st Hidden Layer

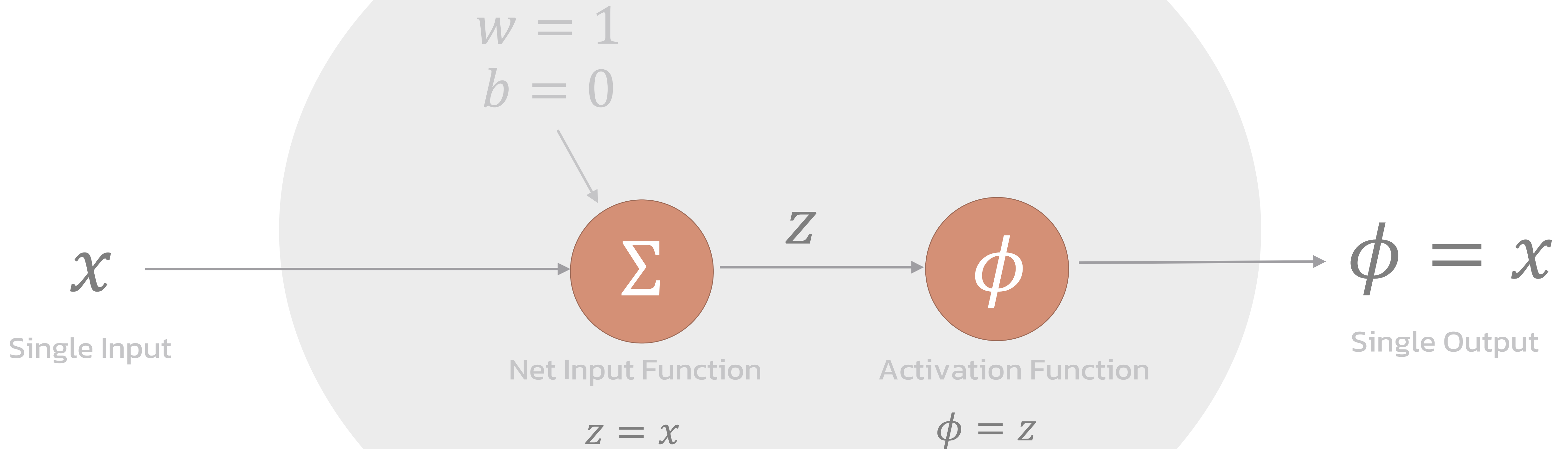
2nd Hidden Layer

Output Layer

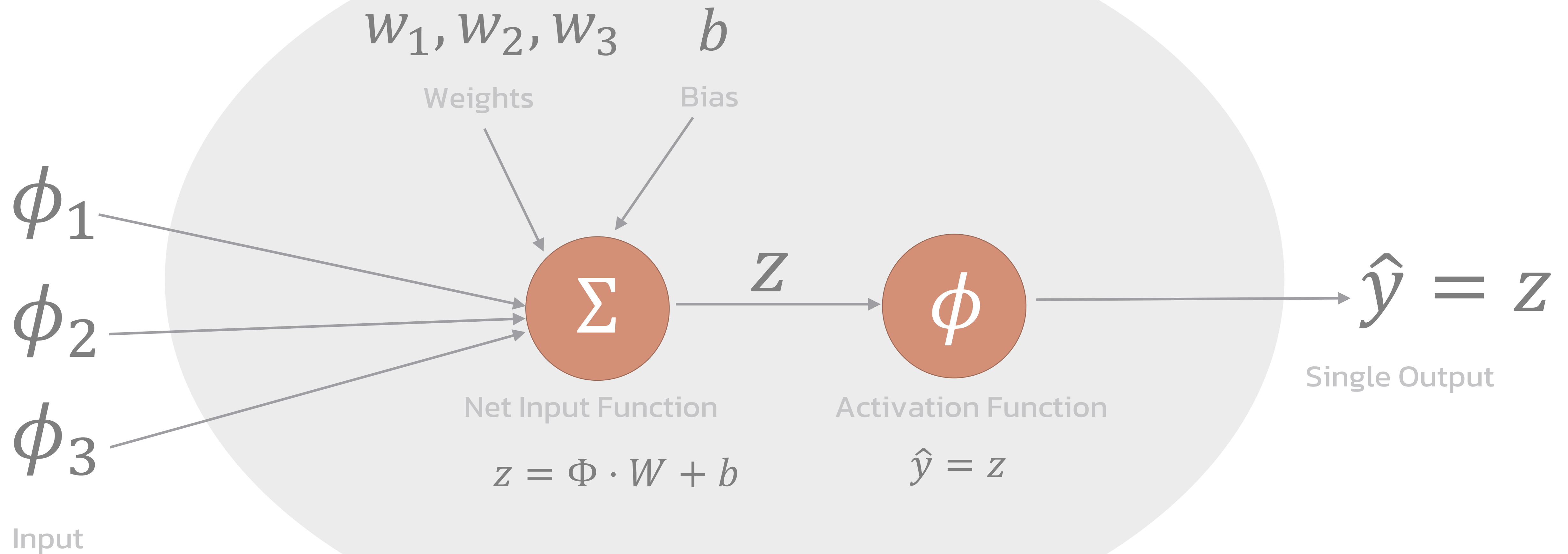
Hidden Node



Input Node

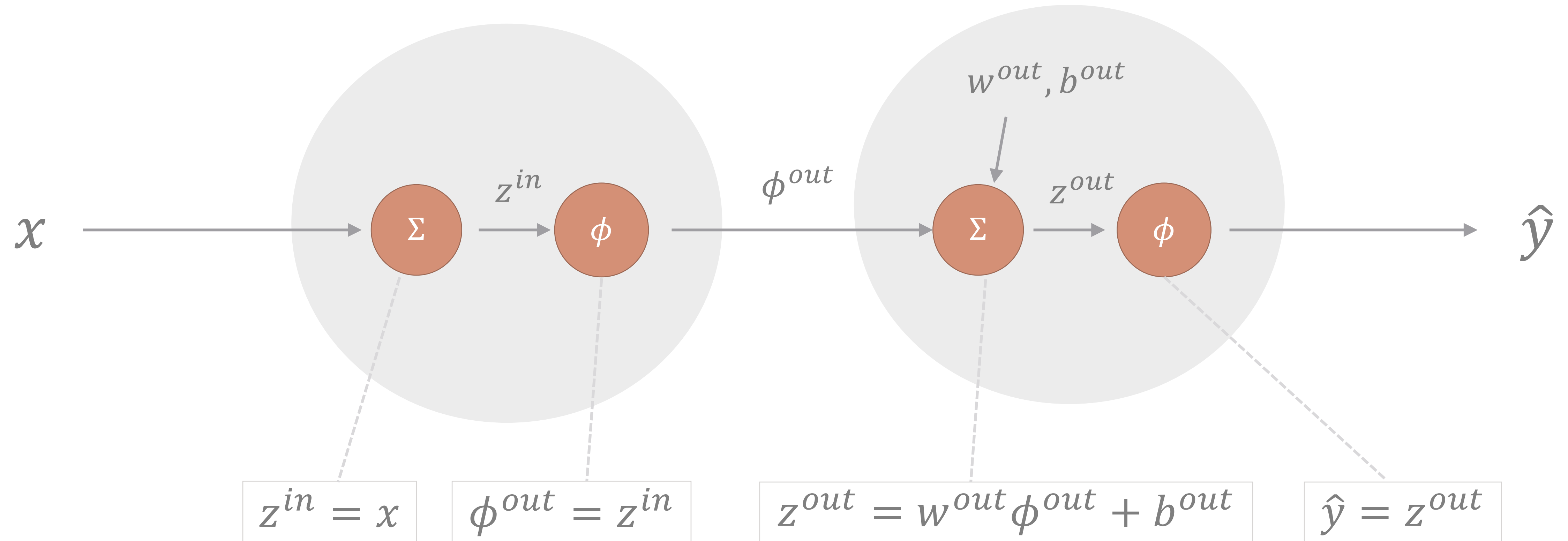


