
DEEP LEARNING
SAJID MAJEED

Machine Learning vs Deep Learning

- A Subset of AI that uses statistical methods to enable machines to improve with experience

- A Subset of Machine Learning using Neural Networks with many layers to learn from data

Approach

Uses a variety of algorithms to find patterns in data and make decisions	Automates the process of feature extraction and learns representations from raw data

Feature Engineering

Typically requires manual extraction and selection of features.	Automates feature extraction, learning from raw data directly.

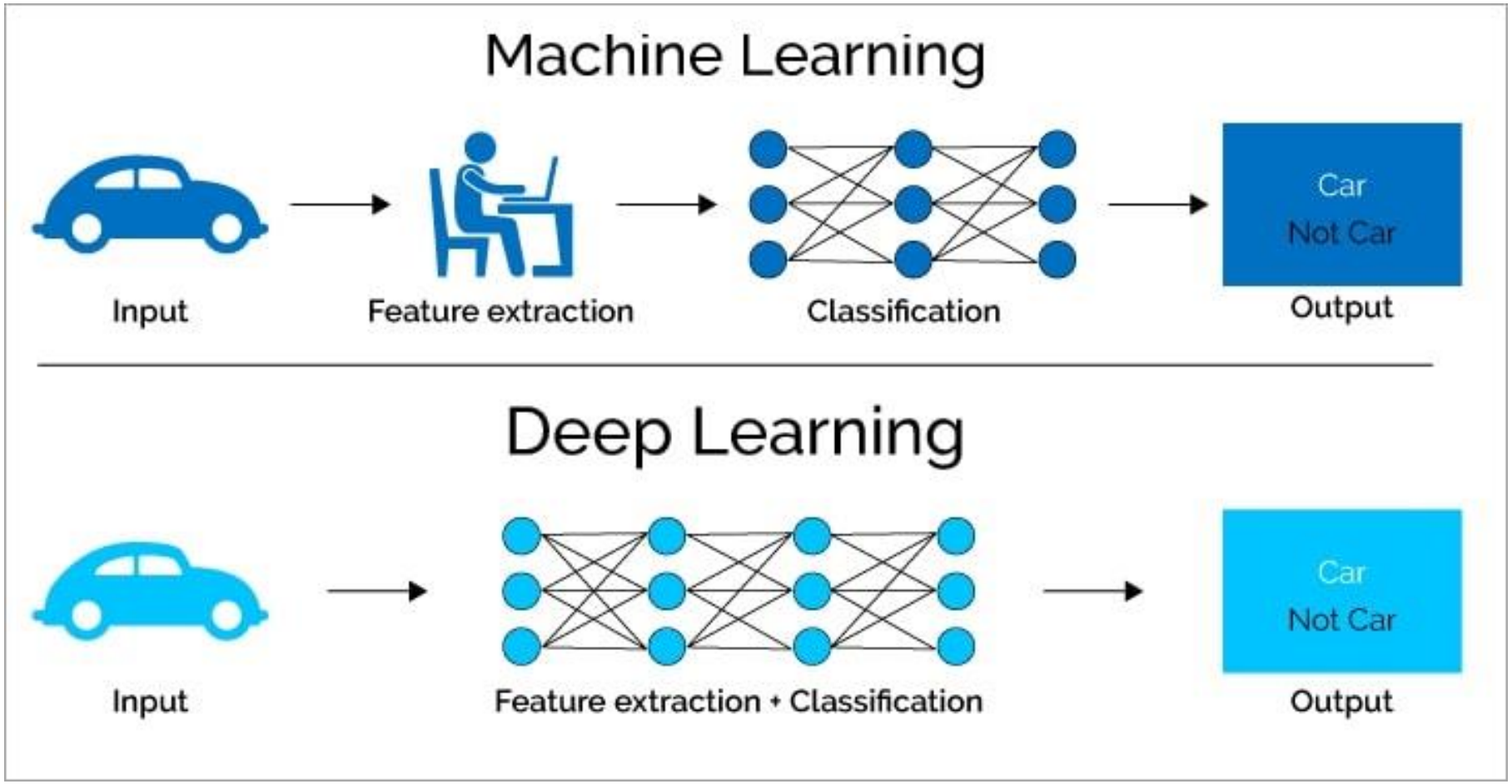
Versatility

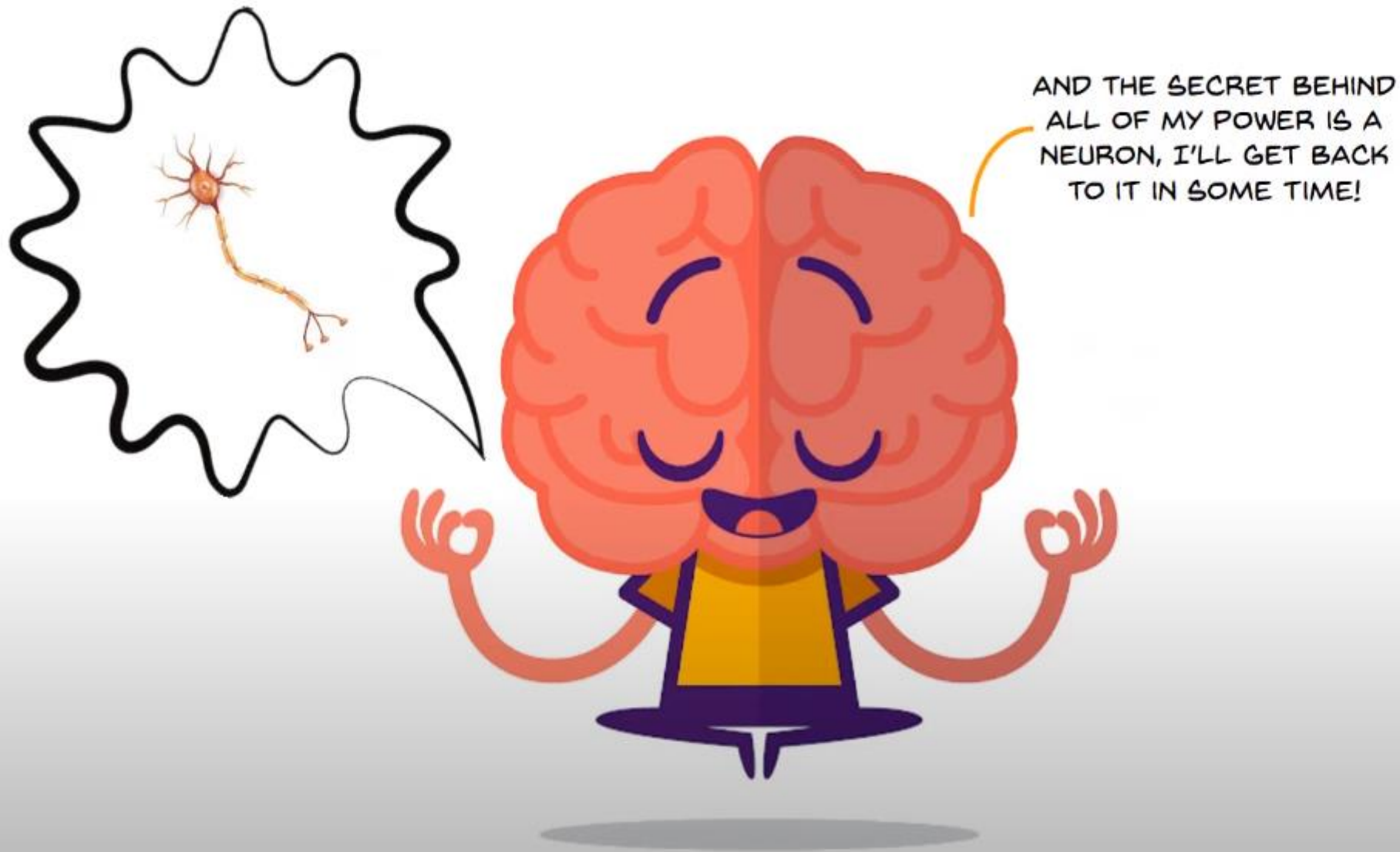
Handles task Regression, classification, clustering , and Anomaly detection.	Particularly strong in image and Speech recognition, and Natural Language Processing.

