UNIT-1
INTRODUCTION TO MACHINE LEARNING

Prepared by : Ritesh Prajapati

INTRODUCTION TO MACHINE LEARNING(4350702)

SEMESTER-5 DIPLOMA COMPUTER ENGINEERING

Topics

1.1.1 Overview of Human Learning and Machine Learning

1.1.2 Types of Machine Learning:

- Supervised Machine Learning
- Unsupervised Machine Learning
- Reinforcement Learning.

1.1.3 Applications of Machine Learning

1.1.4 Tools and Technology for Machine Learning

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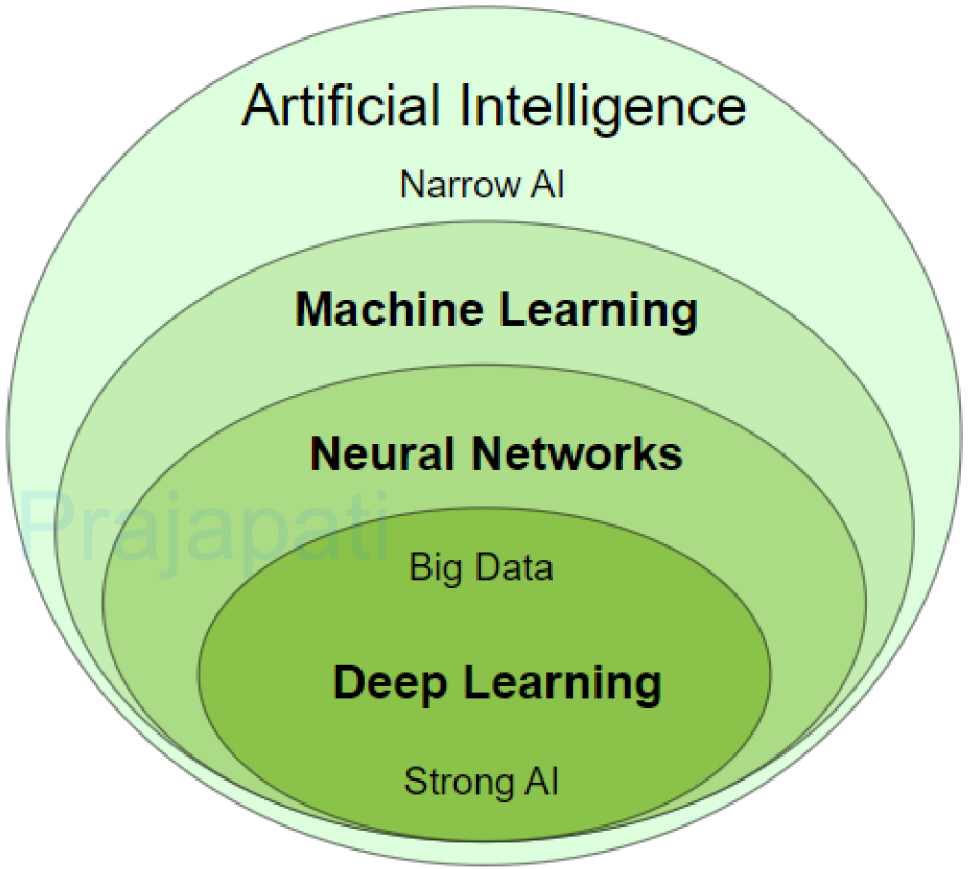
Background

- **Machine Learning** is a subfield of **Artificial intelligence**

- **Artificial Intelligence** suggest that machines can mimic humans in:
- Talking
- Thinking
- Learning
- Planning
- Understanding



