



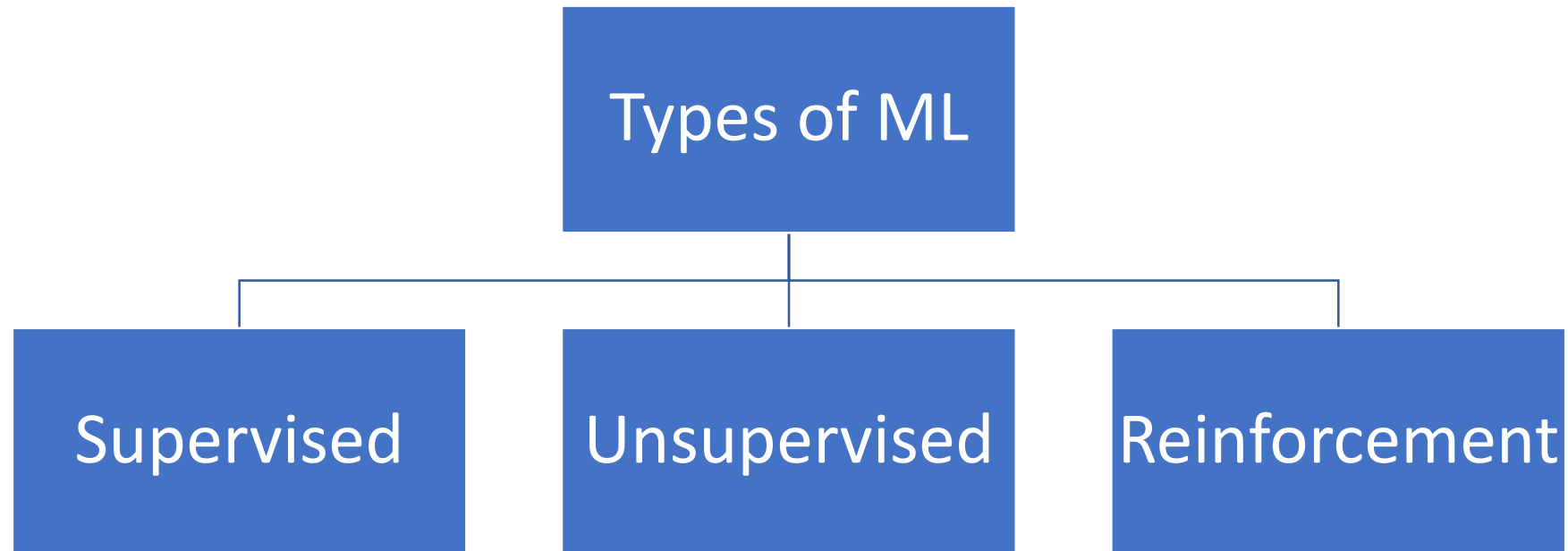
# Introduction to Artificial Intelligence (AI)

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# Types of machine learning

- There are so many different types of Machine Learning systems that it is useful to classify them in broad categories, based on the following criteria
  - Whether or not they are trained with human supervision
    - supervised, unsupervised, and Reinforcement Learning



# Supervised Unsupervised Reinforcement Learning



# Supervised Learning

- The majority of practical machine learning uses supervised learning
- Supervised learning is where you have **input variables (x)** and an **output variable (Y)** and you use an algorithm to learn the mapping function from the input to the output

$$Y = f(X) \quad \longrightarrow \quad \text{model / formula} \quad ,$$

- The goal is to approximate the mapping function so well that when you have new input data (x) that you can predict the output variables (Y) for that data
- It is called supervised learning because the process of an algorithm learning from the training dataset can be thought of as a teacher supervising the learning process
- We know the correct answers, the algorithm iteratively makes predictions on the training data and is corrected by the teacher
- Learning stops when the algorithm achieves an acceptable level of performance (measured in terms of **accuracy**)



# Supervised Learning – Problems

- **Regression**

- Related to predicting future values
- E.g.
  - Population growth prediction
  - Expecting life expectancy
  - Market forecasting/prediction
  - Advertising Popularity prediction
  - Stock prediction
- Algorithms
  - Linear and multi-linear regression
  - Logistic regression
  - Naïve Bayes
  - Support Vector Machine



