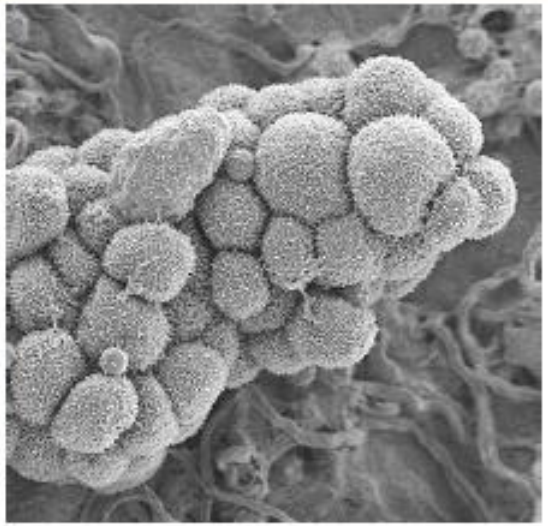
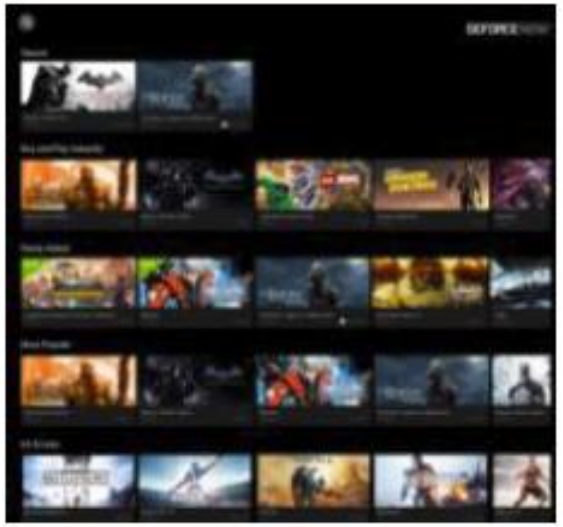
جامعة الجلالة
GALALA UNIVERSITY

Artificial Intelligence Science Program

Chapter 5: Neural Networks and Deep Learning

DEEP LEARNING EVERYWHERE





TERNET & CLOUD

age Classification
eech Recognition
nguage Translation
nguage Processing
entiment Analysis
Recommendation

MEDICINE & BIOLOGY

Cancer Cell Detection
Diabetic Grading
Drug Discovery

MEDIA & ENTERTAINMENT

Video Captioning
Video Search
Real Time Translation

SECURITY & DEFENSE

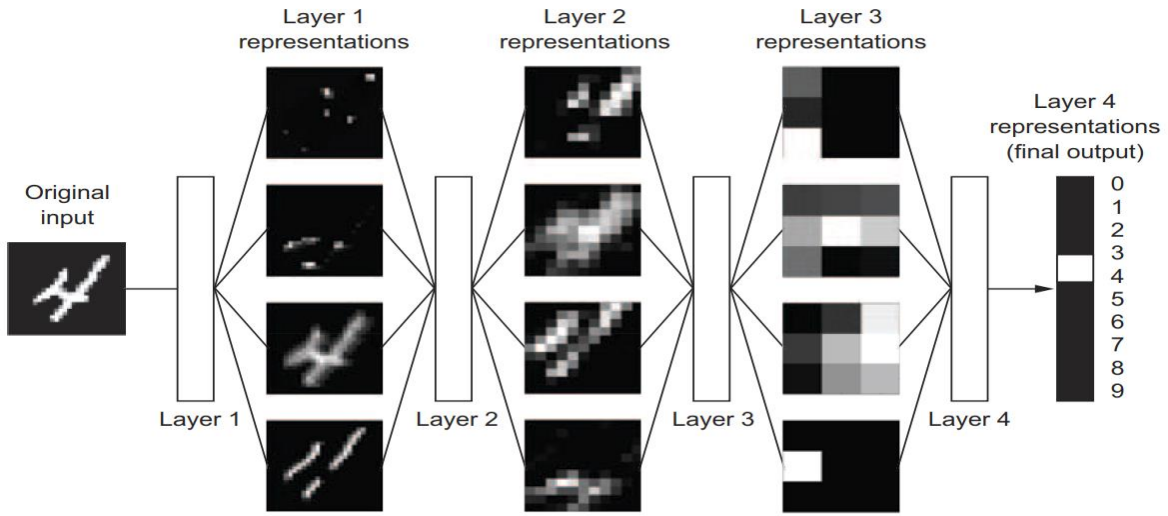
Face Detection
Video Surveillance
Satellite Imagery

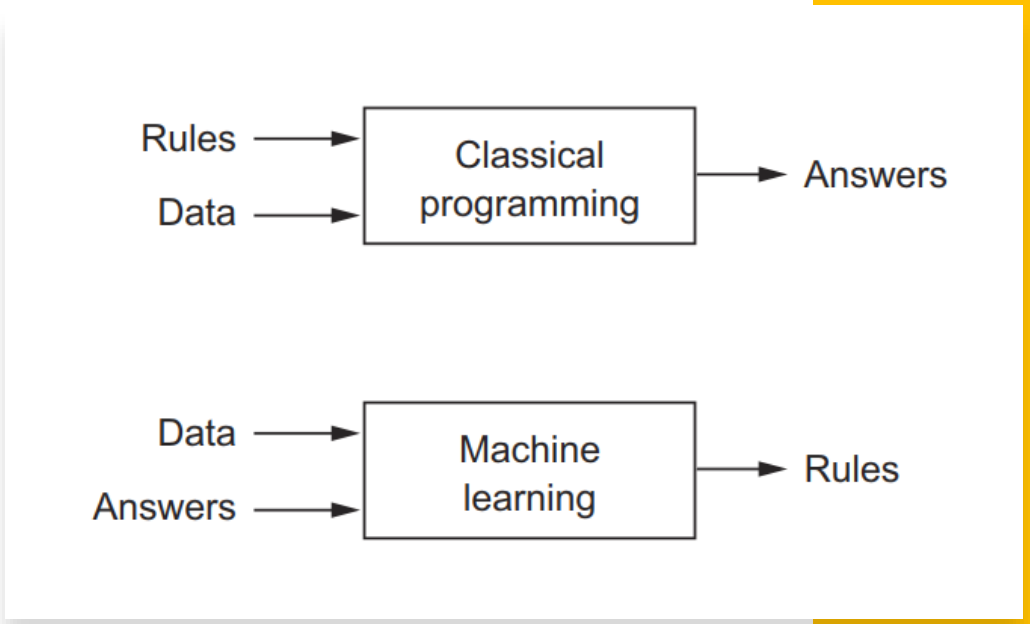
AUTONOM

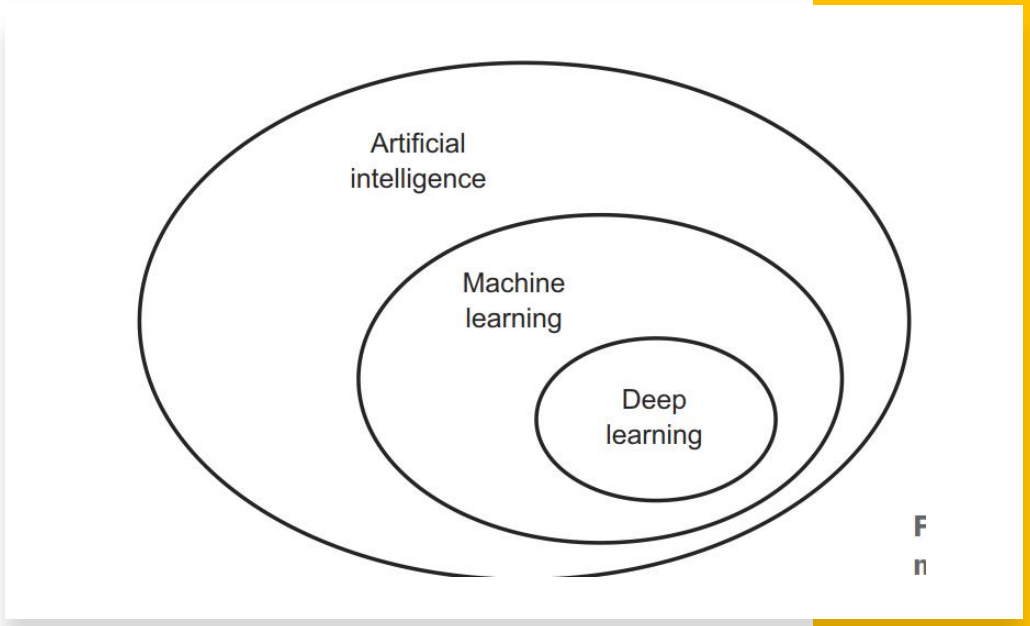
Pedestri
Lane
Recogniz

Deep Learning

- **Deep learning** is a specific subfield of machine learning: learning representations from data that puts an emphasis on learning successive layers of increasingly meaningful representations.