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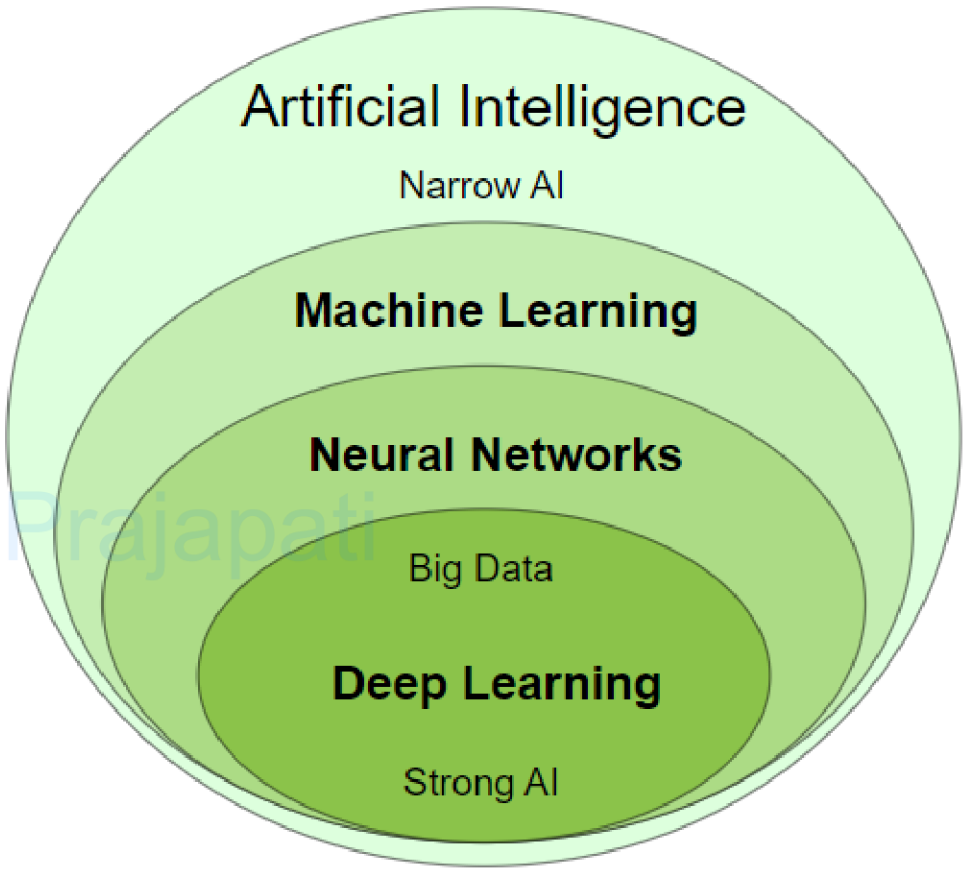
Background

- **Narrow AI** is limited to narrow (specific) areas like:
- Email spam Filters
- Text to Speech
- Speech Recognition
- Self Driving Car
- Text Autocorrect
- Automated Translation
- Chatbots
- Face Detection
- Flying Drones
- Apple's Siri
- Microsoft's Cortana
- Amazon's Alexa



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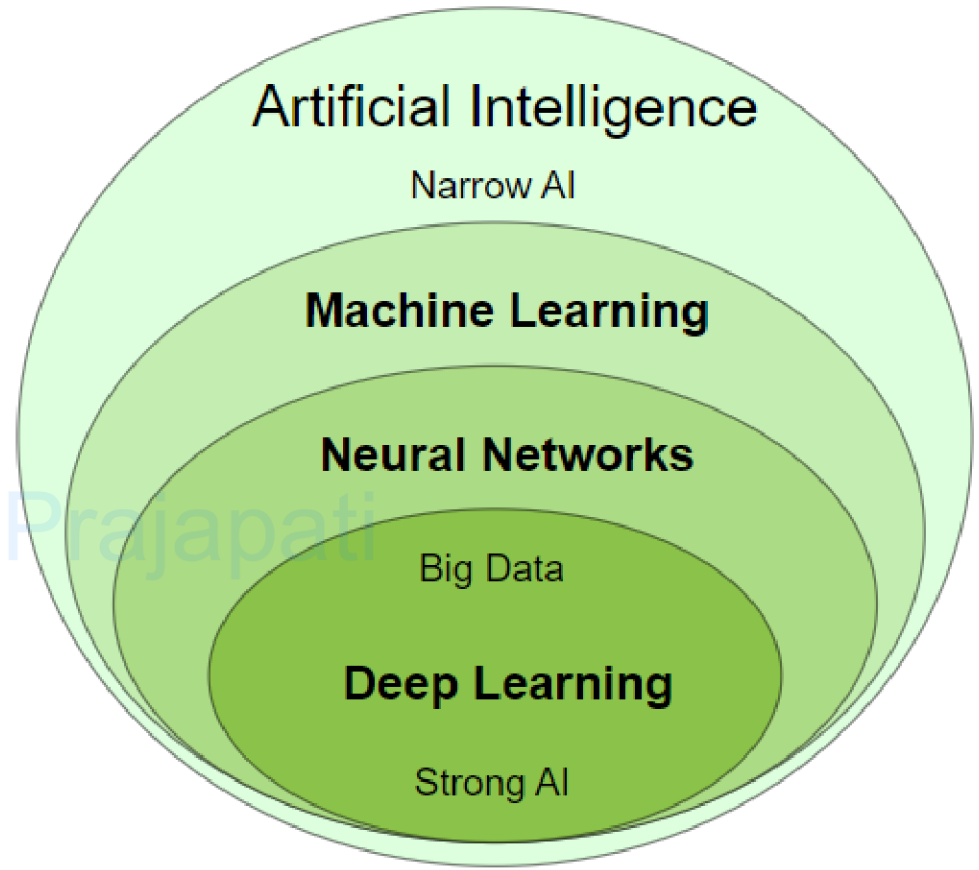
Background