# Supervised Learning – Problems

- **Classification**

- Related to classify the records
- Based on class / labels ( eg. Email : Spam / Ham , Gender : Male / Female , Loan : Yes / No )
- E.g.
  - Find whether an email received is a spam or ham
  - Identify customer segments
  - Find if a bank loan is granted
  - Identify if a kid will pass or fail in an examination
- Algorithms
  - Logistic Regression
  - Decision Tree
  - Random Forest
  - Support Vector Machine
  - K-nearest neighbor



# Unsupervised Learning

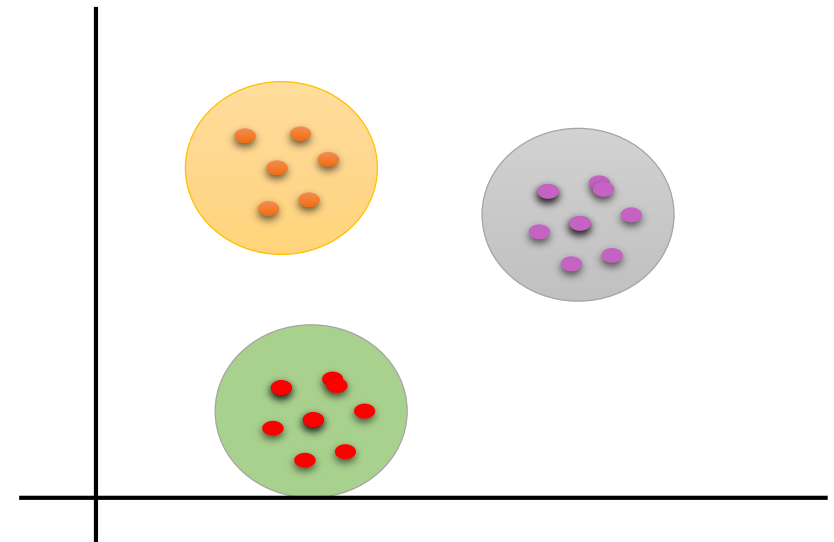
- Unsupervised learning is where you only have input data (X) and no corresponding output variables
- The goal for unsupervised learning is to model the underlying structure or distribution in the data in order to learn more about the data
- These are called unsupervised learning because unlike supervised learning above there is no correct answers and there is no teacher
- Algorithms are left to their own devices to discover and present the interesting **structure** in the data
- Structure in the form of GROUPS / CLUSTERS / ASSOCIATION
- Mostly used for EDA (Exploratory Data Analysis)



# Unsupervised Learning - Problems

- **Clustering**

- discover the inherent groupings in the data, such as grouping customers by purchasing behaviour
- E.g.
  - Batsman vs bowler
  - Customer spending more money vs less money
- Algorithms
  - K-means clustering
  - Hierarchical clustering





# Unsupervised Learning - Problems

- **Association**

- An association rule learning problem is where you want to discover rules that describe large portions of your data, such as people that buy X also tend to buy Y
- E.g.
  - Market basket analysis
- Algorithms
  - Apriori
  - Eclat



# Reinforcement Learning

- It is about taking suitable action to maximize reward in a particular situation
- It is employed by various software and machines to find the best possible behaviour or path it should take in a specific situation
- Reinforcement learning differs from the supervised learning in a way that in supervised learning the training data has the answer key with it so the model is trained with the correct answer itself whereas in reinforcement learning, there is no answer but the reinforcement agent decides what to do to perform the given task
- In the absence of training dataset, it is bound to learn from its experience.
- Examples
  - Resources management in computer clusters
  - Traffic Light Control
  - Robotics
  - Web system configuration
  - Chemistry
- Algorithms
  - Q-Learning
  - Deep Q-Learning



# Deep Learning

- Deep learning is a method in artificial intelligence (AI) that teaches computers to process data in a way that is inspired by the human brain.
- Deep learning models can recognize complex patterns in pictures, text, sounds, and other data to produce accurate insights and predictions.
- Artificial intelligence (AI) attempts to train computers to think and learn as humans do.
- Deep learning technology drives many AI applications used in everyday products, such as the following:
  - Digital assistants
  - Voice-activated television remotes
  - Fraud detection
  - Automatic facial recognition