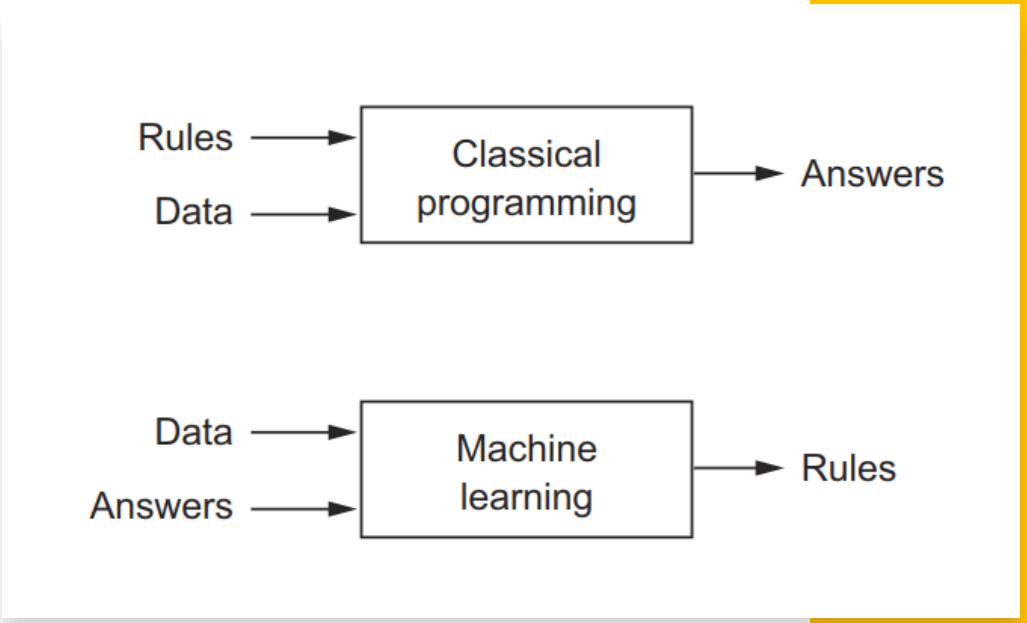


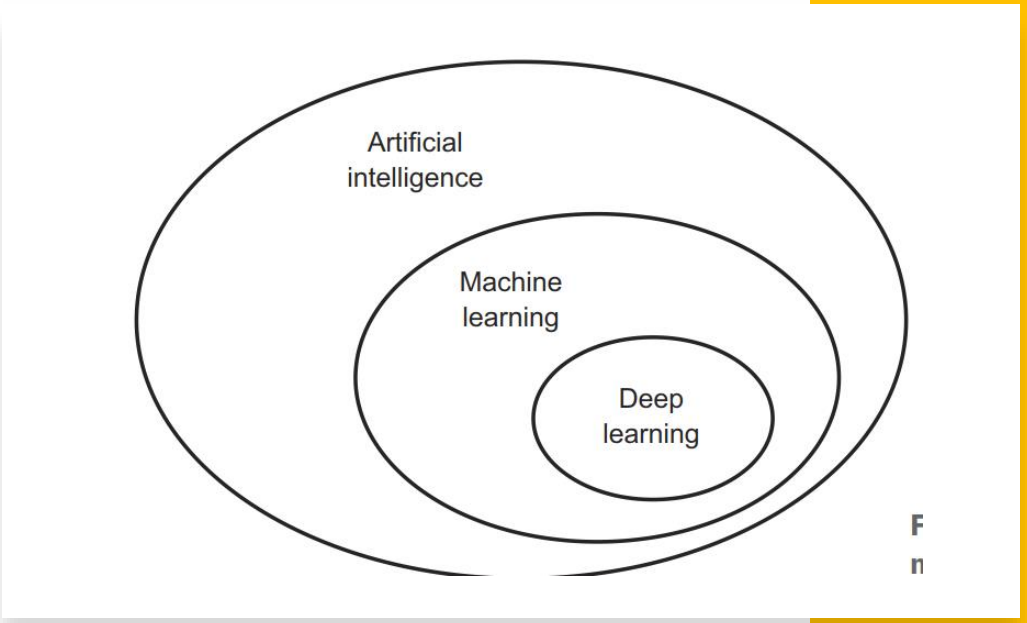




Deep Learning

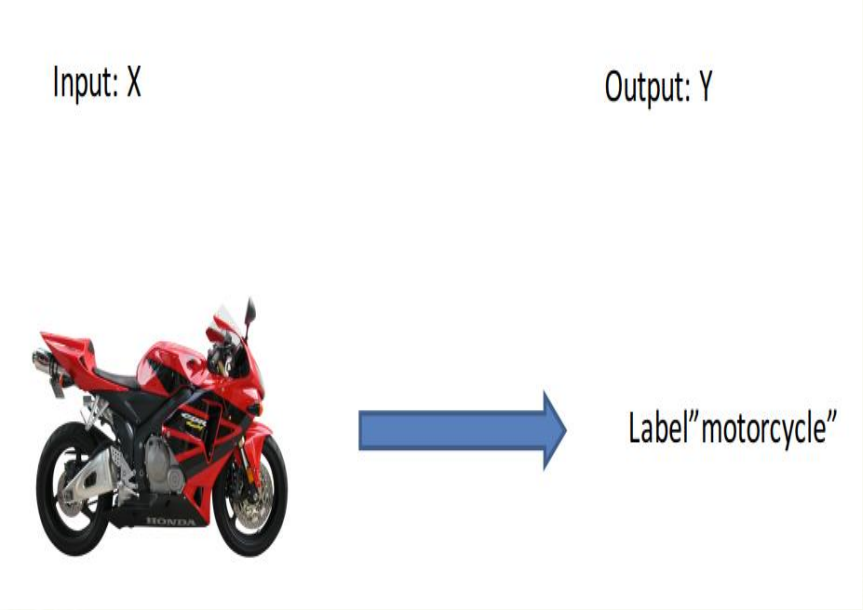
- **Deep learning** is a specific subfield of machine learning: learning representations from data that puts an emphasis on learning successive layers of increasingly meaningful representations.
- Also, called **layered representations learning** and hierarchical representations learning.
- How many layers contribute to a model of the data is called the **depth** of the model.
- Modern deep learning often involves tens or even hundreds of successive layers of representations