- **Narrow AI** is also called **Weak AI**.

- Weak AI: Built to **simulate** human intelligence.
- Strong AI: Built to **copy** human intelligence.

- **Strong AI** is the type of AI that mimics human intelligence.
- Strong AI indicates the ability to think, plan, learn, and communicate.
- Strong AI is the theoretical next level of AI: **True Intelligence**.



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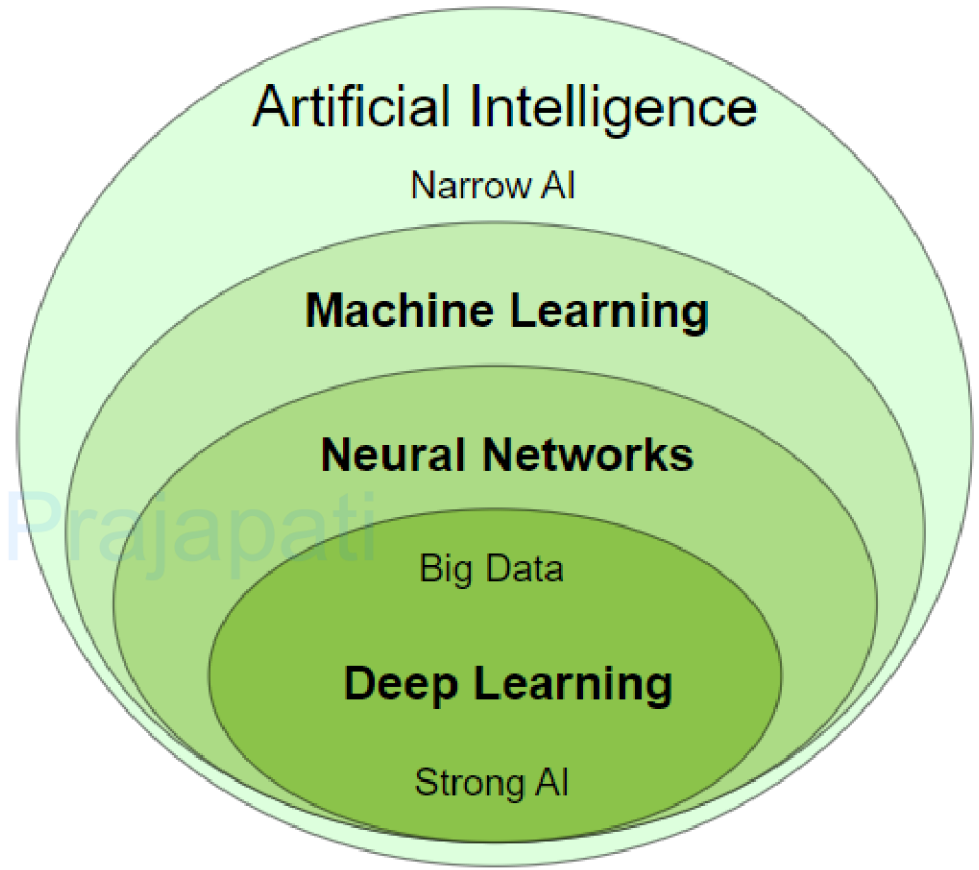
Background

- Machine Learning (ML)
- Traditional programming **uses known algorithms** to produce results from data:

DATA + ALGORITHMS = **RESULTS**

- Machine learning **creates new algorithms** from data and results:

DATA + RESULTS = **ALGORITHMS**.