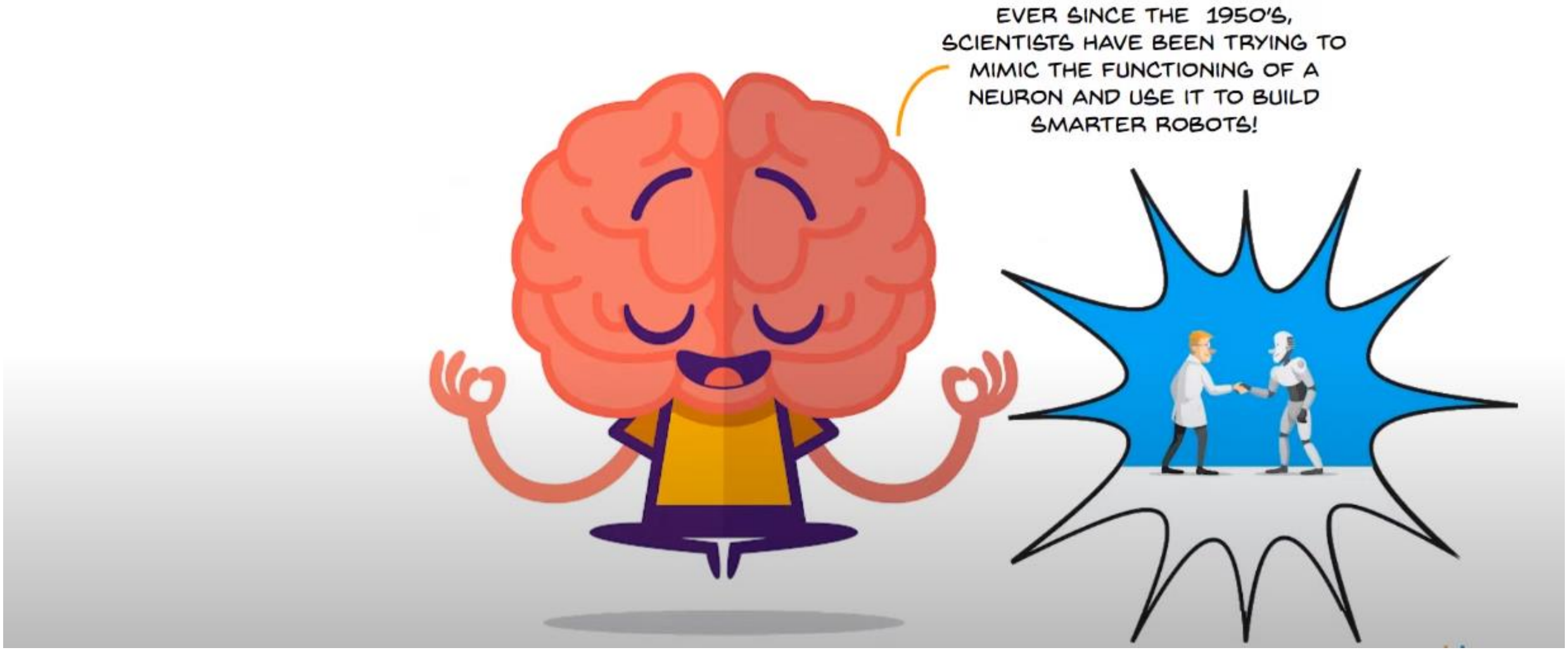
Computation Intensity

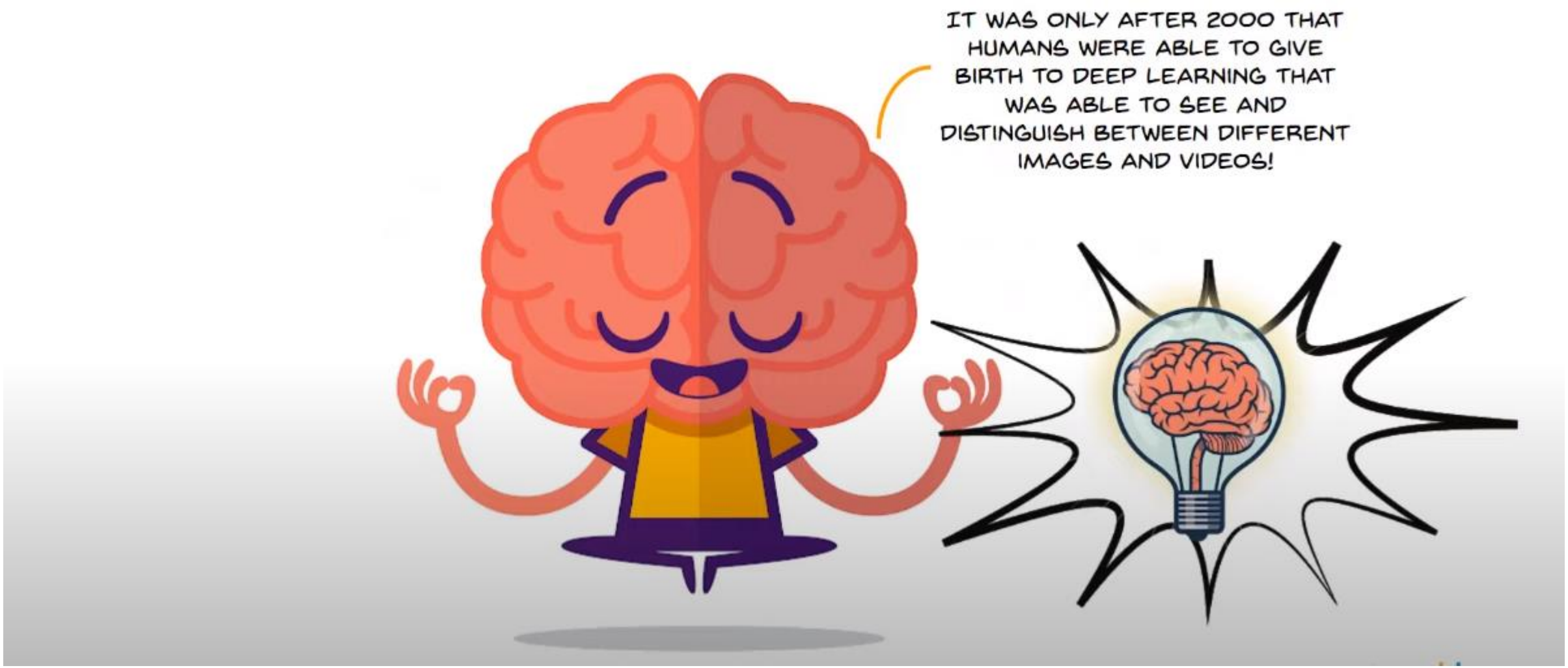
Generally less computationally intensive, can work on standard computing system.	More computationally intensive ,often requires a GPUs and high-end hardware for training

Aspect	Machine Learning	Deep Learning
Definition	A subset of AI that uses statistical methods to enable machines to improve with experience.	A subset of Machine Learning using neural networks with many layers to learn from data.
Approach	Uses a variety of algorithms to find patterns in data and make decisions.	Automates the process of feature extraction and learns representations from raw data.
Feature Engineering	Typically requires manual extraction and selection of features.	Automates feature extraction, learning from raw data directly.
Versatility	Handles tasks like regression, classification, clustering, and anomaly detection.	Particularly strong in image and speech recognition, and natural language processing.