Output Node



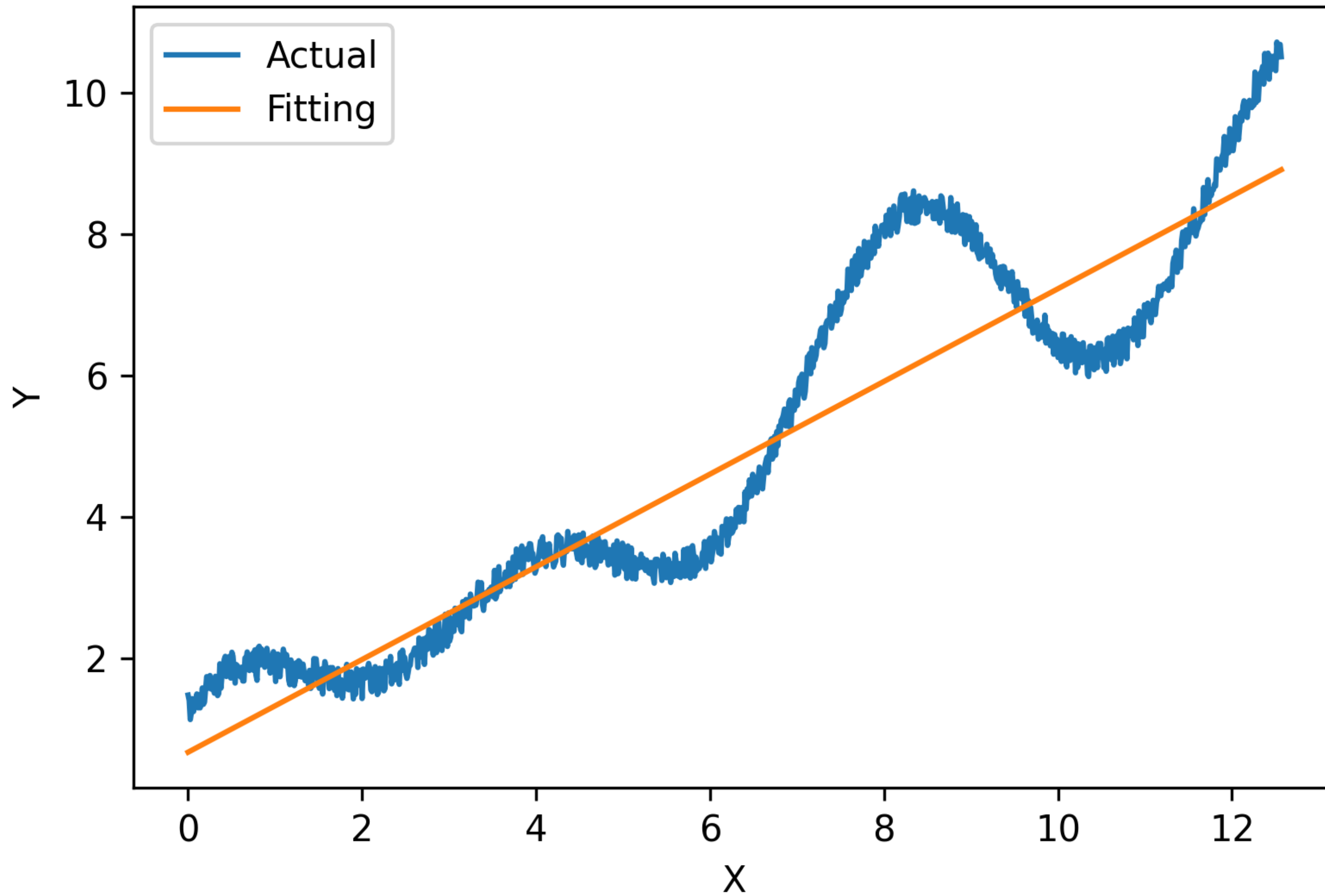
Input Layer

Output Layer



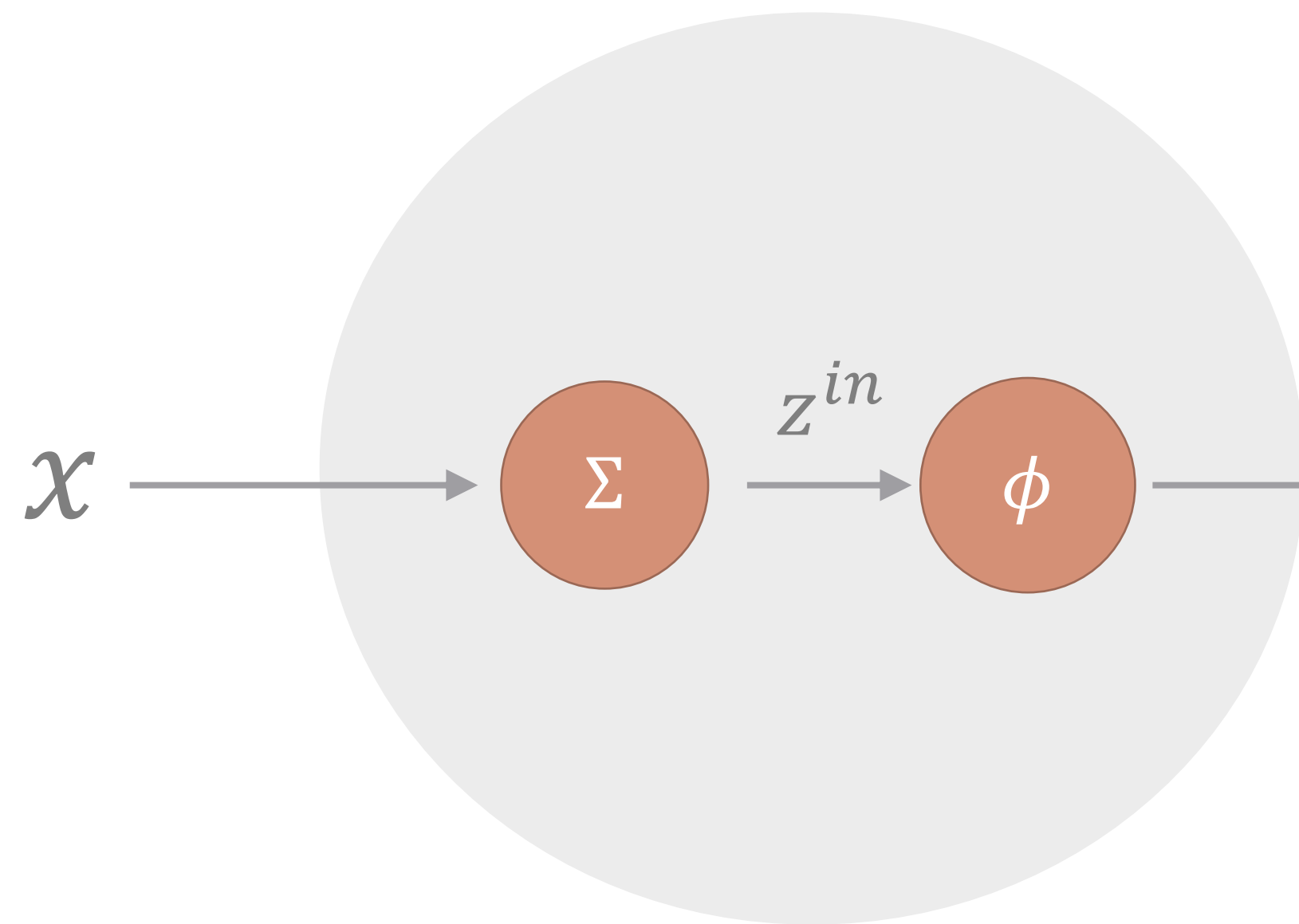
$$\hat{y} = w^{out} x + b^{out}$$

Linear