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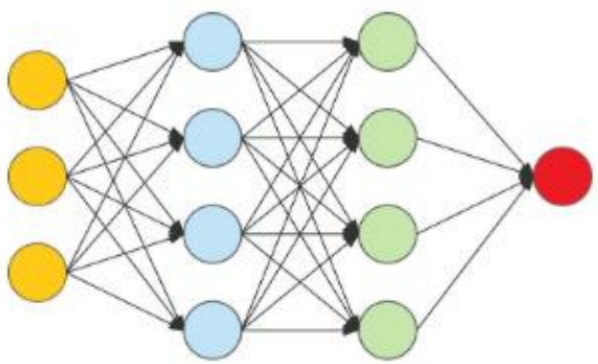
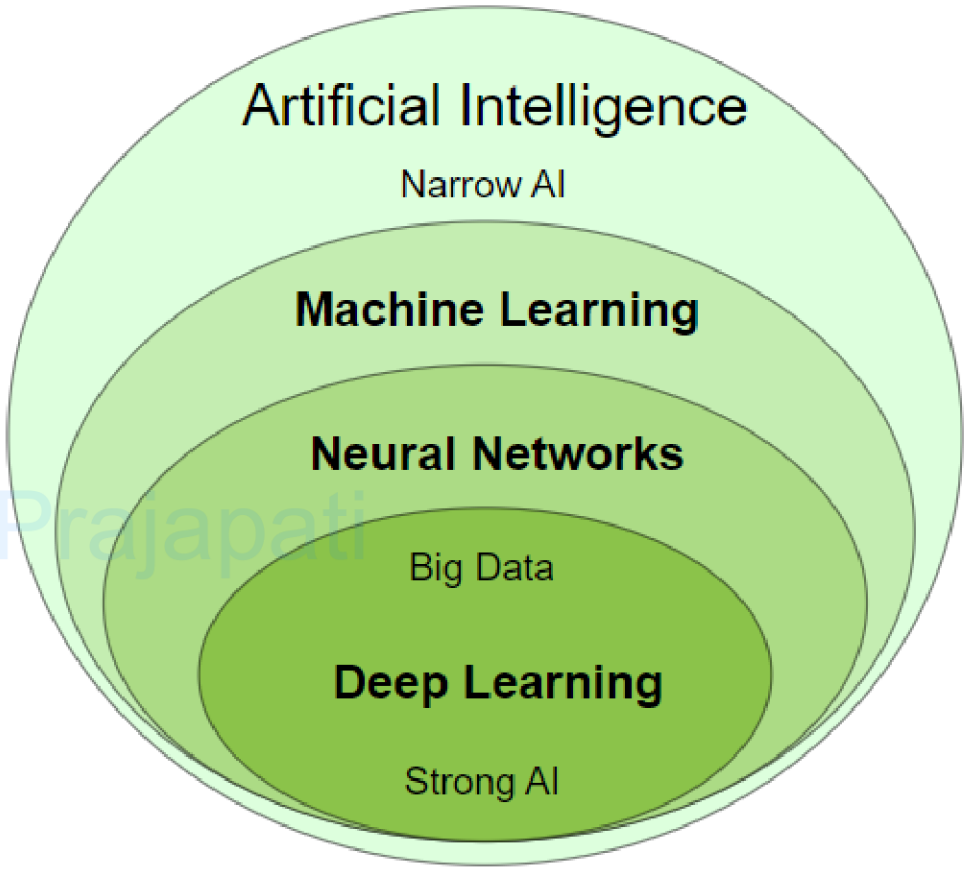
Background

- **Neural Networks** is:
  - A programming technique
  - A method used in machine learning
  - A software that learns from mistakes

- **Neural Networks** are made up of several hidden layers of neural networks that perform complex operations on massive amounts of data.