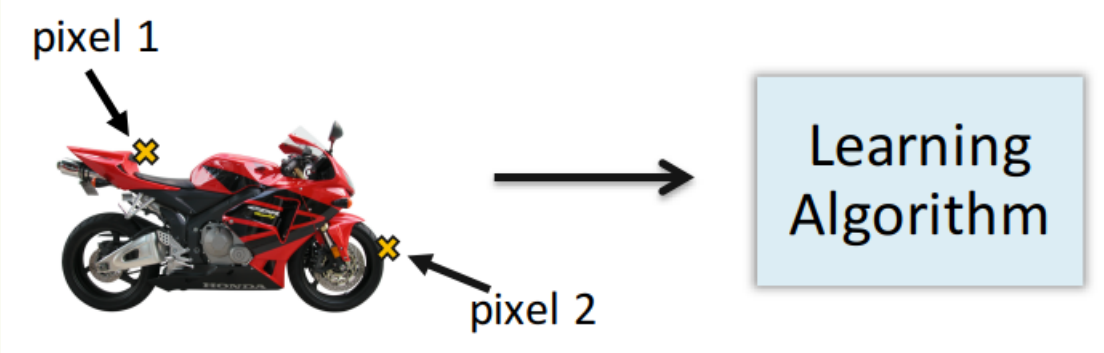


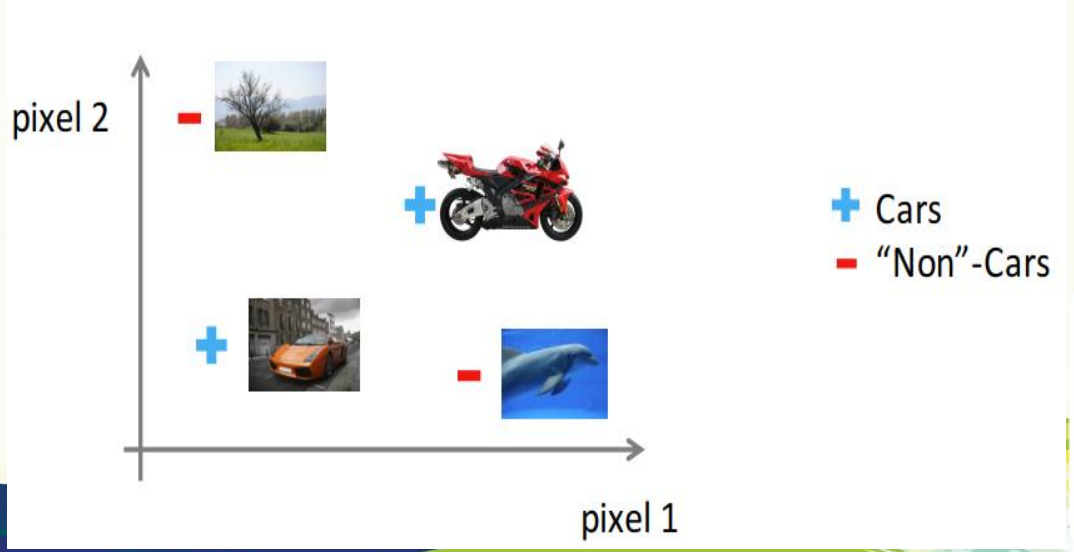


Raw Image Representation

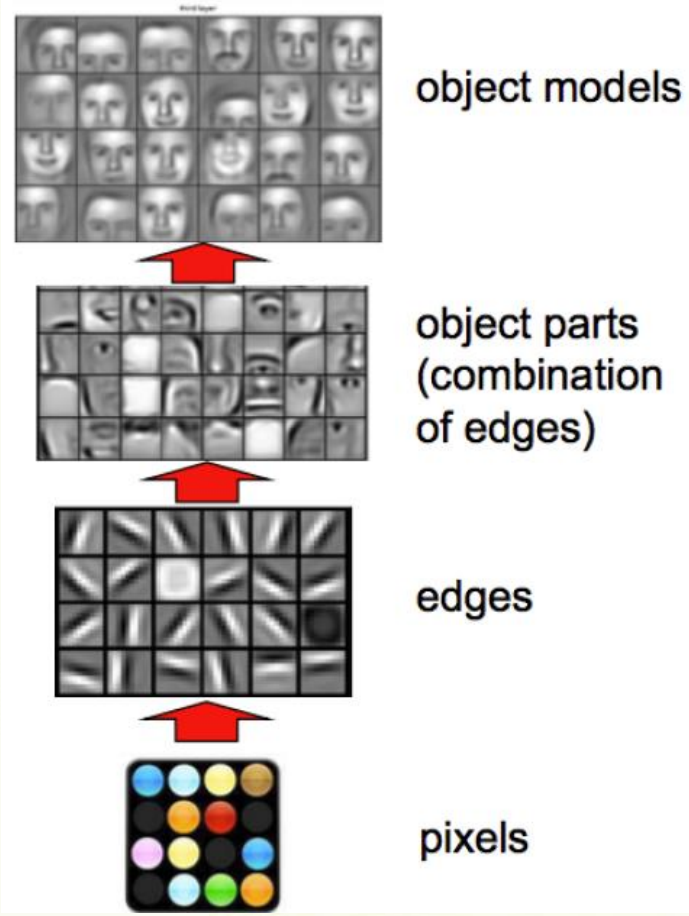
Machine Learning



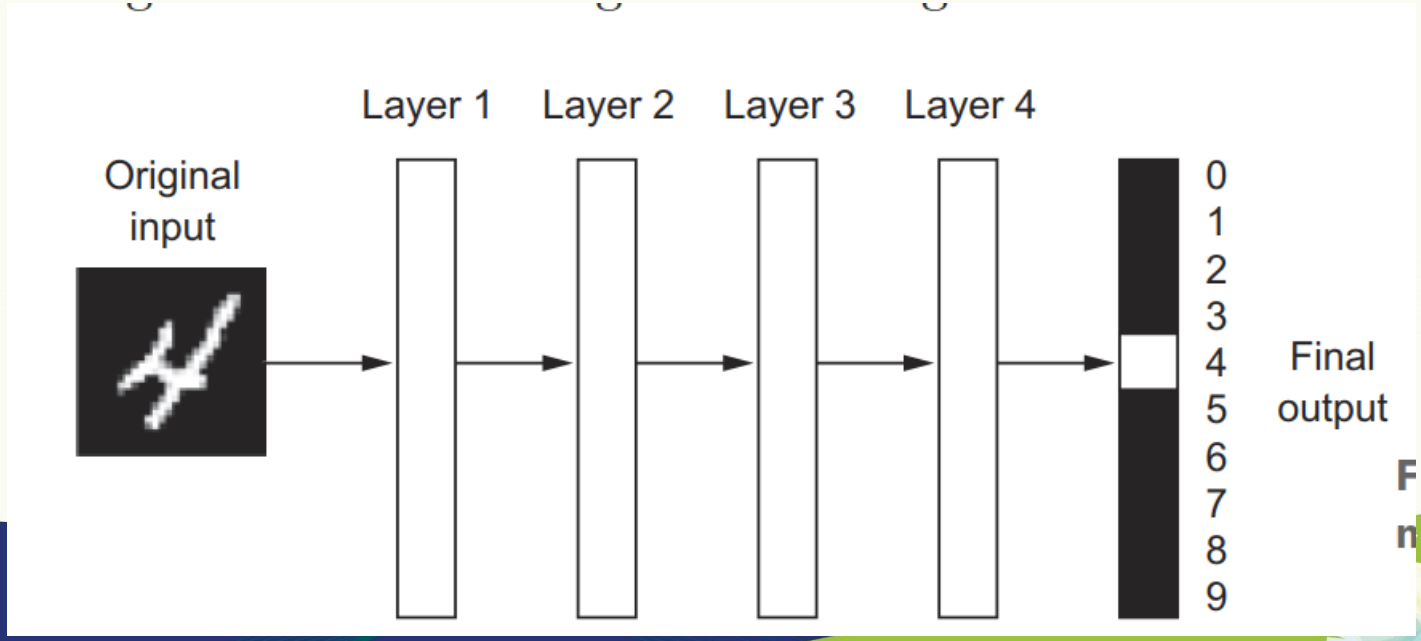




Deep Learning: learn representations!



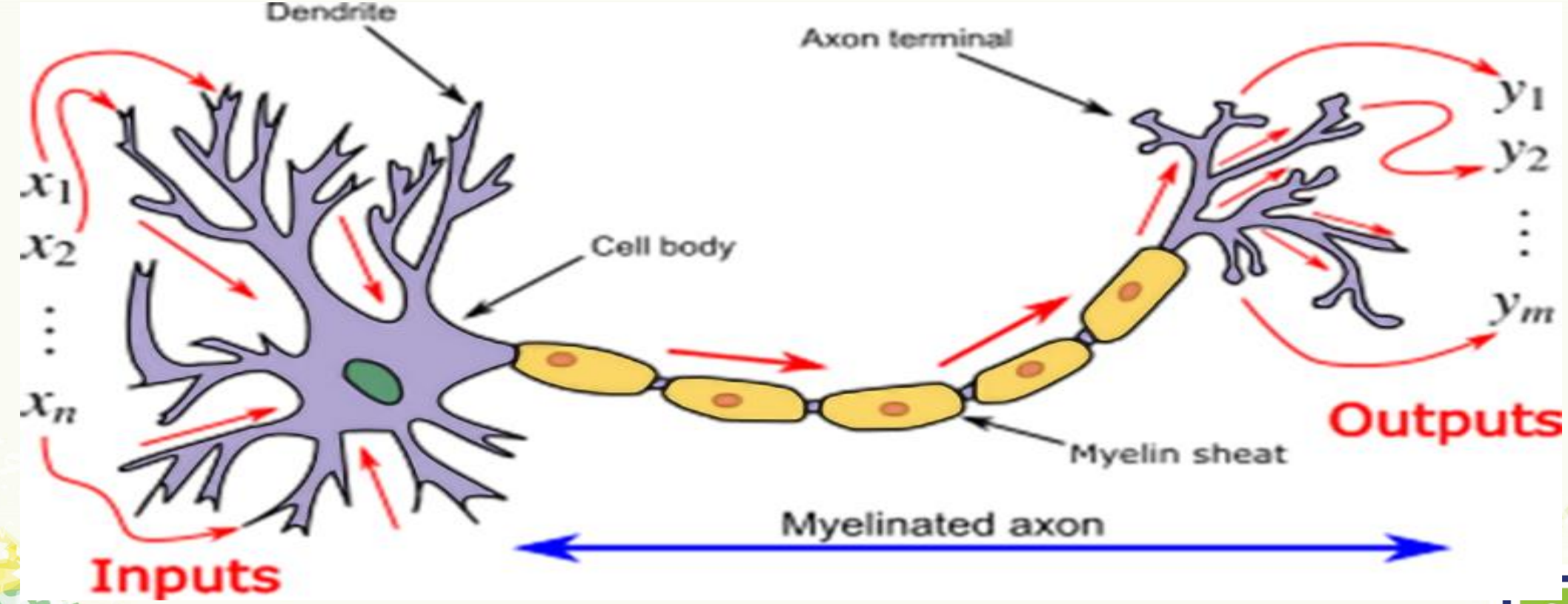
- In deep learning, the layered representations are (almost always) learned via models called neural networks, where layers stacked on top of each other.
- The term neural network is a reference to neurobiology.