#Parameters: 2

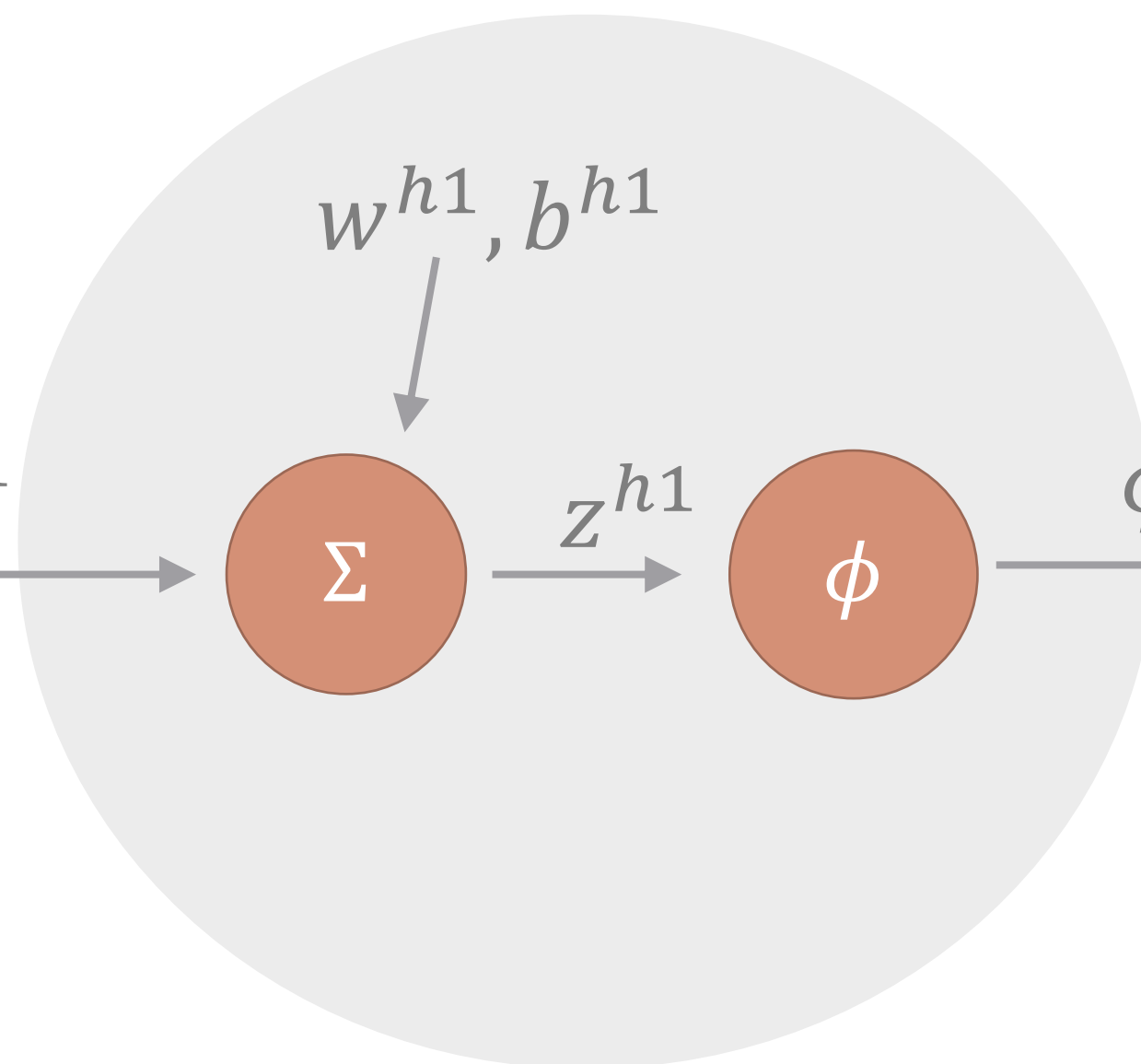
Input Layer



$$z^{in} = x$$

$$\phi^{h1} = z^{in}$$

Hidden Layer

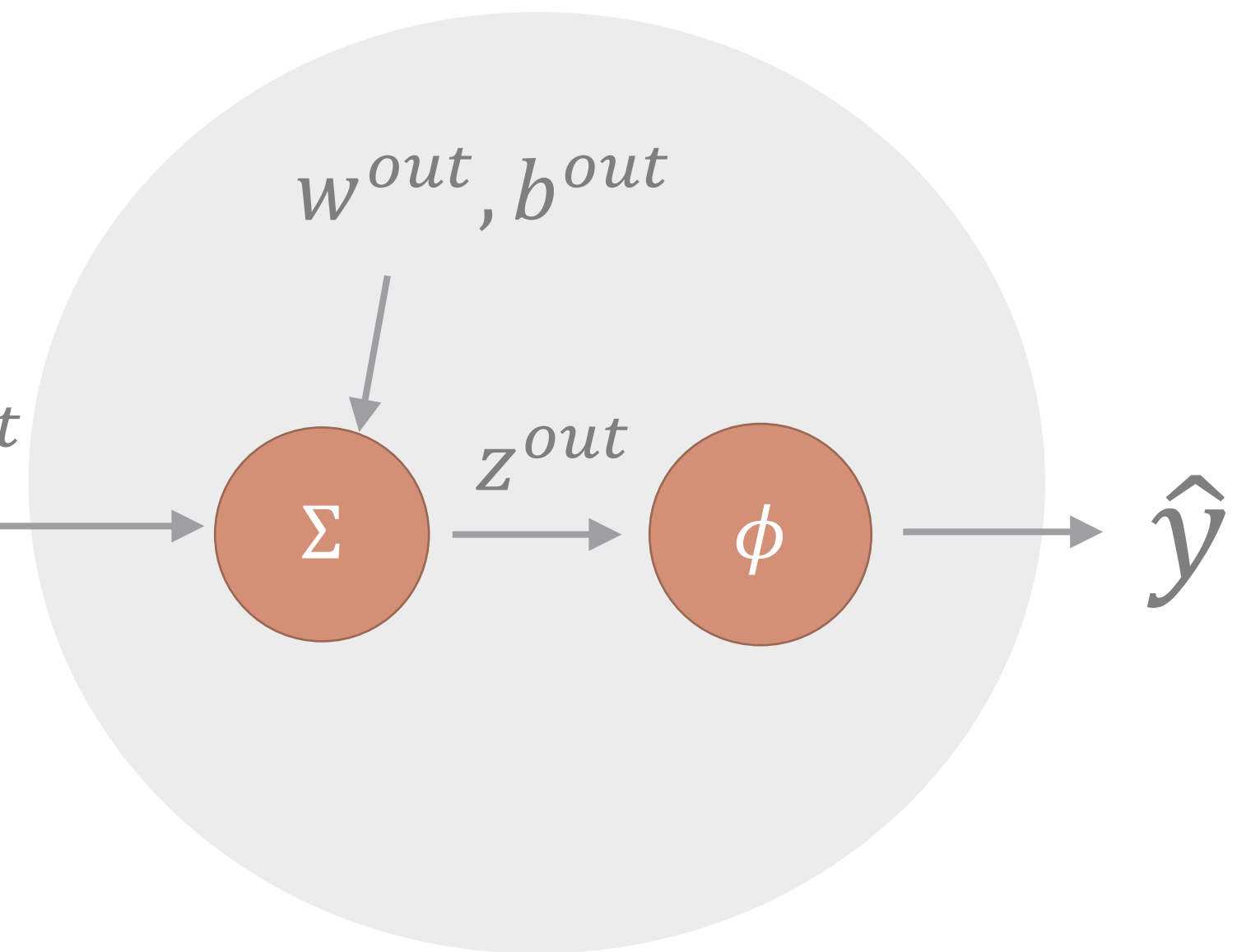