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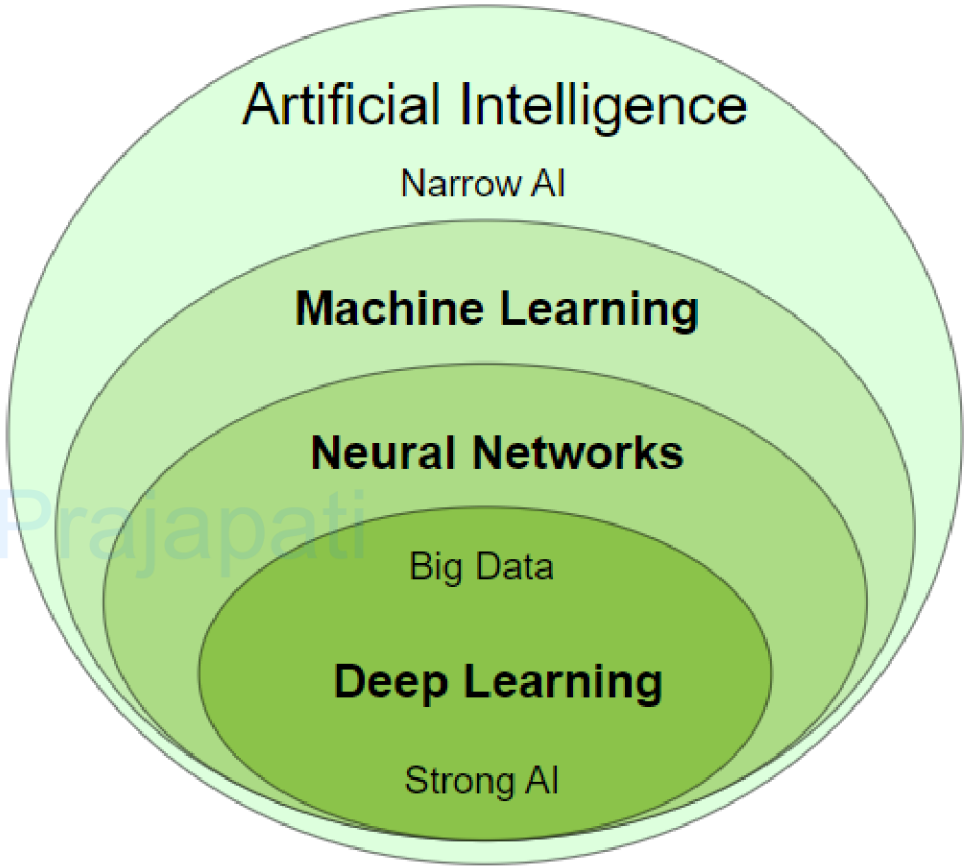
Background

- **Deep Learning** is a subset of Machine Learning.

Machine Learning	Deep Learning
A subset of AI	A subset of Machine Learning
Uses smaller data sets	Uses larger datasets
Trained by humans	Learns on its own
Creates simple algorithms	Creates complex algorithms



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Overview of Human Learning

- Learning

Process of acquiring new understanding, knowledge, behaviors, skills, values, attitudes.

- Human learning

Process by which individuals acquire knowledge, skills, behaviors, and attitudes through experiences, study, and observation.

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Overview of Human Learning

- Key characteristics of human learning include:
  - Acquisition of knowledge
  - Transfer of Knowledge
  - Processing and understanding
  - Application and Experience
  - Practice and repetition
  - Feedback and correction
  - Long-Term Memory
  - Social interaction and collaboration

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Overview of Machine Learning

- Machine Learning (ML) is a subset of artificial intelligence that focuses on the **development of algorithms and models** that enable computers and machines to **learn from data without programming**.
- Instead of being programmed, ML systems learn patterns and representations from data and use them to make predictions, decisions, or identify patterns in new or unseen data.

  DATA + RESULTS = **ALGORITHMS**.

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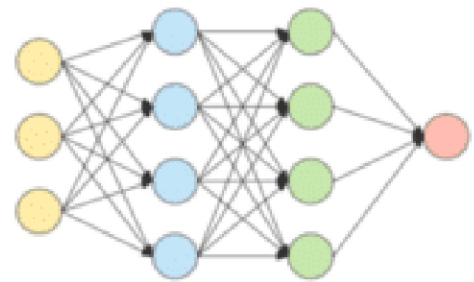
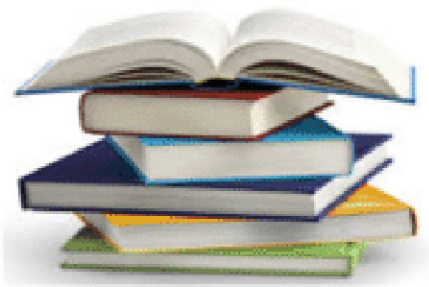
- Tom M. Mitchell definition
- “A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E."