# How does Deep Learning Works ?

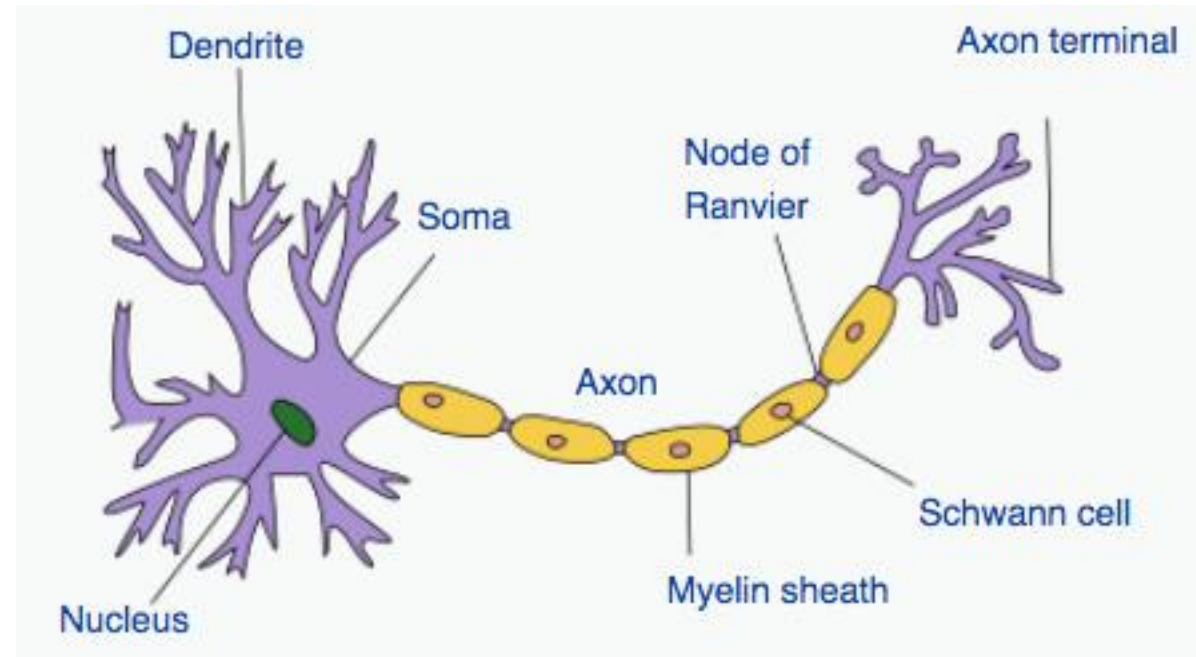
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- Deep learning algorithms are neural networks that are modeled after the human brain.
- For example, a human brain contains millions of interconnected neurons that work together to learn and process information.
- Similarly, deep learning neural networks, or artificial neural networks, are made of many layers of artificial neurons that work together inside the computer.



# Neuron

- A neuron or nerve cell, is an electrically excitable cell that communicates with other cells via specialized connections called synapses
- A typical neuron consists of a cell body (soma), dendrites, and a single axon
- The soma is the body of the neuron
- The dendrites of a neuron are cellular extensions with many branches
- The axon primarily carries nerve signals away from the soma, and carries some types of information back to it