Traditional Neural Network

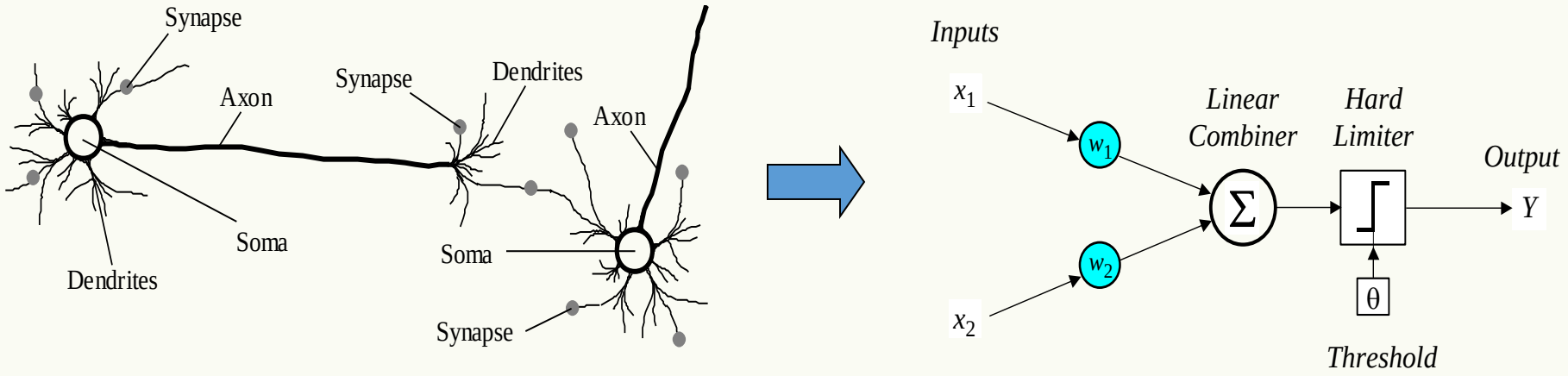
- Artificial Neural Networks(ANN) are part of supervised machine learning where we will be having input as well as corresponding output present in our dataset.
- ANN can be used for solving both regression and classification problems.
- Neural networks form the base of deep learning,
- Neural networks take input data, train themselves to recognize patterns found in the data, and then predict the output for a new set of similar data.
- Therefore, a neural network can be thought of as the functional unit of deep learning, which mimics the behavior of the human brain to solve complex data-driven problems.