$$z^{h1} = w^{h1} \phi^{h1} + b^{h1}$$

$$\phi^{out} = \frac{1}{1 + e^{-z^{h1}}}$$

Sigmoid Function

Output Layer



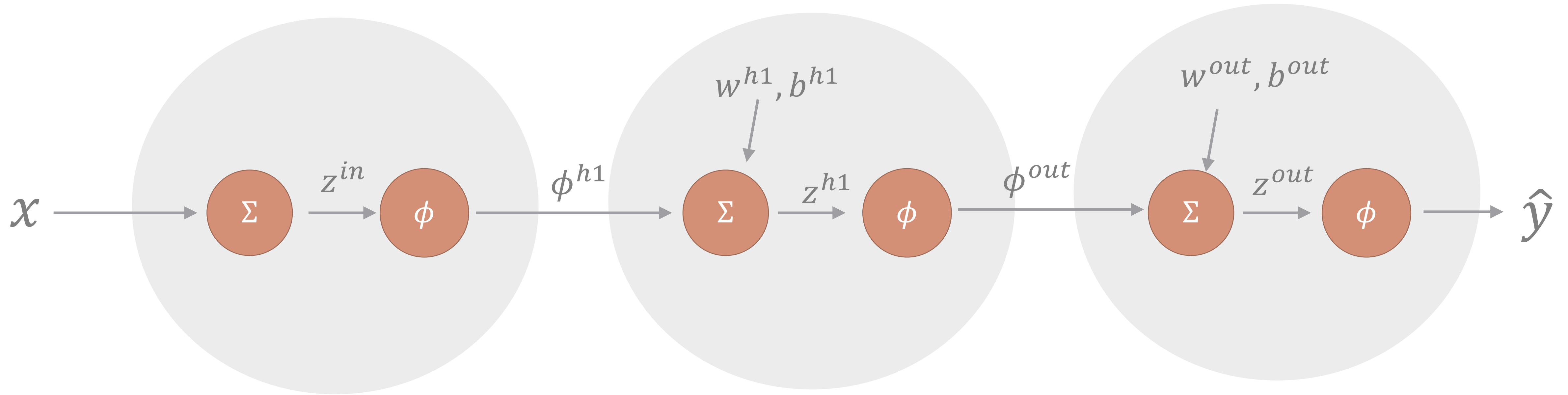
$$z^{out} = w^{out} \phi^{out} + b^{out}$$