# Types of Neural Network

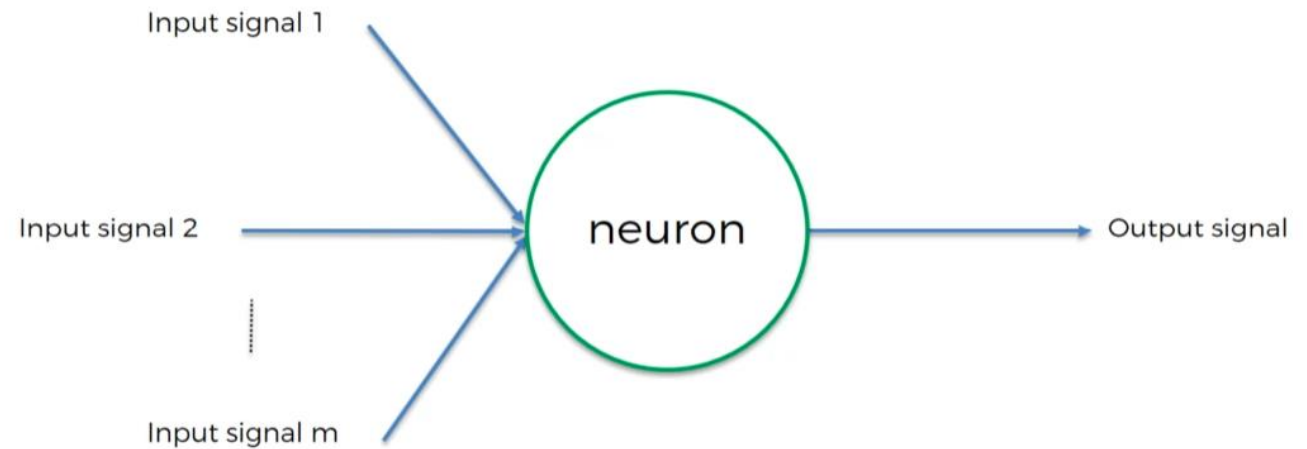
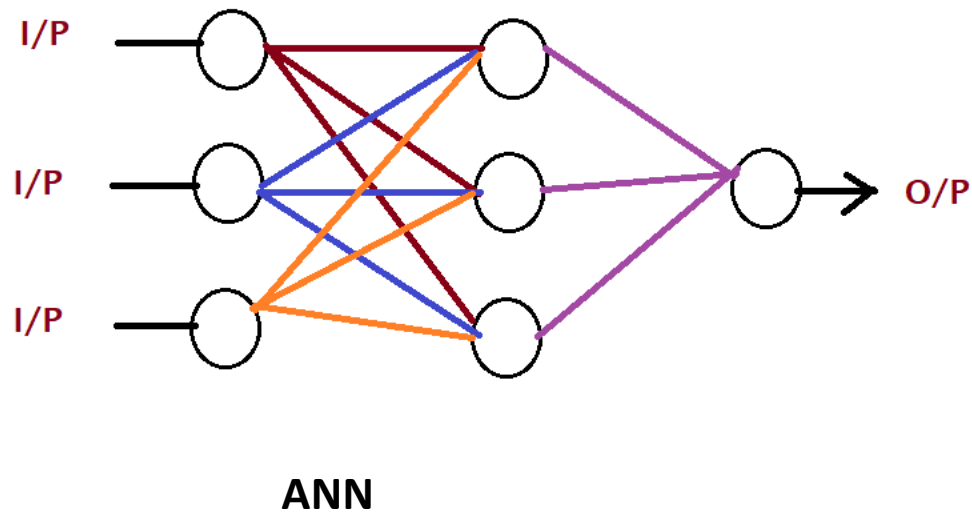
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- Artificial Neural Networks (ANN)
- Convolution Neural Networks (CNN)
- Recurrent Neural Networks (RNN)