Neural Network

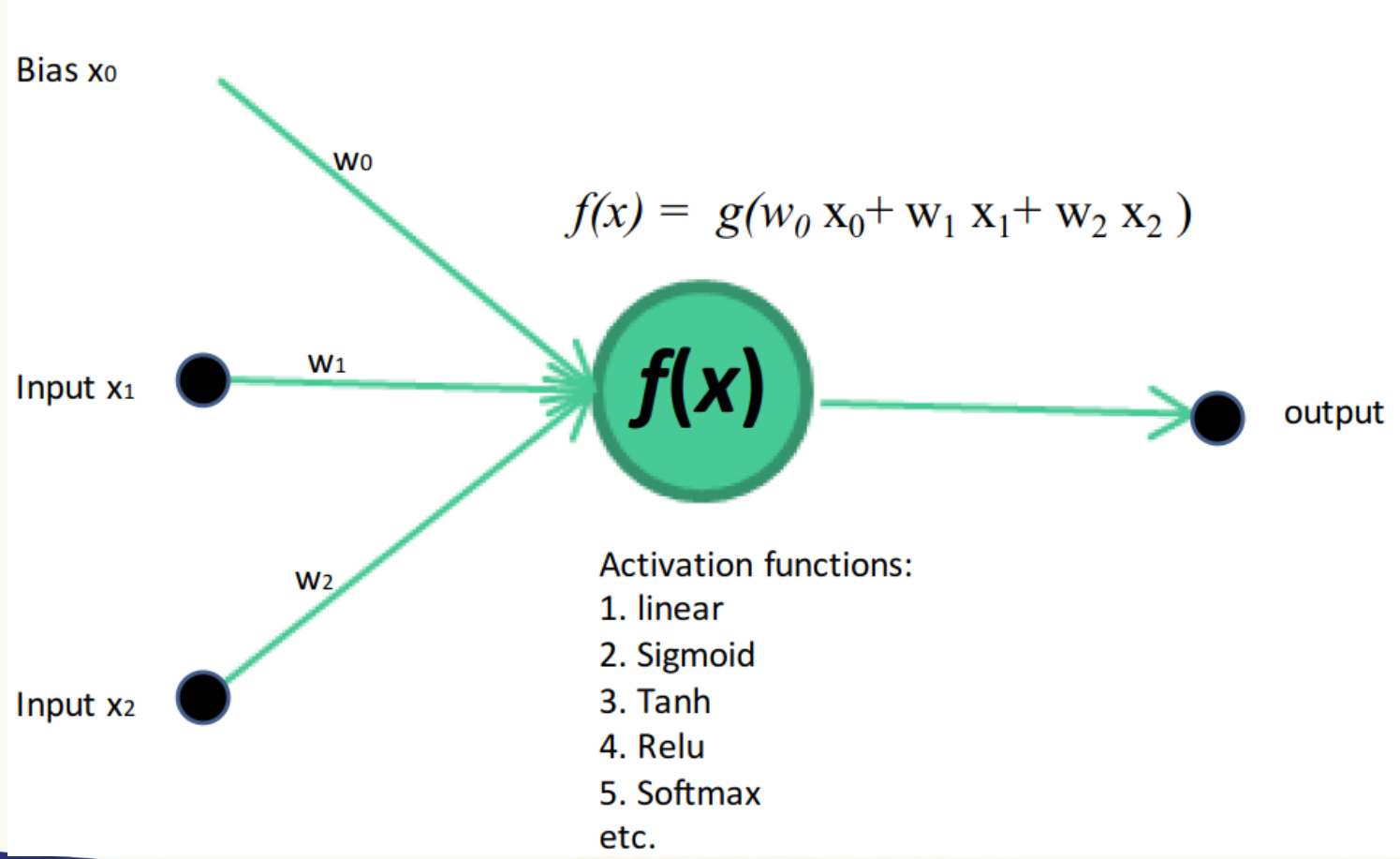


Perceptron and Neural Nets

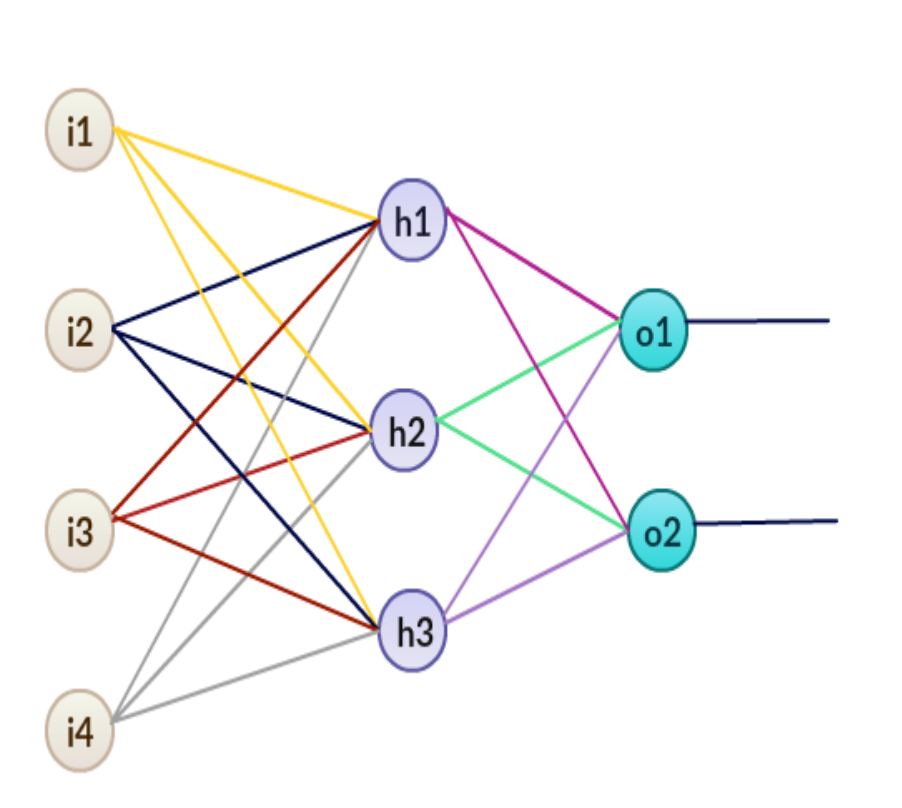
- From biological neuron to artificial neuron (perceptron)