$$\hat{y} = z^{out}$$

Input Layer

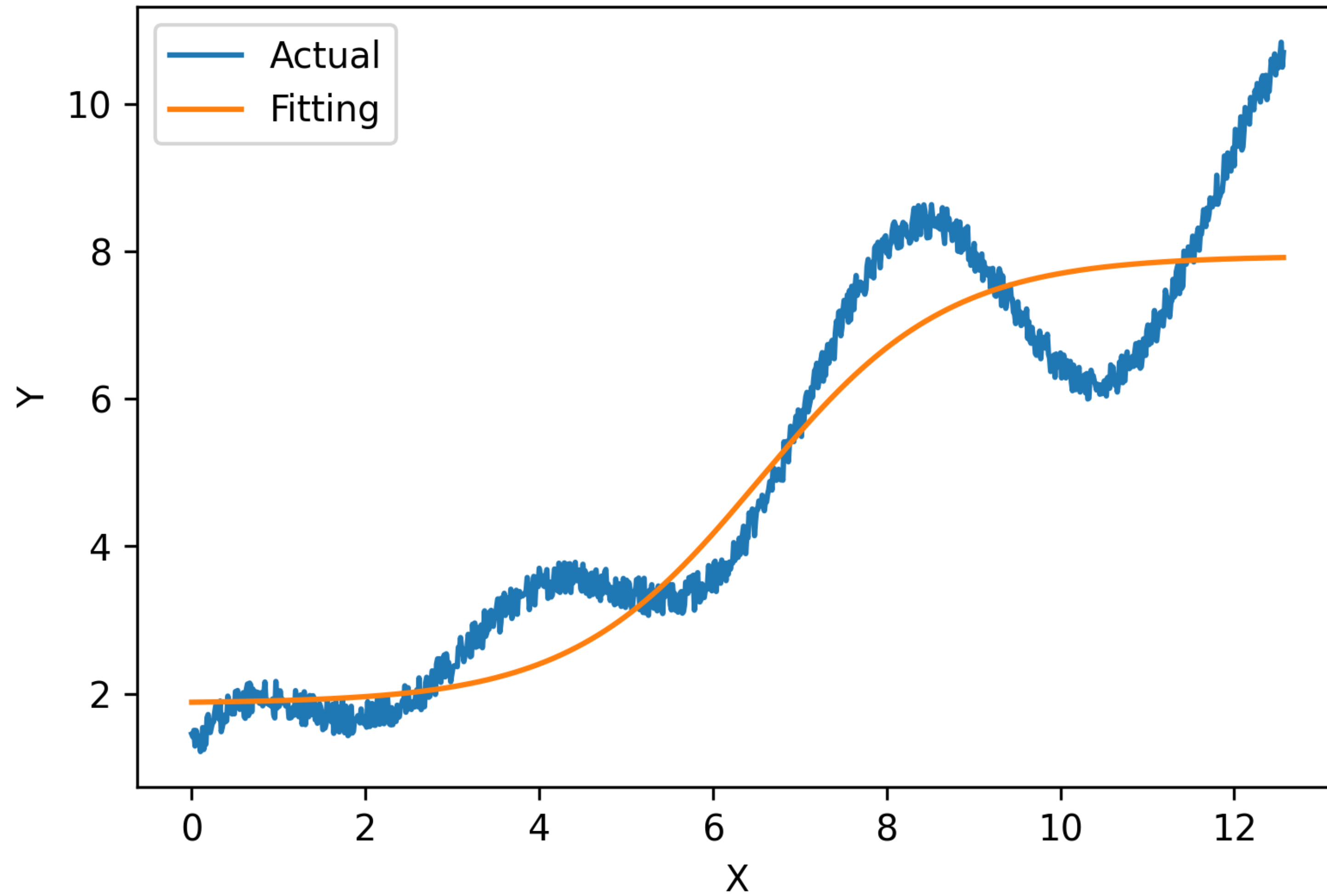
Hidden Layer

Output Layer

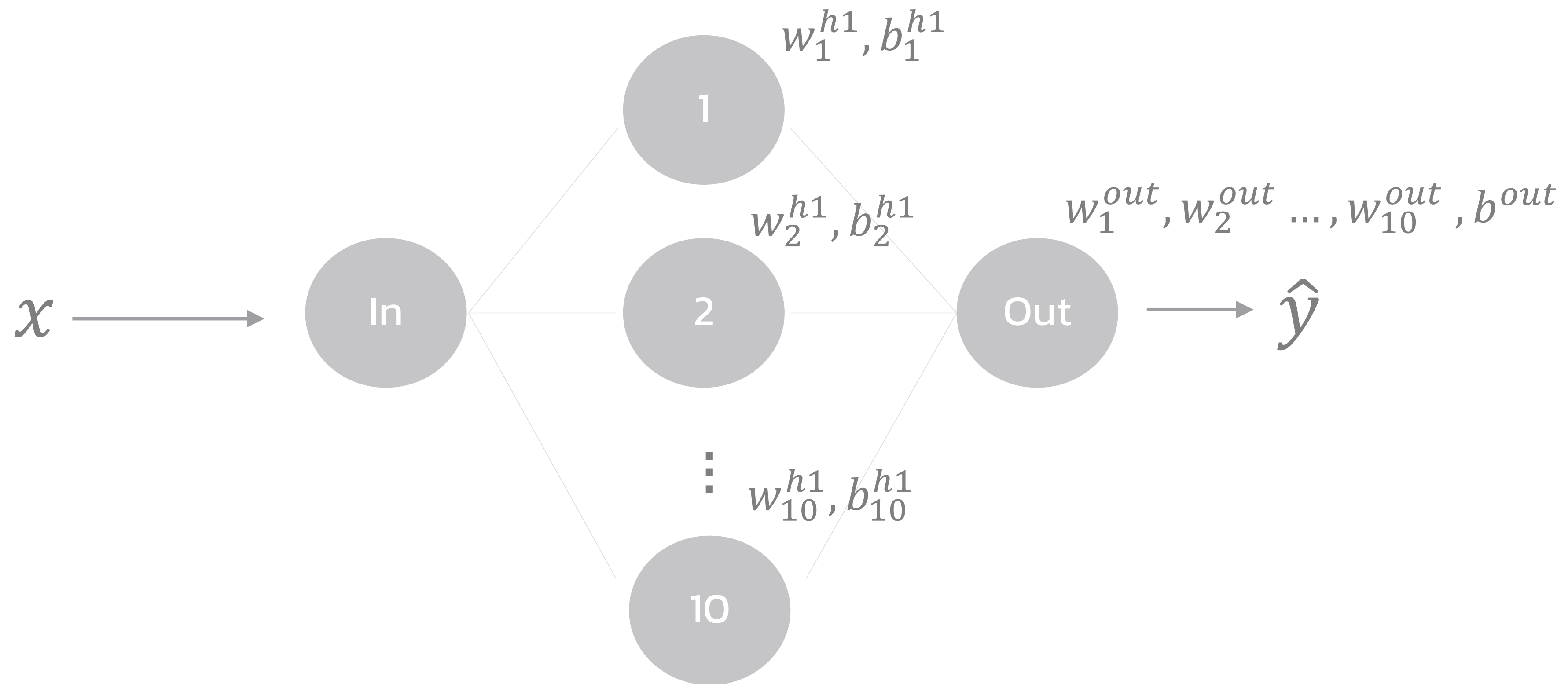


$$\hat{y} = w^{out} \left[\frac{1}{1 + e^{-(w^{h1}x + b^{h1})}} \right] + b^{out}$$