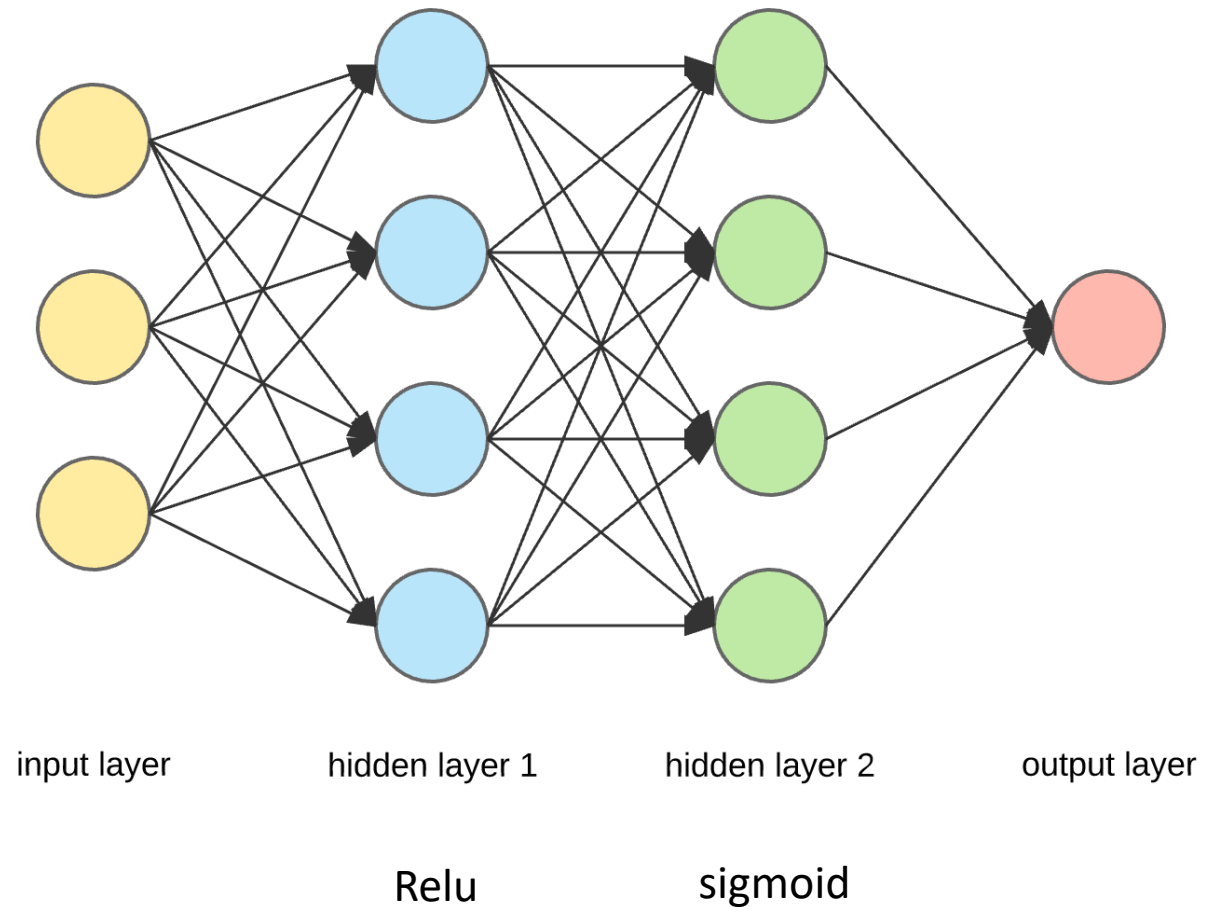
# Artificial Neural Network

- Artificial neural networks (ANN) or connectionist systems are computing systems vaguely inspired by the biological neural networks that constitute animal brains
- The basic building block is a neuron



# Artificial Neural Network

- Artificial Neural Networks (ANN) are **multi-layer** fully-connected neural nets
- They consist of an **input layer**, multiple hidden layers, and an **output layer**
- Every node in one layer is connected to every other node in the next layer
- We can make the network deeper by increasing the number of hidden layers.





# Characteristics of Artificial Neural Network

- It is neurally implemented mathematical model
- It contains huge number of interconnected processing elements called **neurons** to do all operations
- Information stored in the neurons are basically the weighted linkage of neurons
- The input signals arrive at the processing elements through connections and connecting weights.
- It has the ability to learn , recall and generalize from the given data by suitable assignment and adjustment of weights.
- The collective behavior of the neurons describes its computational power, and no single neuron carries specific information