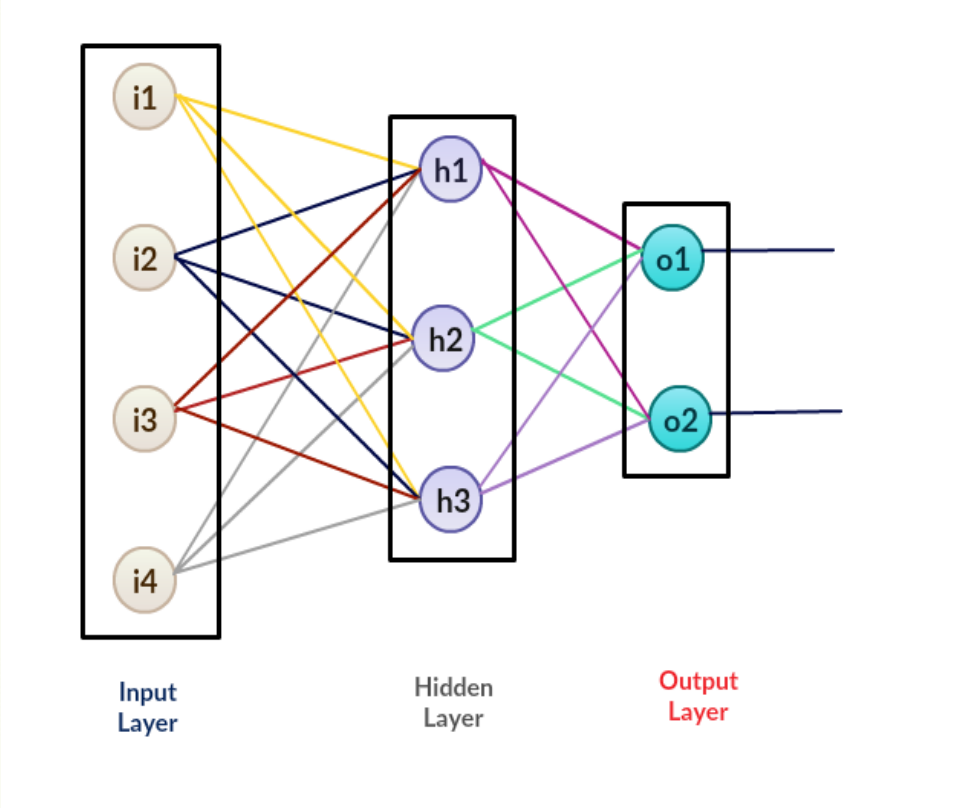


Traditional Neural Network



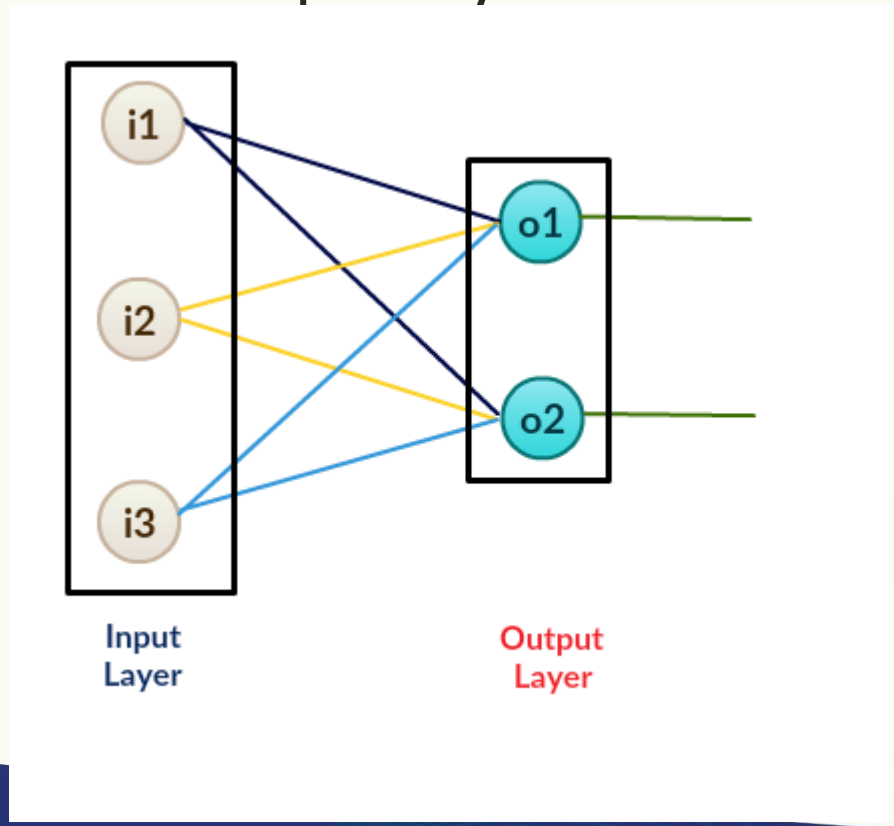
General Structure of ANN

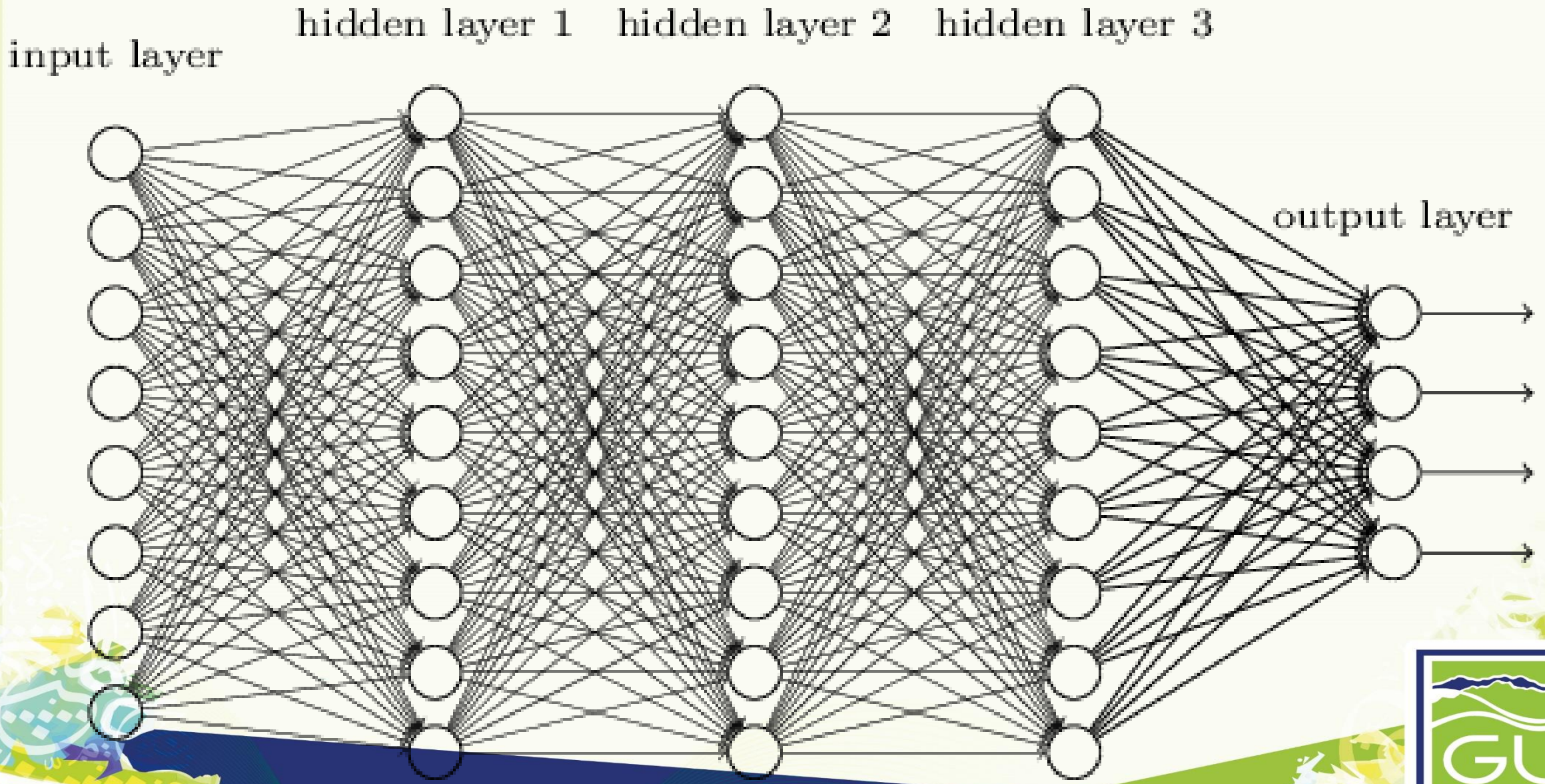




Perceptron

- A perceptron is a neural network without any hidden layer. A perceptron only has an input layer and an output layer.




input layer
hidden layer 1
hidden layer 2
hidden layer 3
output layer

Steps involved in the implementation of a neural network:

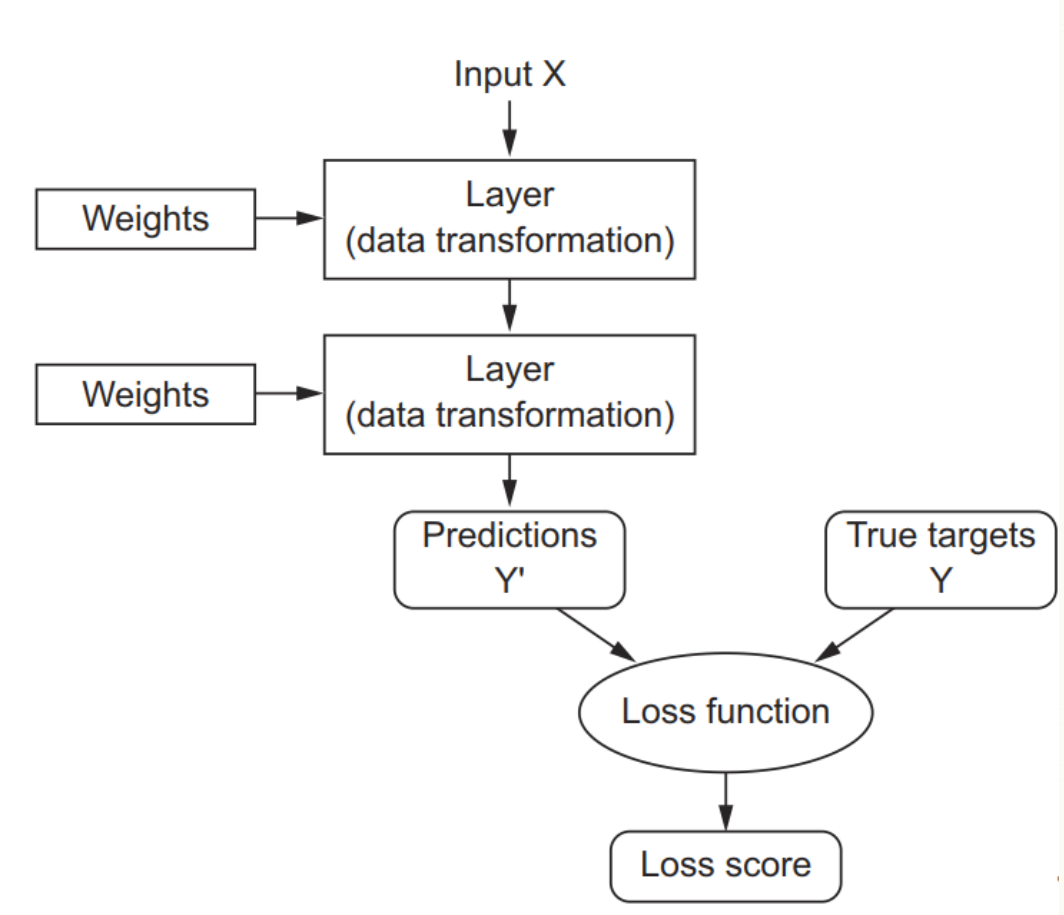
1. **Feedforward:**

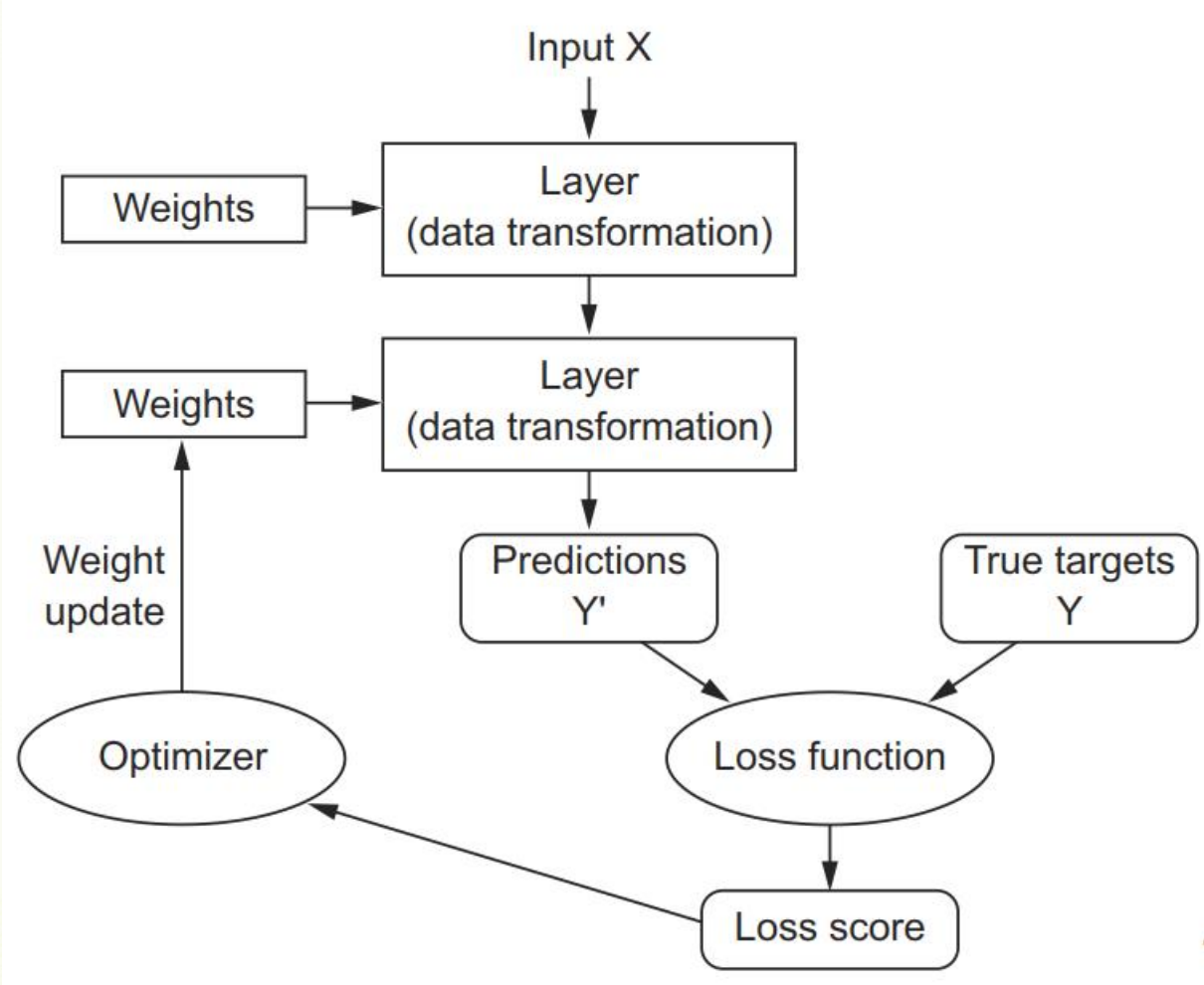
- we have a set of input features and some random weights. Notice that in this case, we are taking random weights that we will optimize using backward propagation.