Data Requirement	Often effective with smaller datasets and less data intensive.	Requires large datasets to perform well, due to model complexity.
Computational Intensity	Generally less computationally intensive, can work on standard computing systems.	More computationally intensive, often requires GPUs or high-end hardware for training.


Machine Learning
Input
Feature extraction
Classification
Car
Not Car
Output
Deep Learning
Input
Feature extraction + Classification
Car
Not Car
Output


AND THE SECRET BEHIND ALL OF MY POWER IS A NEURON, I'LL GET BACK TO IT IN SOME TIME!


EVER SINCE THE 1950'S, SCIENTISTS HAVE BEEN TRYING TO MIMIC THE FUNCTIONING OF A NEURON AND USE IT TO BUILD SMARTER ROBOTS!

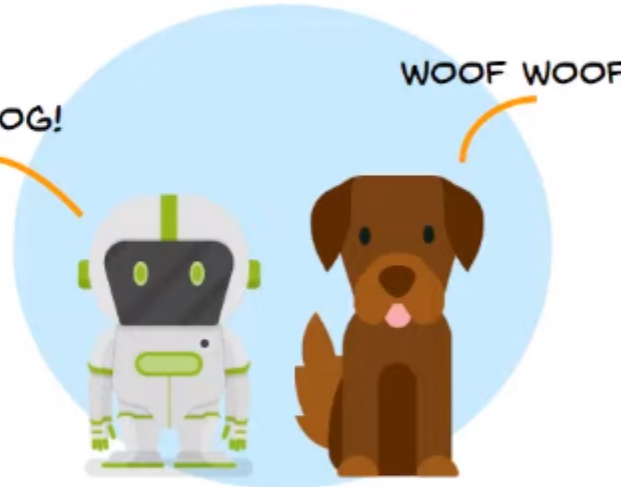

IT WAS ONLY AFTER 2000 THAT HUMANS WERE ABLE TO GIVE BIRTH TO DEEP LEARNING THAT WAS ABLE TO SEE AND DISTINGUISH BETWEEN DIFFERENT IMAGES AND VIDEOS!