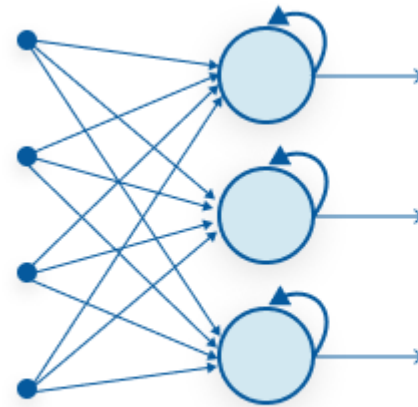


# Application of Neural Network

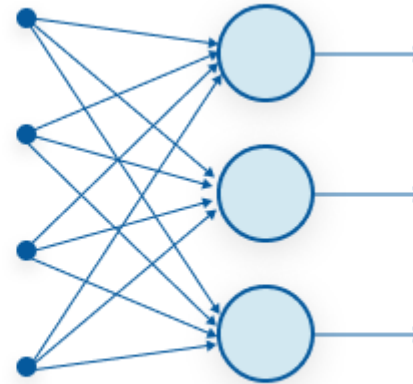
- Neural network is suitable for the research on *Animal behavior, predator/prey relationships etc.*
- It would be easier to do *proper valuation* of property, buildings, automobiles, machinery etc. with the help of neural network.
- Neural Network can be used in betting on horse races, sporting events and most importantly in stock market .
- It can be used to predict the correct judgement for any crime by using a large data of crime details as input and the resulting sentences as output.
- By analyzing data and determining which of the data has any fault ( files diverging from peers ) called as *Data mining, cleaning and validation* can be achieved through neural network.
- Neural Network can be used to predict targets with the help of echo patterns we get from sonar, radar, seismic and magnetic instruments .
- It can be used efficiently in *Employee hiring* so that any company can hire right employee depending upon the skills the employee has and what should be it's productivity in future .
- It has a large application in *Medical Research* .
- It can be used to for *Fraud Detection* regarding credit cards , insurance or taxes by analyzing the past records



- A looping constraint on the hidden layer of ANN turns to RNN.
- We can use recurrent neural networks to solve the problems related to:
  - Time Series data
  - Text data
  - Audio data



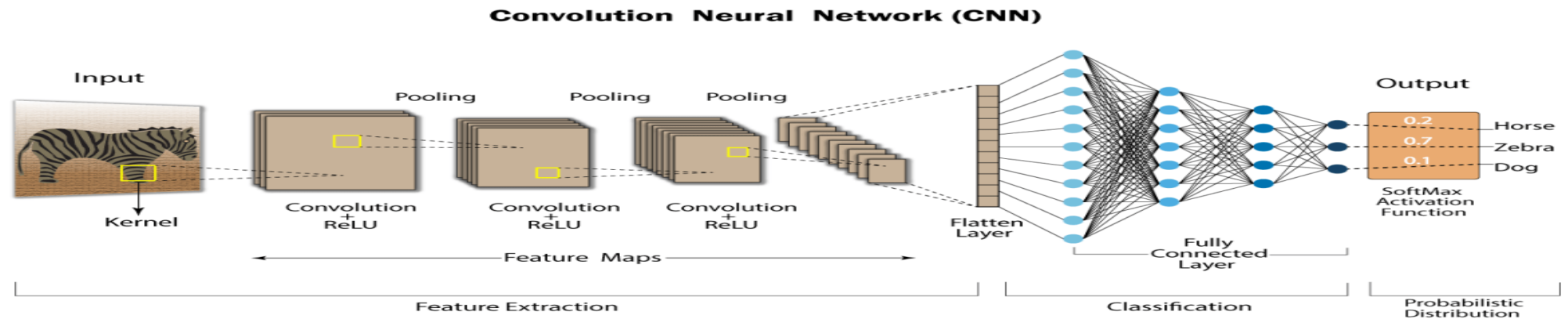
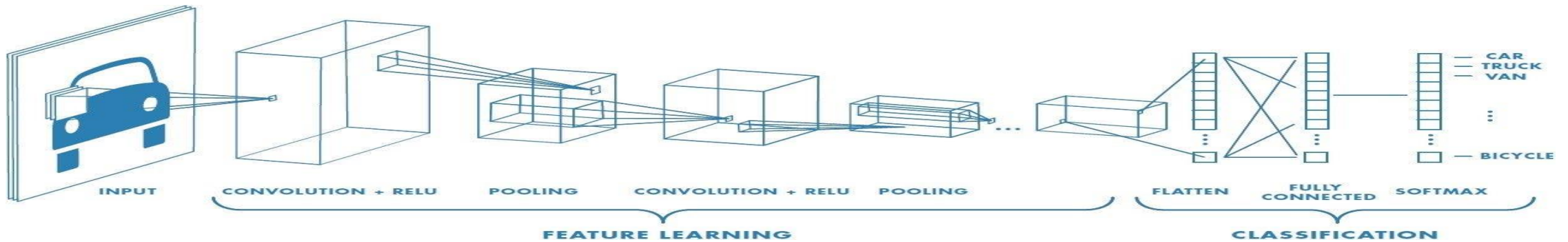
Recurrent Neural Network



Feed-Forward Neural Network

# Convolution Neural Network (CNN)

- These CNN models are being used across different applications and domains, and they're especially used in image and video processing projects.