2. Backpropagation:

- we calculate the error between predicted output and target output and then use an algorithm (gradient descent) to update the weight values.

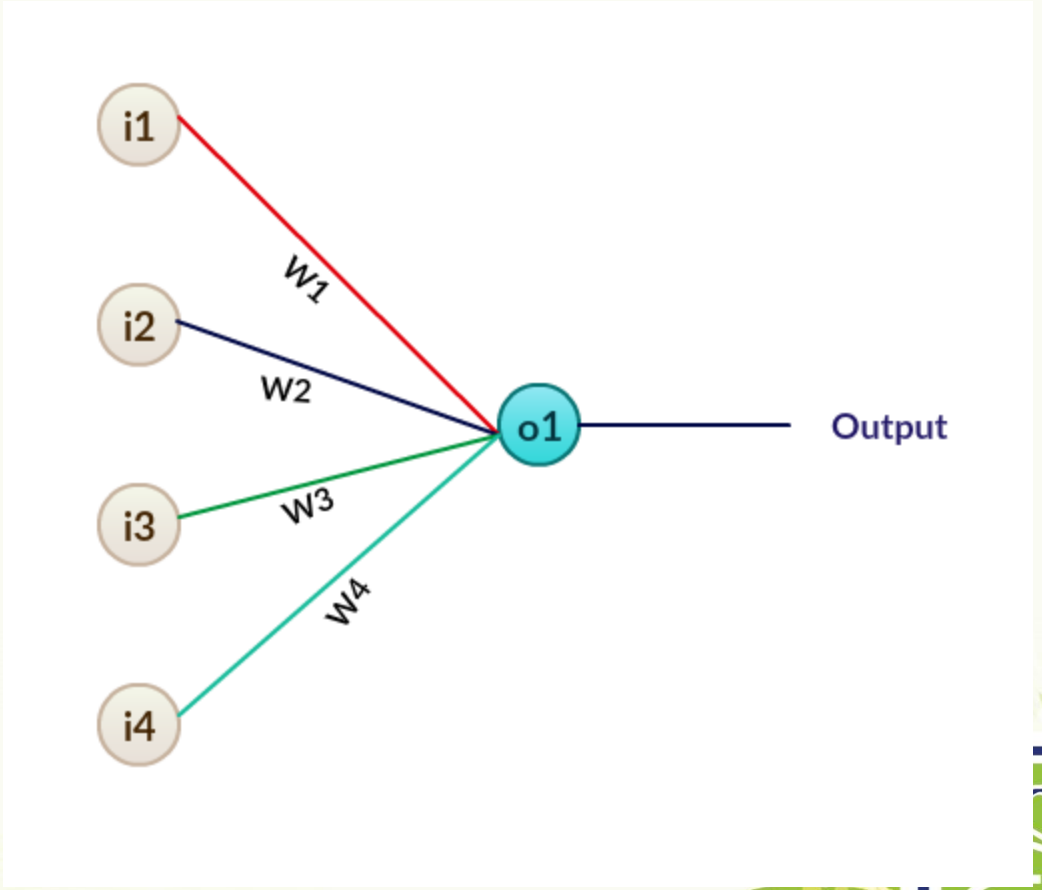
Flow chart for a simple NN

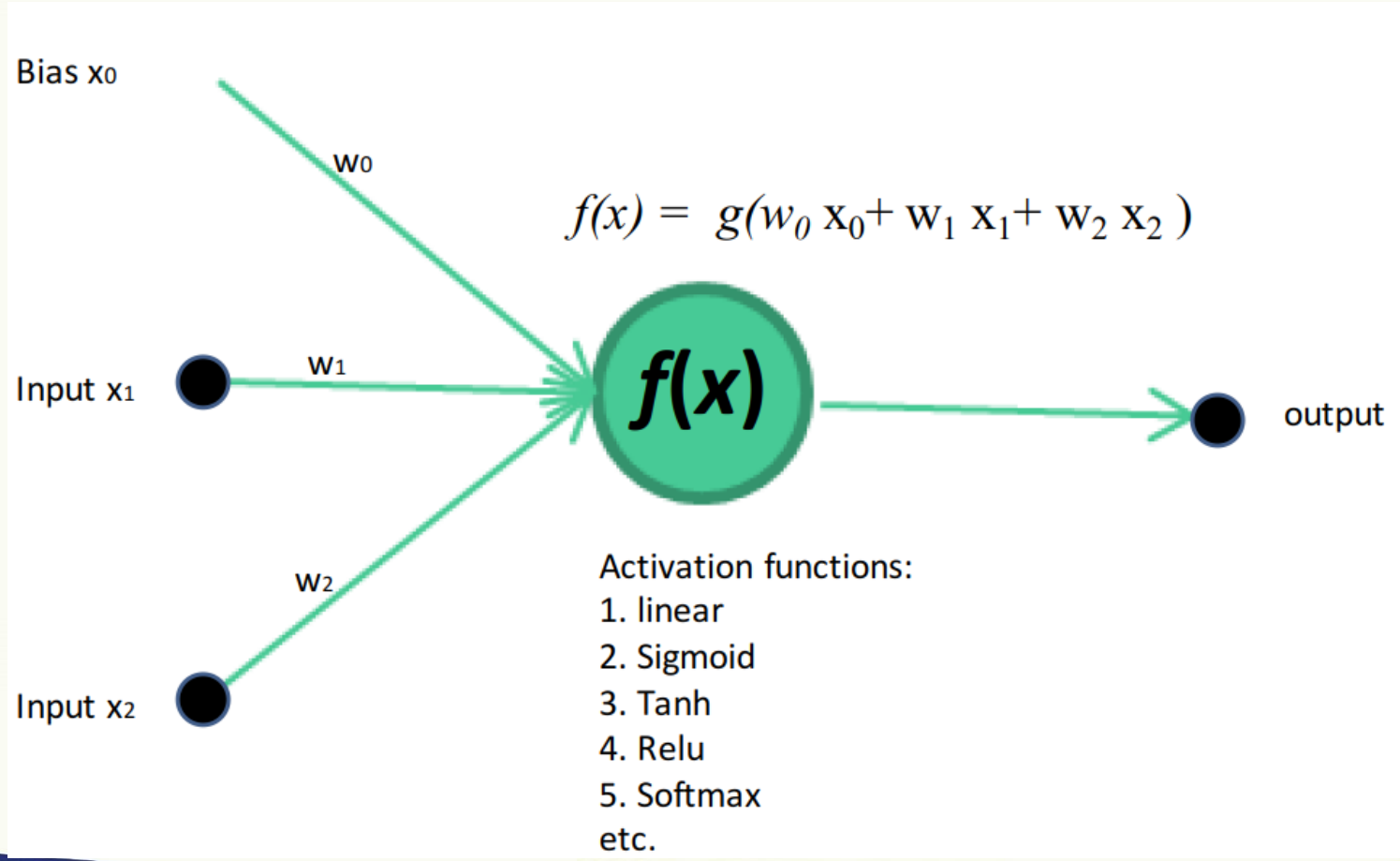




Perceptron Example

Input	Target Output
0	0
1	2
2	4
3	6




Bias x0
w0
$f(x) = g(w_0 x_0 + w_1 x_1 + w_2 x_2)$
Input x1
w1
f(x)
output
w2
Input x2
Activation functions:
1. linear
2. Sigmoid
3. Tanh
4. Relu
5. Softmax
etc.