DEEP LEARNING IS A MACHINE LEARNING TECHNIQUE THAT TEACHES COMPUTERS TO DO WHAT COMES NATURALLY TO HUMANS: LEARN BY EXAMPLE

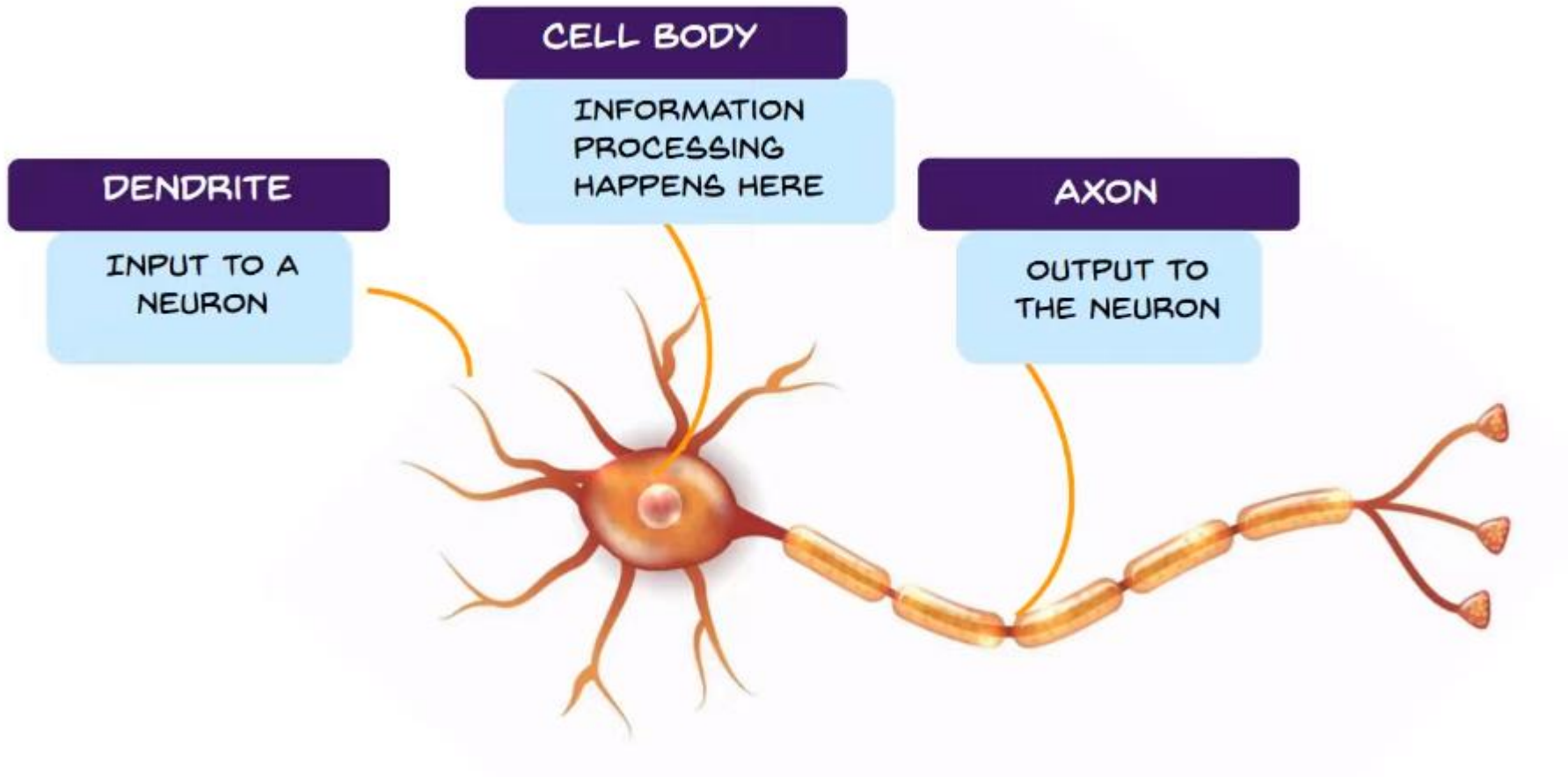
THESE ARE THE IMAGES OF 'DOGS'

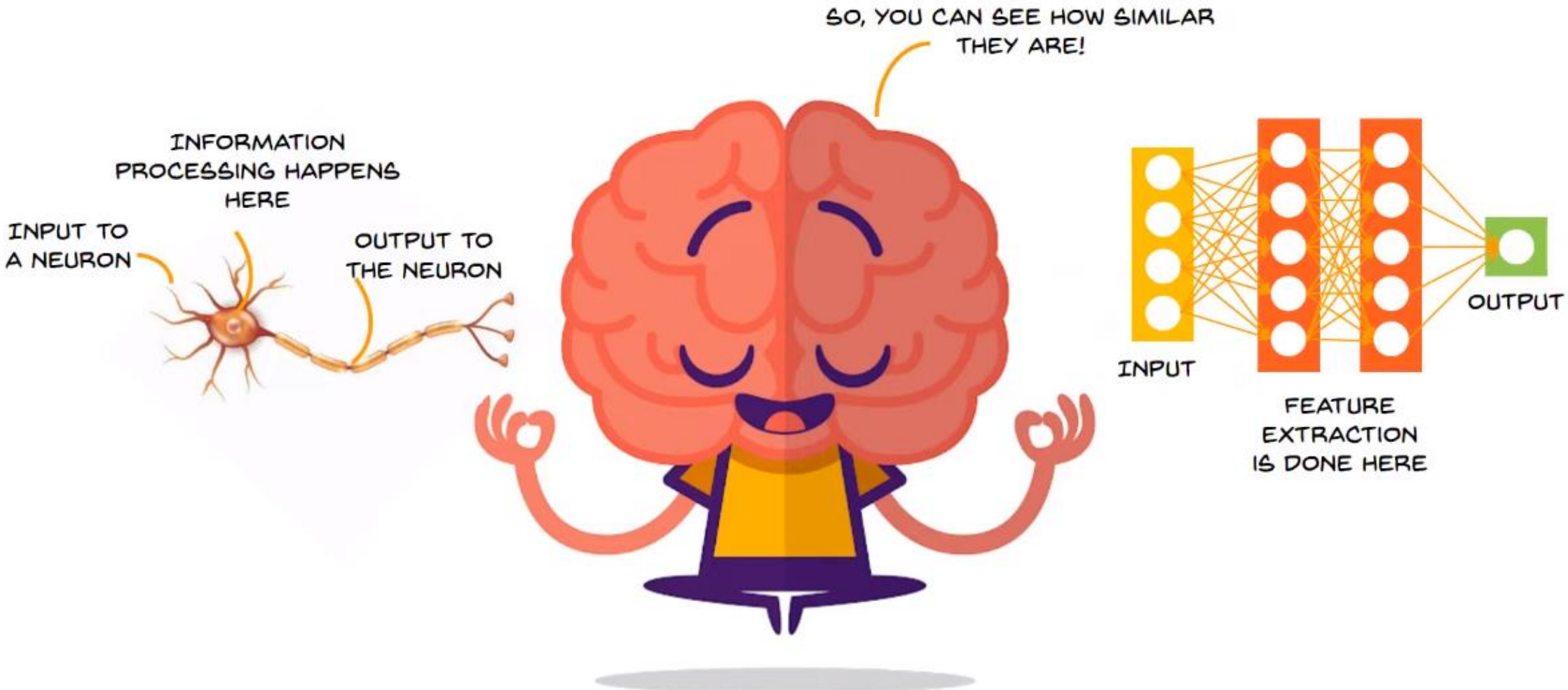
THE ROBOT GETS TRAINED WITH PHOTOS AS EXAMPLE!