S1

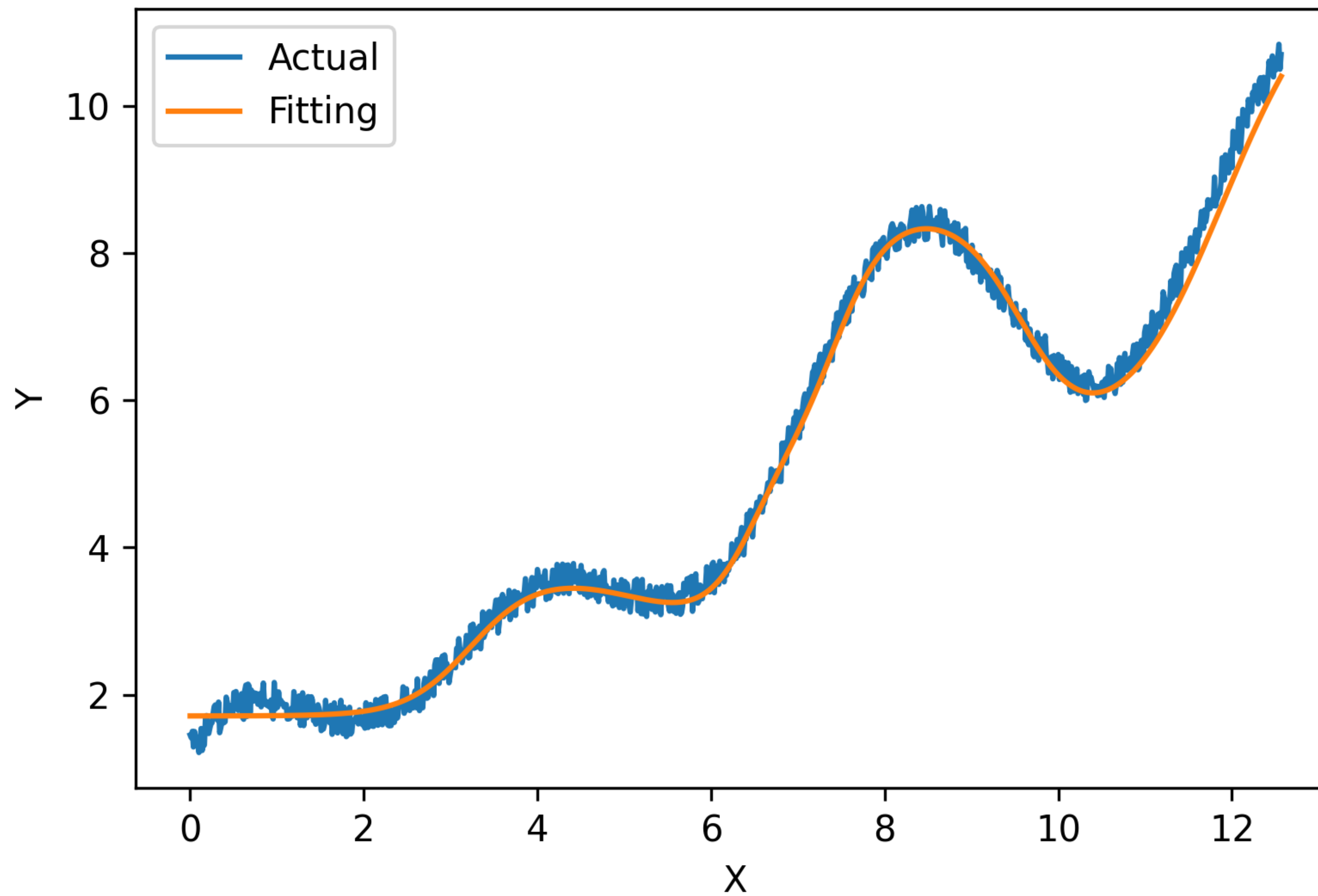


#Parameters: 4

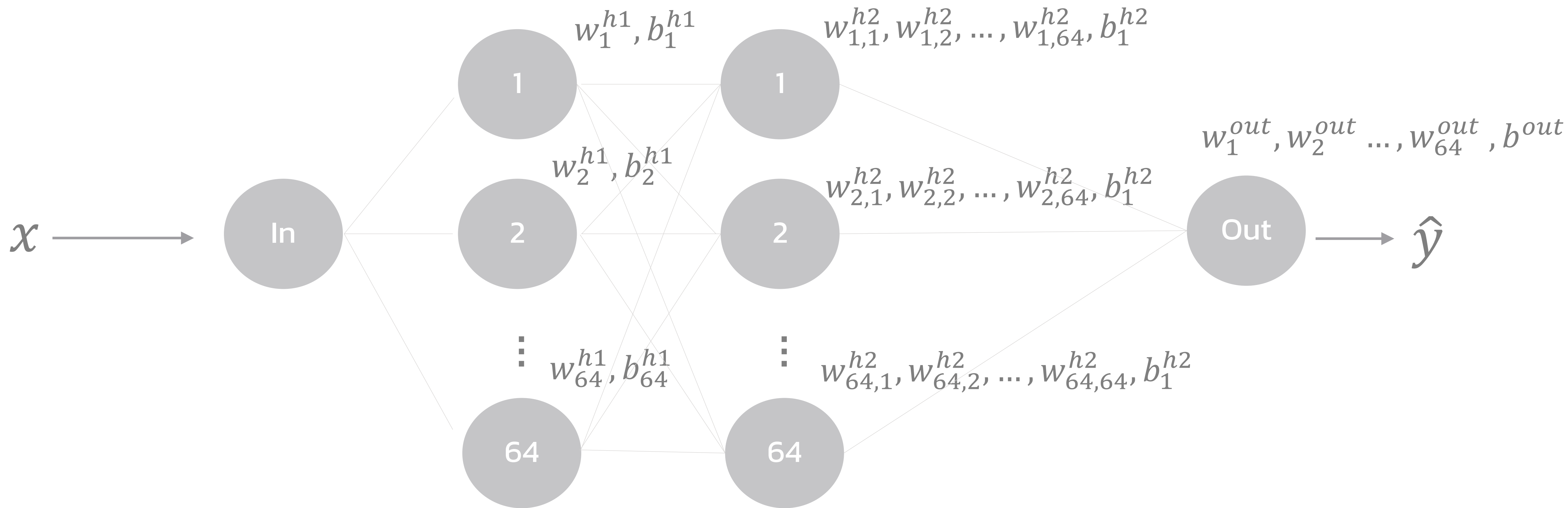


$$\hat{y} = \sum_{i=1}^{10} \left[w_i^{out} \frac{1}{1 + e^{-(w_i^{h1}x + b_i^{h1})}} \right] + b^{out}$$