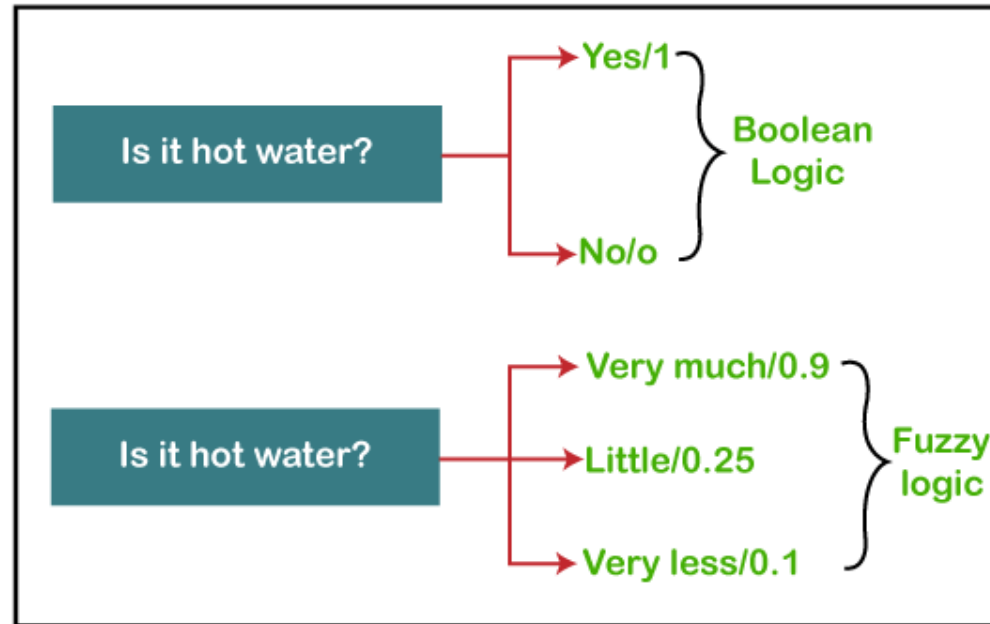
# Fuzzy Logic

- The '**Fuzzy**' word means the things that are not clear or are vague.
- Sometimes, we cannot decide in real life that the given problem or statement is either true or false.
- At that time, this concept provides many values between the true and false and gives the flexibility to find the best solution to that problem.
- In artificial intelligence systems, fuzzy logic is used to imitate human reasoning and cognition.
- fuzzy logic is well-suited for the following:
  - Engineering for decisions without clear certainties and uncertainties, or with imprecise data -- such as with natural language processing technologies; and
  - Regulating and controlling machine outputs, according to multiple inputs/input variables -- such as with temperature control systems.



# Example of Fuzzy Logic

- Fuzzy logic contains the multiple logical values and these values are the truth values of a variable or problem between 0 and 1.
- This concept provides the possibilities which are not given by computers, but similar to the range of possibilities generated by humans.
- the fuzzy system, there are multiple possibilities present between the 0 and 1, which are partially false and partially true



# Computer Vision

- Computer vision is the computer's ability to extract information and insights from images and videos.
- Computers can use deep learning techniques to comprehend images in the same way that humans do.
- Computer vision has several applications, such as the following:
  - Content moderation to automatically remove unsafe or inappropriate content from image and video archives
  - Facial recognition
  - Image classification



# What is NLP?

- Natural Language Processing (NLP) refers to AI method of communicating with an intelligent systems using a natural language such as English
- It is the sub-field of AI that is focused on enabling computers to understand and process human language
- The ultimate objective of NLP is to read, decipher, understand, and make sense of the human languages in a manner that is valuable
- Most NLP techniques rely on machine learning to derive meaning from human languages





# Uses cases of NLP

- NLP enables the recognition and **prediction of diseases** based on electronic health records and patient's own speech
- Organizations can determine what customers are saying about a service or product by identifying and extracting information in sources like social media (**sentiment analysis**)
- Companies like Yahoo and Google filter and classify your emails with NLP by analyzing text in emails that flow through their servers and **stopping spam** before they even enter your inbox
- To help **identifying fake news**, a system can be developed to determine if a source is accurate or politically biased, detecting if a news source can be trusted or not
- Amazon's Alexa and Apple's Siri are examples of intelligent **voice driven interfaces** that use NLP to respond to vocal prompts
- NLP is also being used in both the search and selection phases of **talent recruitment**
- NLP is particularly booming in the **healthcare industry**