DEEP LEARNING IS A MACHINE LEARNING TECHNIQUE THAT TEACHES COMPUTERS TO DO WHAT COMES NATURALLY TO HUMANS: LEARN BY EXAMPLE



AND IS ABLE TO IDENTIFY THE THING THAT IT SAW IN THE IMAGES!

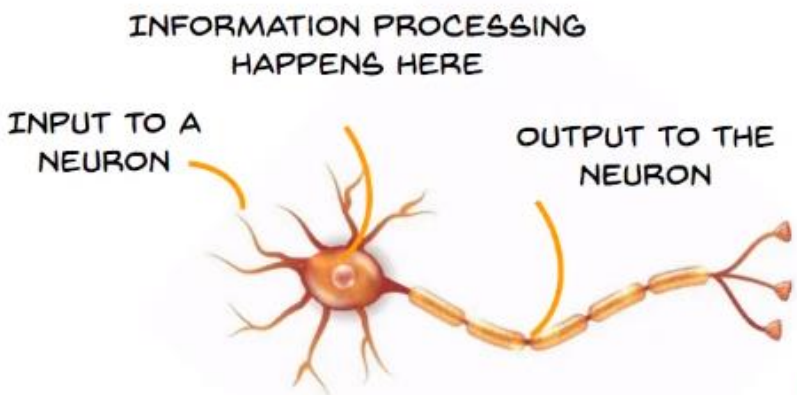

CELL BODY
INFORMATION PROCESSING HAPPENS HERE
DENDRITE
INPUT TO A NEURON
AXON
OUTPUT TO THE NEURON


SO, YOU CAN SEE HOW SIMILAR THEY ARE!
INFORMATION PROCESSING HAPPENS HERE
INPUT TO A NEURON
OUTPUT TO THE NEURON
INPUT
OUTPUT
FEATURE EXTRACTION IS DONE HERE

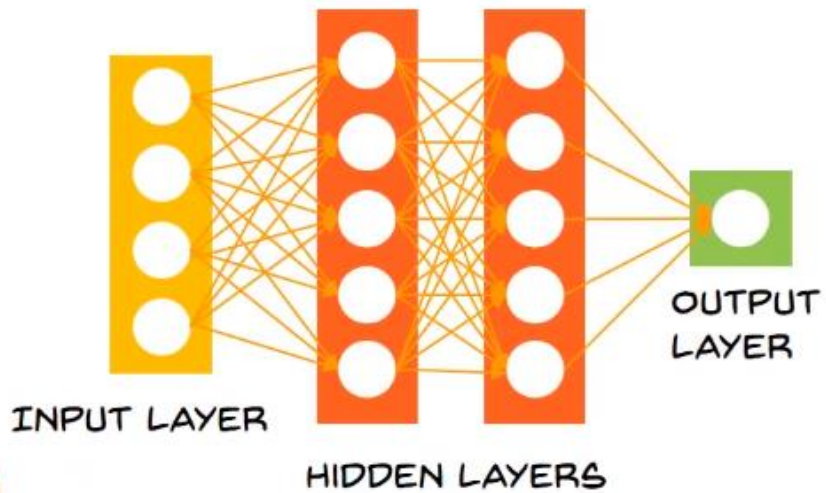
What is Artificial Neural Network?

A NEURAL NETWORK IS A SYSTEM OF HARDWARE AND/OR SOFTWARE PATTERNED AFTER THE OPERATION OF NEURONS IN THE HUMAN BRAIN. NEURAL NETWORKS ALSO CALLED ARTIFICIAL NEURAL NETWORKS IS A WAY OF ACHIEVING DEEP LEARNING

BIOLOGICAL NEURAL NETWORK



ARTIFICIAL NEURAL NETWORK



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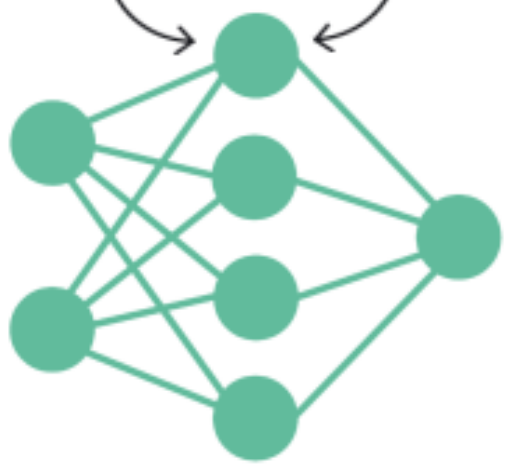
Neural Networks

Similar to humans in that a nueral network constantly adjusts based on changing inputs or situations.