S2



#Parameters: 31



128

Parameters

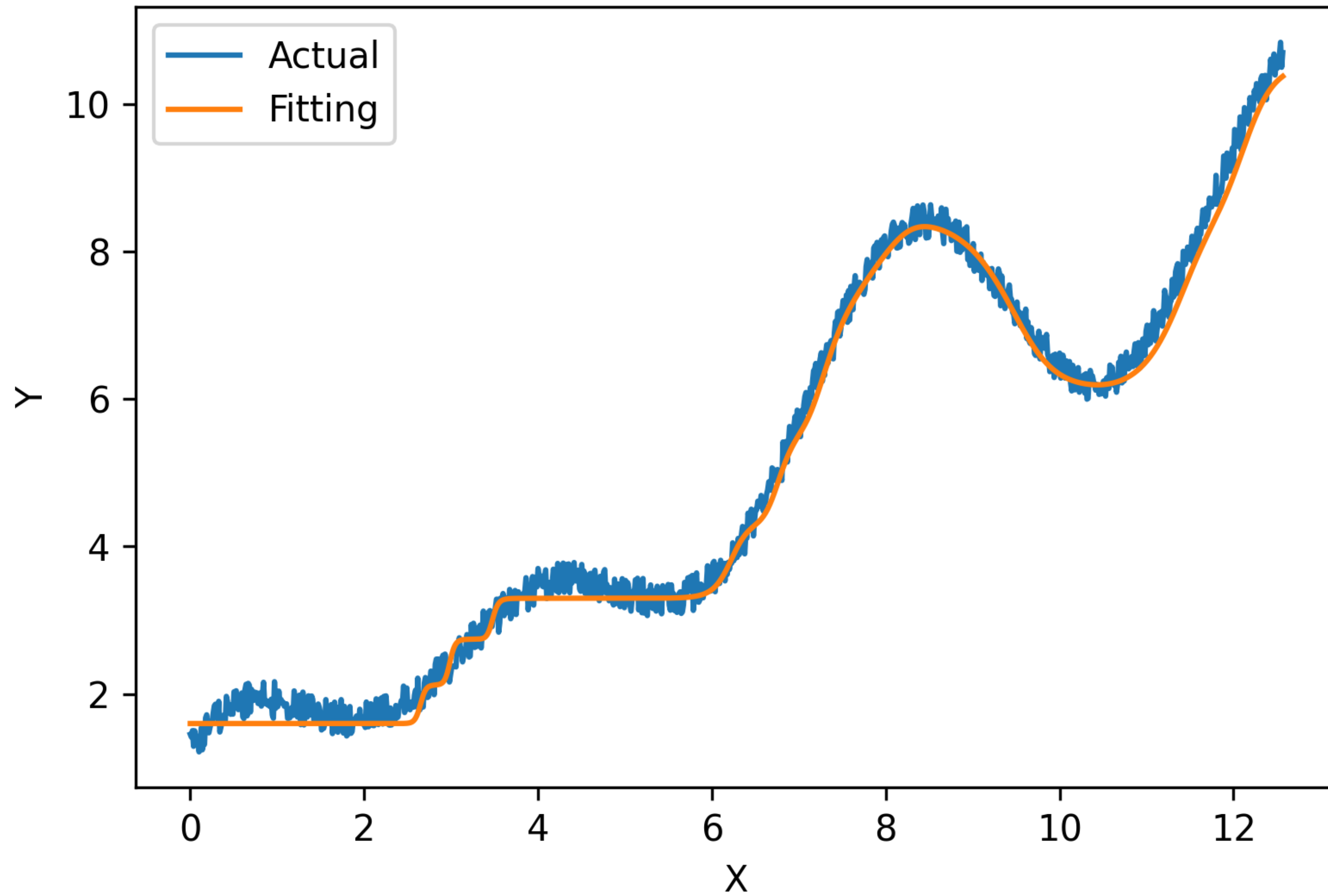
4160

Parameters

65

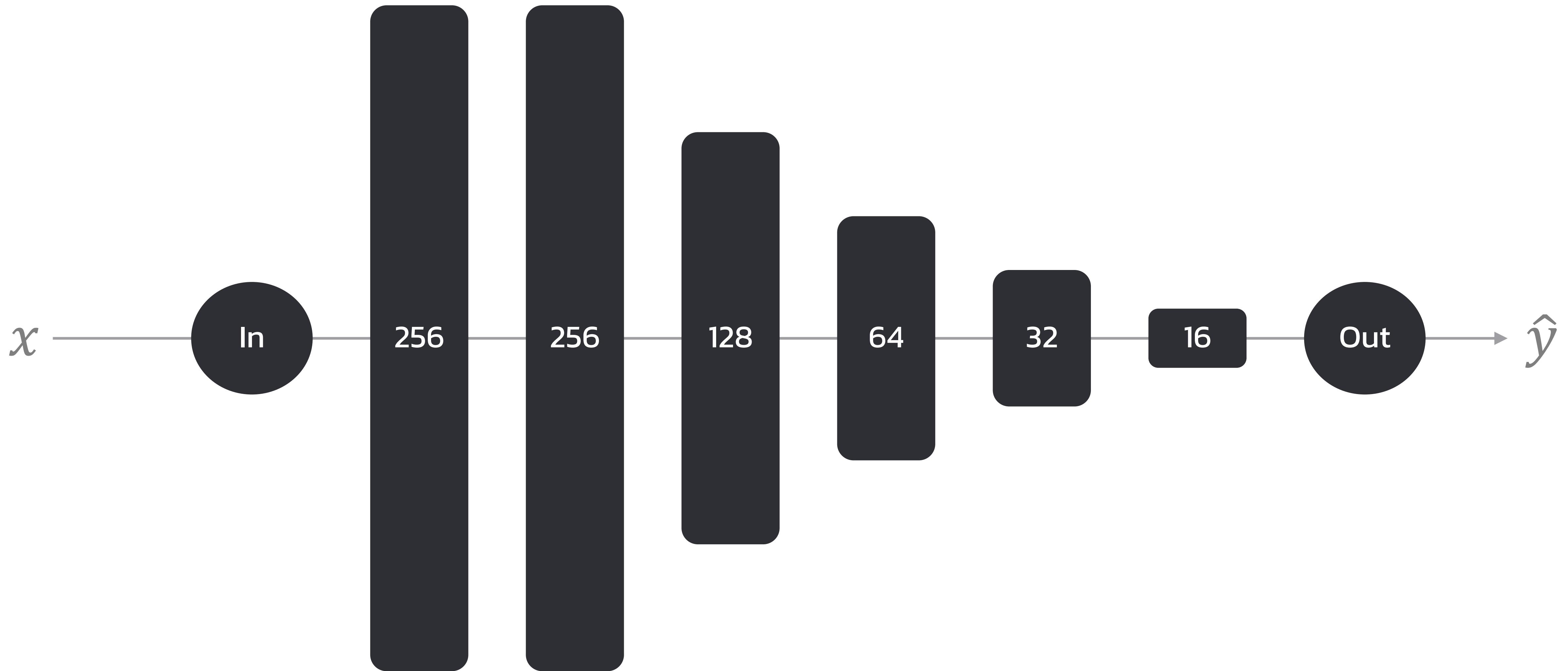
Parameters

S3

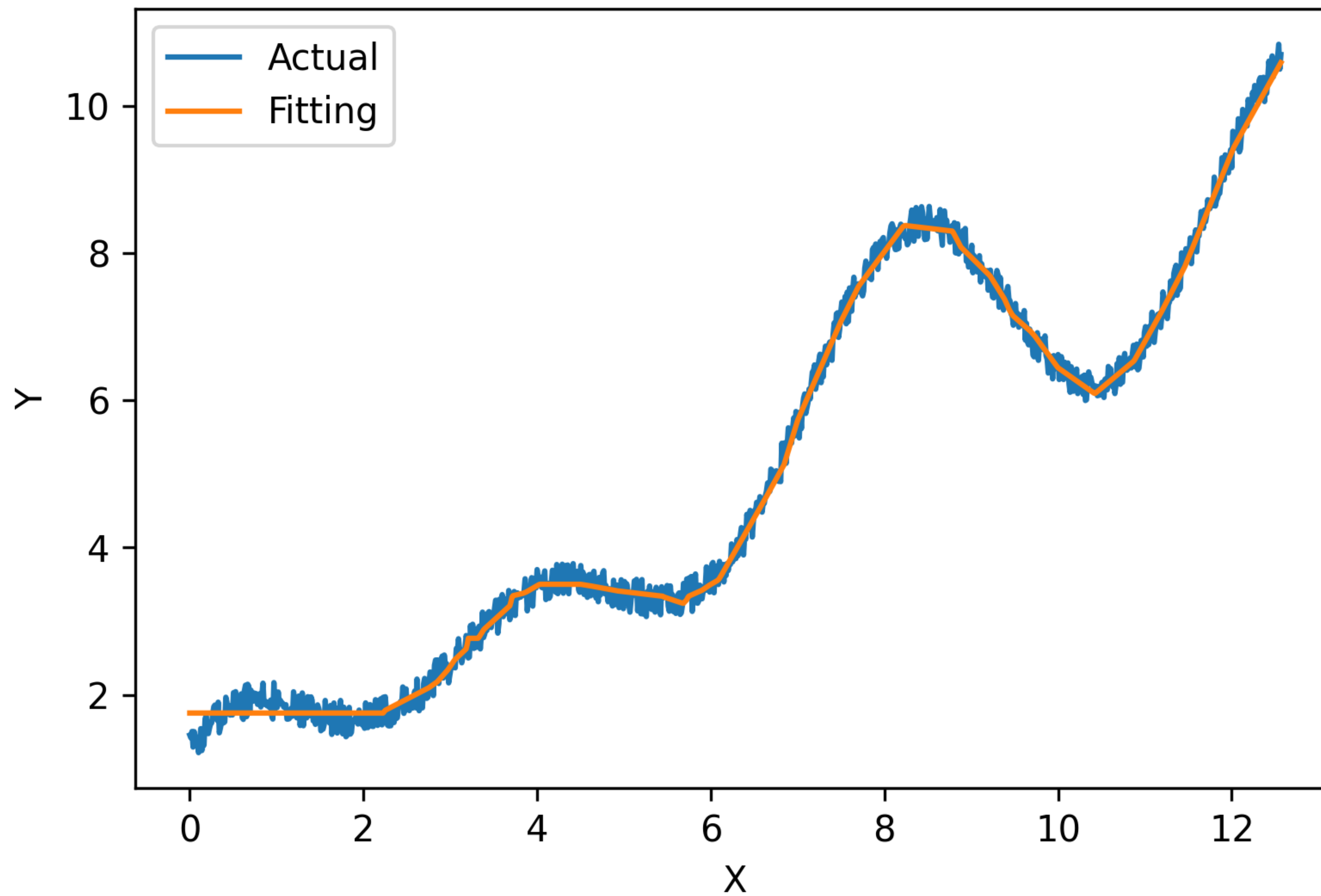


#Parameters: 4,353

Deep Neural Network



S6



#Parameters: 110,081

Types of DNN

- Deep ANN
 - Data prediction
- Convolutional neural network
 - Image
- Recurrent neural network
 - Languages, audio
- Transformer
 - Languages, audio