# Terminology used in NLP

- **Phonology**
  - It is study of organizing sound systematically.
- **Morphology**
  - It is a study of construction of words from primitive meaningful units.
- **Morpheme**
  - It is primitive unit of meaning in a language.
- **Syntax**
  - It refers to arranging words to make a sentence. It also involves determining the structural role of words in the sentence and in phrases.
- **Semantics**
  - It is concerned with the meaning of words and how to combine words into meaningful phrases and sentences.
- **Pragmatics**
  - It deals with using and understanding sentences in different situations and how the interpretation of the sentence is affected.
- **Discourse**
  - It deals with how the immediately preceding sentence can affect the interpretation of the next sentence.
- **World Knowledge**
  - It includes the general knowledge about the world.



# Steps in NLP

## Lexical Analysis

It involves identifying and analyzing the structure of words. Lexicon of a language means the collection of words and phrases in a language. Lexical analysis is dividing the whole chunk of txt into paragraphs, sentences, and words

## Syntactic Analysis

It involves analysis of words in the sentence for grammar and arranging words in a manner that shows the relationship among the words. The sentence such as “The school goes to boy” is rejected by English syntactic analyzer

## Semantic Analysis

It draws the exact meaning or the dictionary meaning from the text. The text is checked for meaningfulness. It is done by mapping syntactic structures and objects in the task domain.

## Discourse Integration

The meaning of any sentence depends upon the meaning of the sentence just before it. In addition, it also brings about the meaning of immediately succeeding sentence.

## Pragmatic Analysis

During this, what was said is re-interpreted on what it actually meant. It involves deriving those aspects of language which require real world knowledge



# AI Uses and Applications

## Natural Language Processing (NLP)

- AI is used in NLP to analyze and understand human language.
- speech recognition, machine translation, sentiment analysis
- Eg. Siri , alexa

## Image and Video Analysis

- AI techniques, including computer vision, enable the analysis and interpretation of images and videos.
- Eg. facial recognition, object detection, medical imaging

## Robotics and Automation

- Robots equipped with AI algorithms can perform complex tasks in manufacturing, healthcare, logistics, and exploration.
- They can adapt to changing environments, learn from experience, and collaborate with humans.



# AI Uses and Applications Cont...

## Recommendation Systems

- AI-powered recommendation systems are used in e-commerce, streaming platforms, and social media to personalize user experiences.

## Financial Services

- AI is extensively used in the finance industry for fraud detection, algorithmic trading, credit scoring, and risk assessment. Machine learning models can analyze vast amounts of financial data to identify patterns and make predictions.

## Healthcare

- AI applications in healthcare include disease diagnosis, medical imaging analysis, drug discovery, personalized medicine, and patient monitoring. AI can assist in identifying patterns in medical data and provide insights for better diagnosis and treatment.



# AI Uses and Applications Cont..

## Virtual Assistants and Chatbots

- AI-powered virtual assistants and chatbots interact with users, understand their queries, and provide relevant information or perform tasks. They are used in customer support, information retrieval, and personalized assistance.

## Gaming

- AI algorithms are employed in gaming for creating realistic virtual characters, opponent behavior, and intelligent decision-making. AI is also used to optimize game graphics, physics simulations, and game testing.

## Smart Homes and IoT

- AI enables the development of smart home systems that can automate tasks, control devices, and learn from user preferences. AI can enhance the functionality and efficiency of Internet of Things (IoT) devices and networks

## Cybersecurity

- AI helps in detecting and preventing cyber threats by analyzing network traffic, identifying anomalies, and predicting potential attacks. It can enhance the security of systems and data through advanced threat detection and response mechanisms.



# Advantages and Disadvantages of AI

- Pros
  - It reduces human error
  - It never sleeps, so it's available 24x7
  - It never gets bored, so it easily handles repetitive tasks
  - It's fast
- Cons
  - It's costly to implement
  - It can't duplicate human creativity
  - It will definitely replace some jobs, leading to unemployment
  - People can become overly reliant on it



# Current Trends and Future Directions in AI

- When one considers the computational costs and the technical data infrastructure running behind artificial intelligence, actually executing on AI is a complex and costly
- Ai in transportation
- Ai in manufacturing
- Ai in healthcare
- AI IN education
- AI in media
- AI in customer service





# Thank You

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