Constantly changing input data

Hidden layer that processes the data



Consistent output data used for analysis

Use Cases for Neural Networks

Example use cases

1) Pattern recognition
2) Forecasting data
3) Credit worthiness
4) Valuation

Pattern recognition – Neural networks help finance and accounting professional identify patterns in the data they have collected, which allows the professional to make more informed business decisions. For example, sales data by customer could be processed through a neural network and could be used to identify customer purchasing behavior.

Forecasting data – Forecasting is critical for any company. A neural network brings another level of sophistication to forecasting.

Credit worthiness – Neural networks have been used to forecast bankruptcy, which helps banks assess a company's credit worthiness when applying for a loan.

Valuation – Valuation models for every industry can be more accurate and sophisticated with the use of neural networks.

Application of ANN

HANDWRITING RECOGNITION

NEURAL NETWORK IS USED TO CONVERT HANDWRITTEN CHARACTERS INTO DIGITAL CHARACTERS THAT THE SYSTEM CAN RECOGNIZE

STOCK EXCHANGE PREDICTION

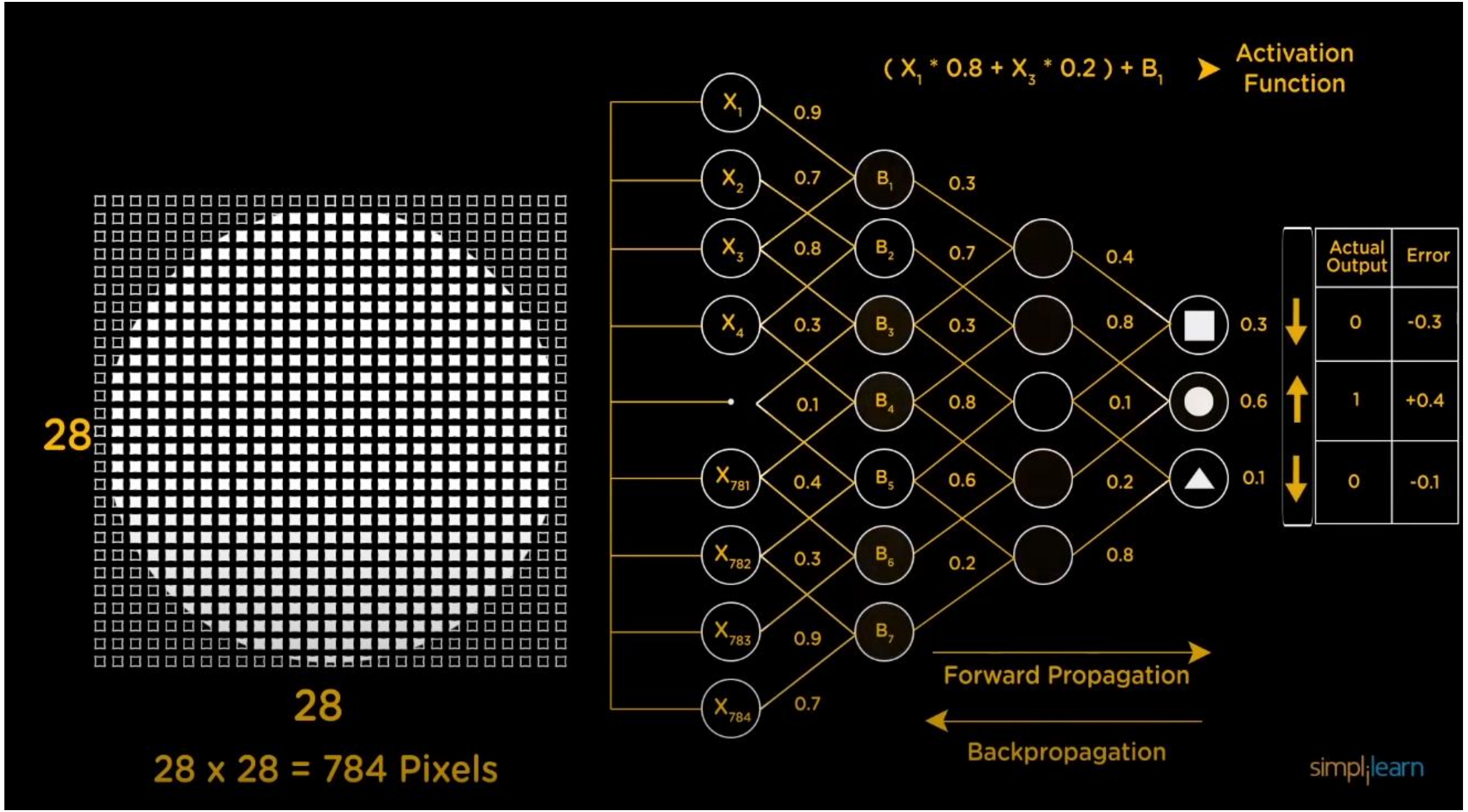
THERE ARE MANY FACTORS THAT EFFECT THE STOCK MARKET. NEURAL NETWORK CAN EXAMINE A LOT OF FACTORS AND PREDICT THE PRICES ON A DAILY BASIS HELPING THE STOCK BROKERS

TRAVELLING SALESMAN PROBLEM

IT REFERS TO FINDING THE OPTIMAL PATH TO TRAVEL BETWEEN ALL CITIES IN AN AREA. NEURAL NETWORK HELPS SOLVE THIS PROBLEM PROVIDING HIGHER REVENUE AT A MINIMAL COST

IMAGE COMPRESSION

IDEA BEHIND DATA COMPRESSION NEURAL NETWORKS IS TO STORE, ENCRYPT AND RE-CREATE THE ACTUAL IMAGE AGAIN.