Input	Target Output	Predicted Output (W=3)
0	0	0
1	2	3
2	4	6
3	6	9

Input	Target Output	Predicted Output (W=3)	Error In Prediction
0	0	0	0
1	2	3	1
2	4	6	2
3	6	9	3

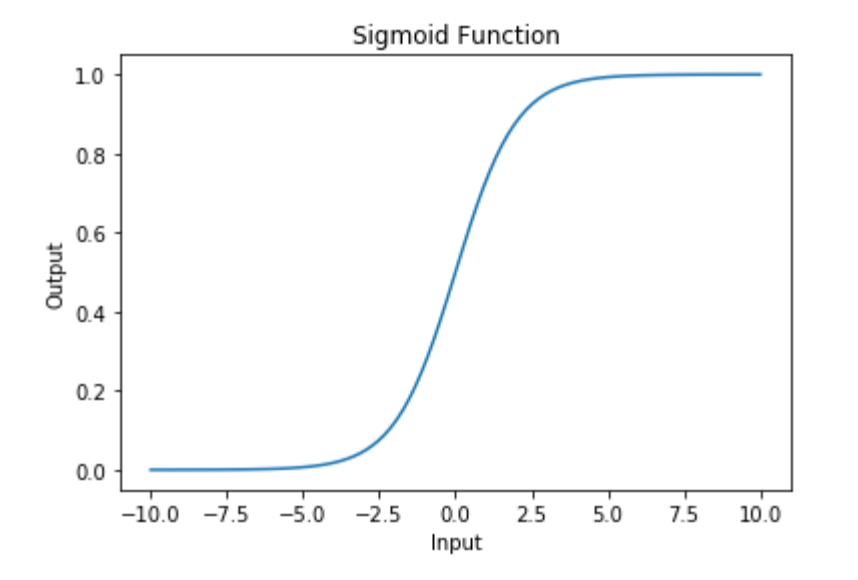
Input	Target Output	Predicted Output (W=2)
0	0	0
1	2	2
2	4	4
3	6	6

Input	Target Output	Predicted Output (W=3)	Error In Prediction	Predicted Output (W=4)
0	0	0	0	0
1	2	3	1	4
2	4	6	2	8
3	6	9	3	12

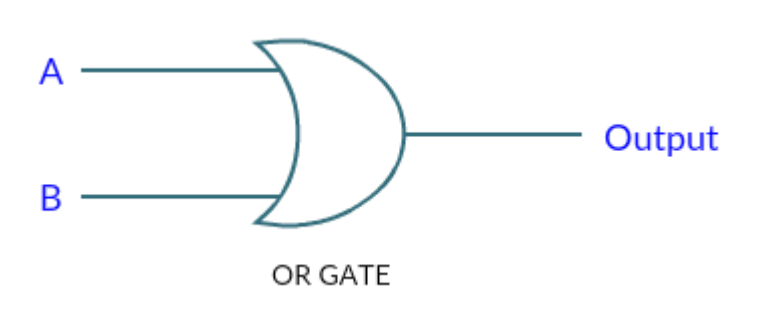
Input	Target Output	Predicted Output (W=2)	Error In Prediction (W=2)
0	0	0	0
1	2	2	0
2	4	4	0
3	6	6	0

Activation Function

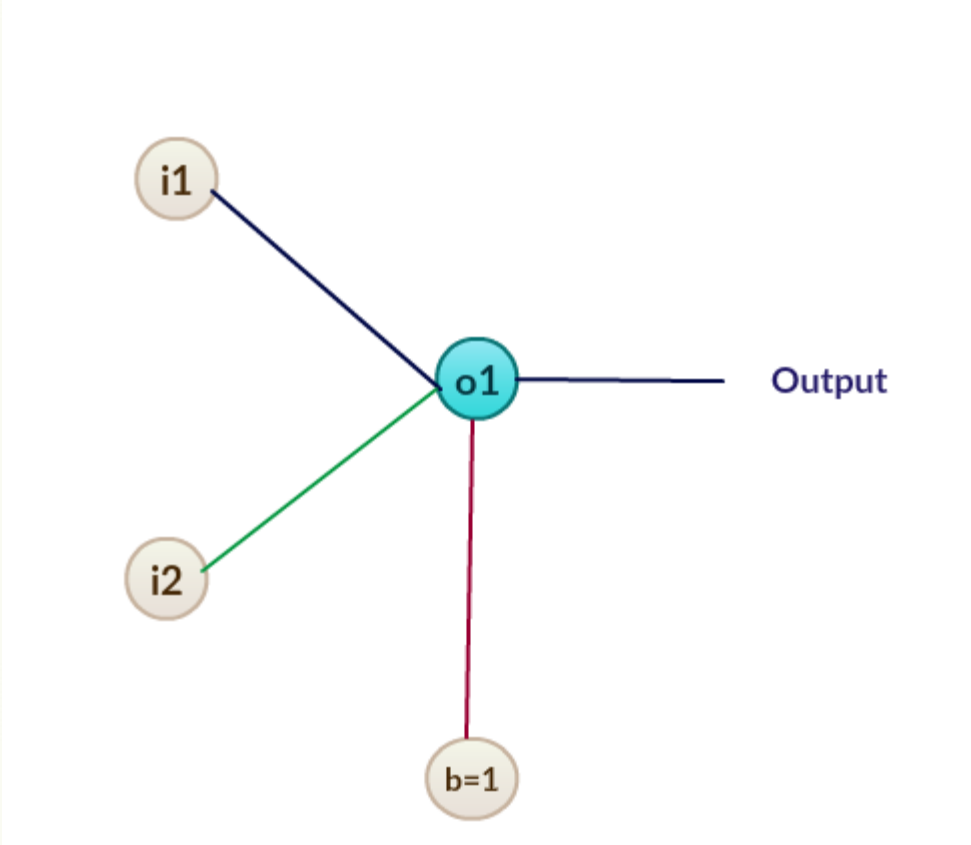
- **Sigmoid Function**



Example (**logical OR Gate**)



Input 1	Input 2	Output
0	0	0
0	1	1
1	0	1
1	1	1

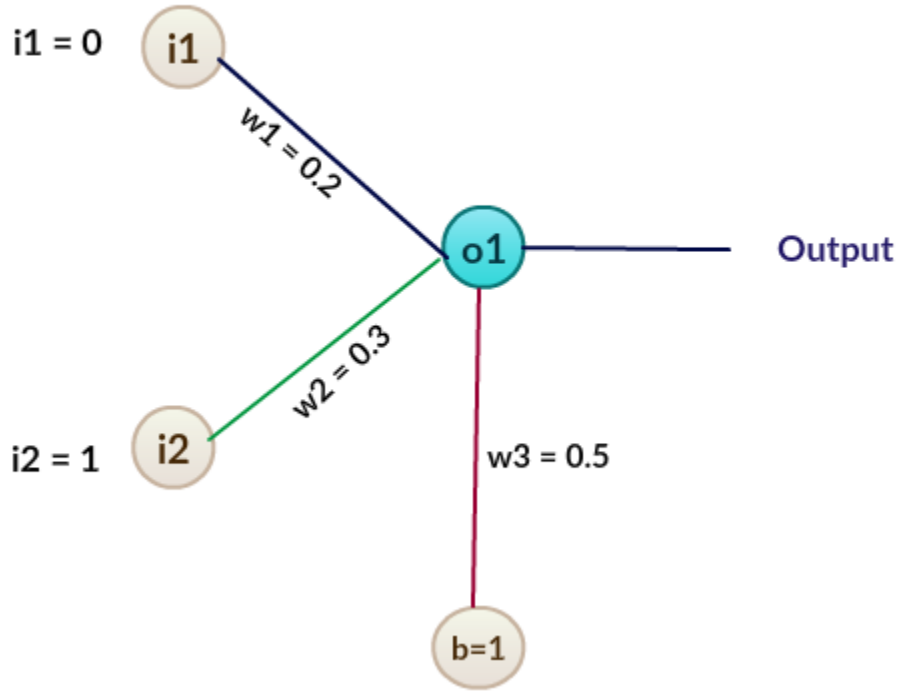


Input for o1 = w1*x1 + w2*x2 + b*x3

= 0.2*0 + 0.3*1 + 0.5*1

= 0 + 0.3 + 0.5

= 0.8



$$f(X) = \frac{1}{1 + e^{-X}}$$

Output for 01 = $\frac{1}{1+e^{-0.8}}$

= 0.68997

$$MSE = \sum \frac{1}{2} * (target - output)^2$$

$$MSE = \frac{1}{2} * (1 - 0.68997)^2 = 0.048059$$