(X1 * 0.8 + X3 * 0.2) + B1
Activation Function
28
28
28 x 28 = 784 Pixels
X1
X2
X3
X4
X781
X782
X783
X784
0.9
0.7
0.8
0.3
0.1
0.4
0.3
0.9
0.7
B1
B2
B3
B4
B5
B6
B7
0.3
0.7
0.3
0.8
0.6
0.2
0.4
0.8
0.1
0.2
0.8
0.3
0.6
0.1
Actual Output
Error
0
-0.3
1
+0.4
0
-0.1
Forward Propagation
Backpropagation
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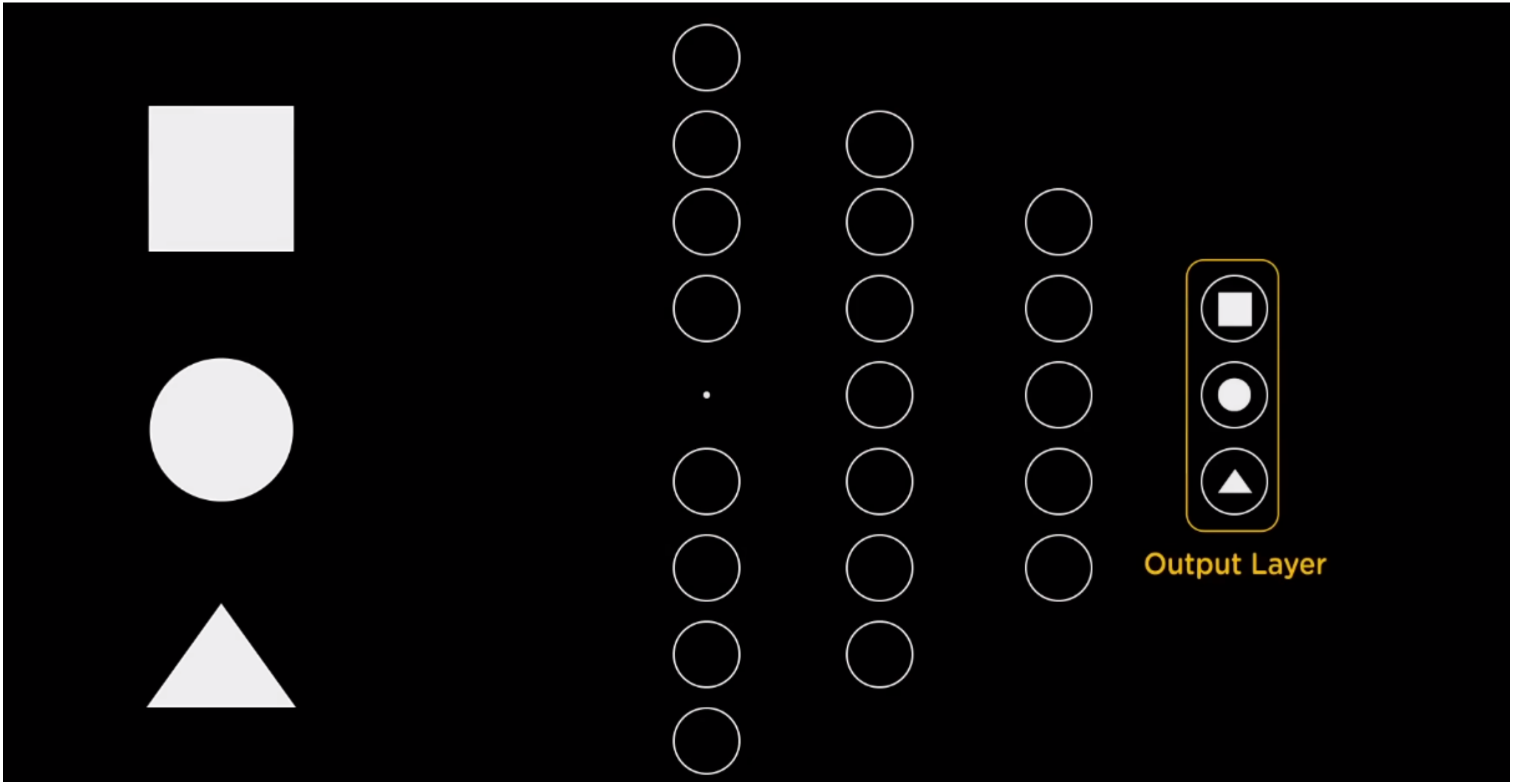
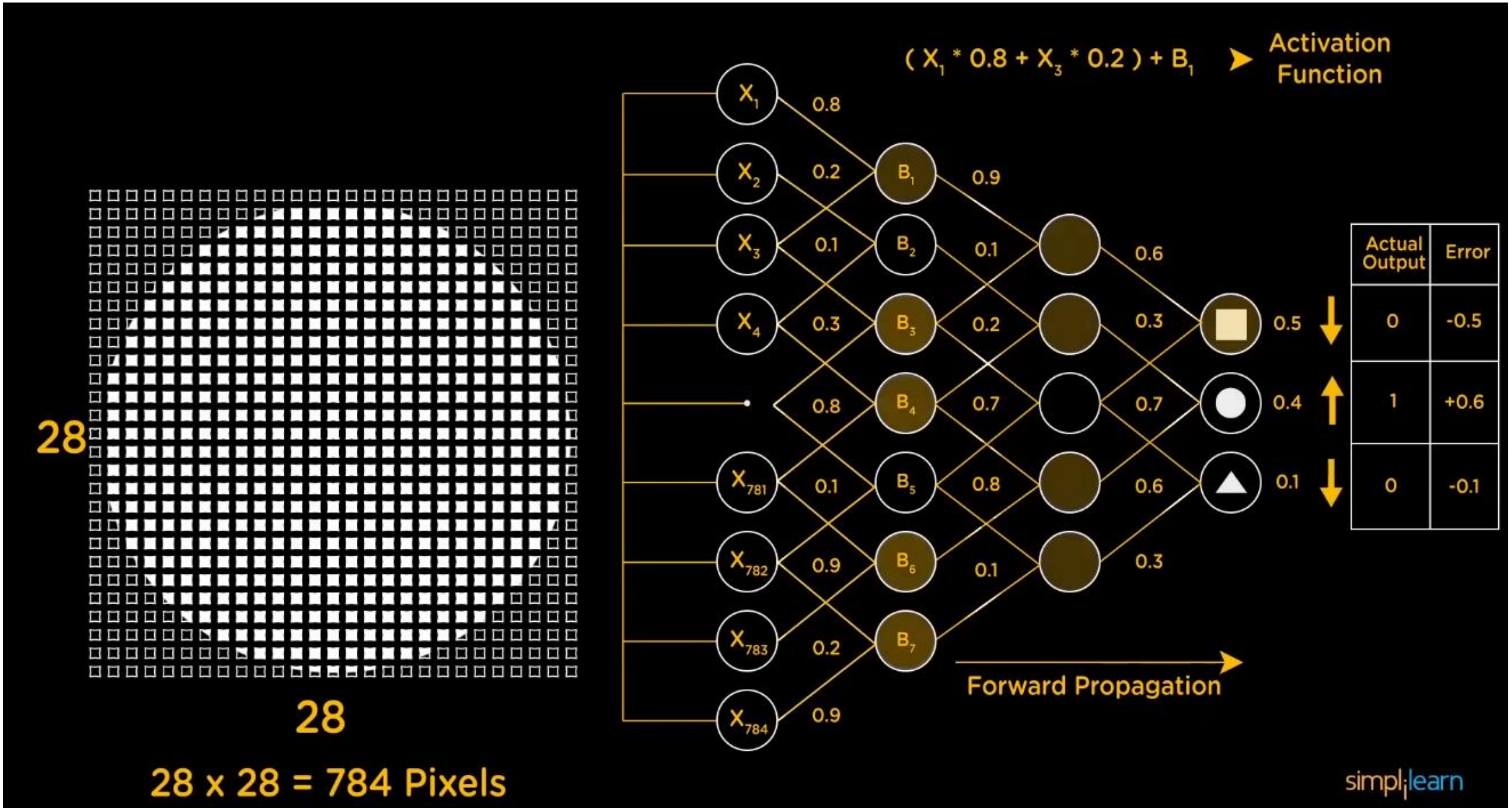

Output Layer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Activation Function
X1
X2
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X4
X781
X782
X783
X784
0.8
0.2
0.1
0.3
0.8
0.1
0.9
0.2
0.1
B1
B2
B3
B4
B5
B6
B7
0.9
0.1
0.2
0.7
0.8
0.1
0.6
0.3
0.7
0.6
0.3
0.5
0.4
0.1
Actual Output
Error
0
-0.5
1
+0.6
0
-0.1
Forward Propagation
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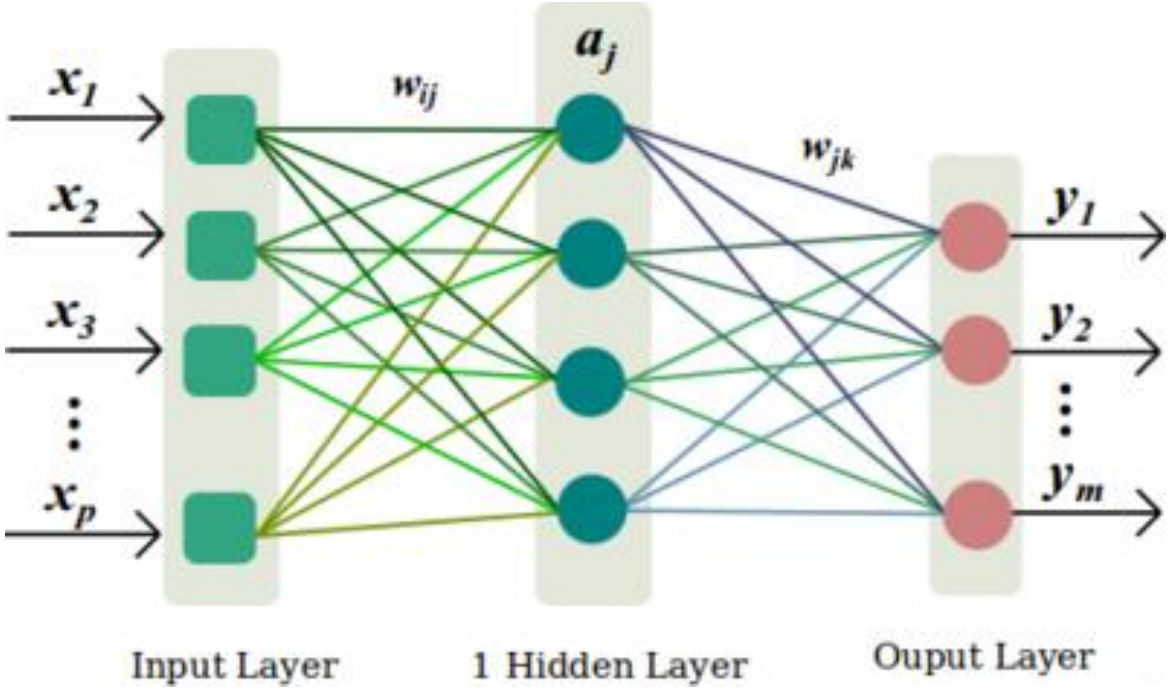
Single Hidden-Layer Neural Network

A Single Hidden-Layer Neural Network is an artificial neural network composed of one Neural Network Input Layer, one hidden neural network layer and one Neural Network Output Layer.



Multiple- Hidden-Layer Neural Network

A Multi-Layer Neural Network is an artificial neural network composed of one Neural Network Input Layer, more then one hidden neural network layer and one Neural Network Output Layer.