Overview of Machine Learning

Human Learning		Machine Learning
	Intelligence →	Models 
	Learning materials →	Data
	Learning skills →	Skillearn

- Learning by creating tests
- Interleaving learning
- Learning by ignoring
- …

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Overview of Machine Learning

Key aspects of machine learning include:

- Data-driven Approach
- Types of Learning
- Model Training
- Generalization
- Diverse Applications

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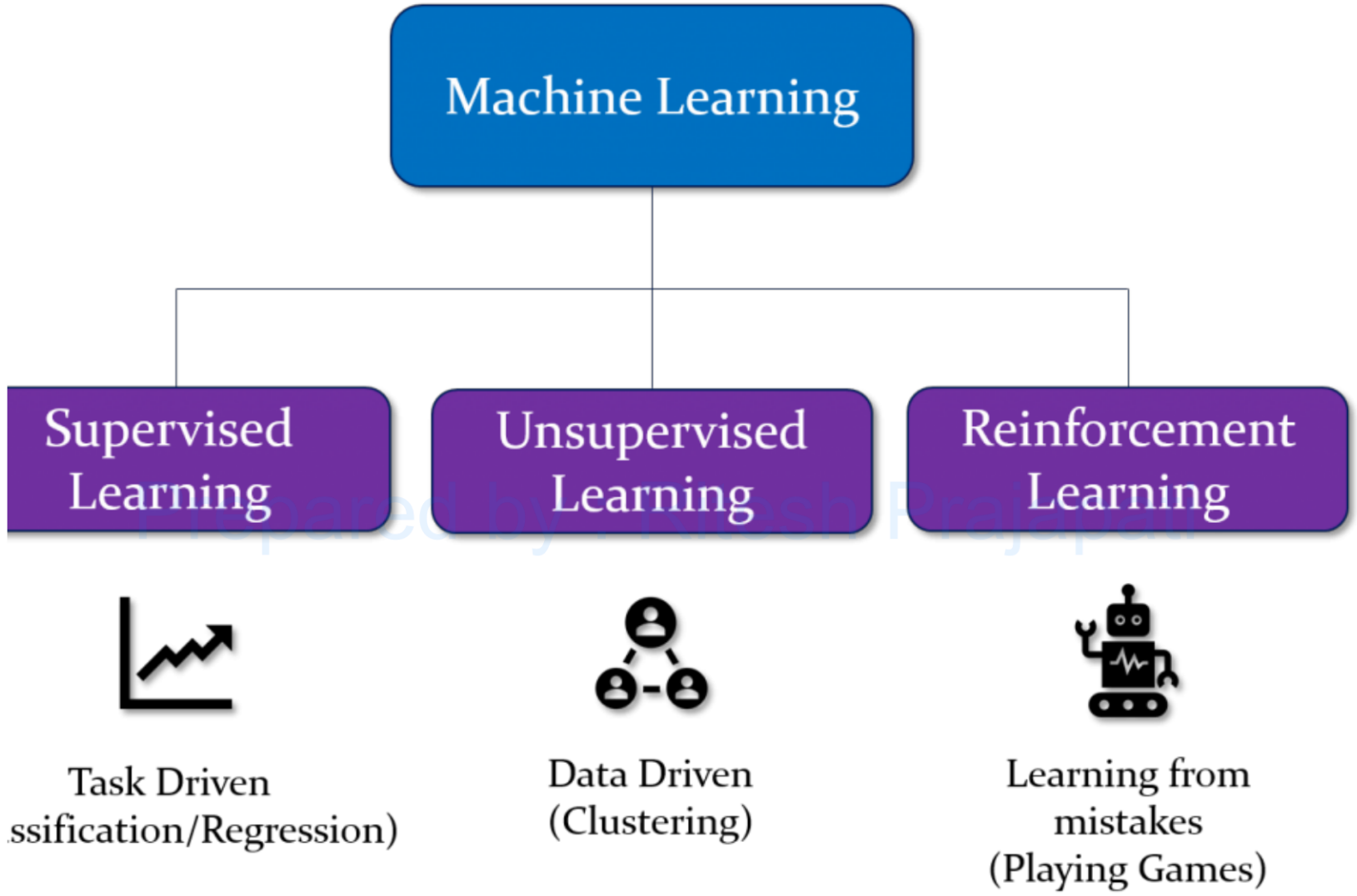
Types of Machine Learning:



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Supervised Machine Learning

- Idea of learning from past information.
- Past information= ‘EXPERIENCE’

- Supervised learning is the types of machine learning in which machines are trained using **well "labelled" training data, and on basis of that data, machines predict the output.**

Examples of supervised learning tasks:

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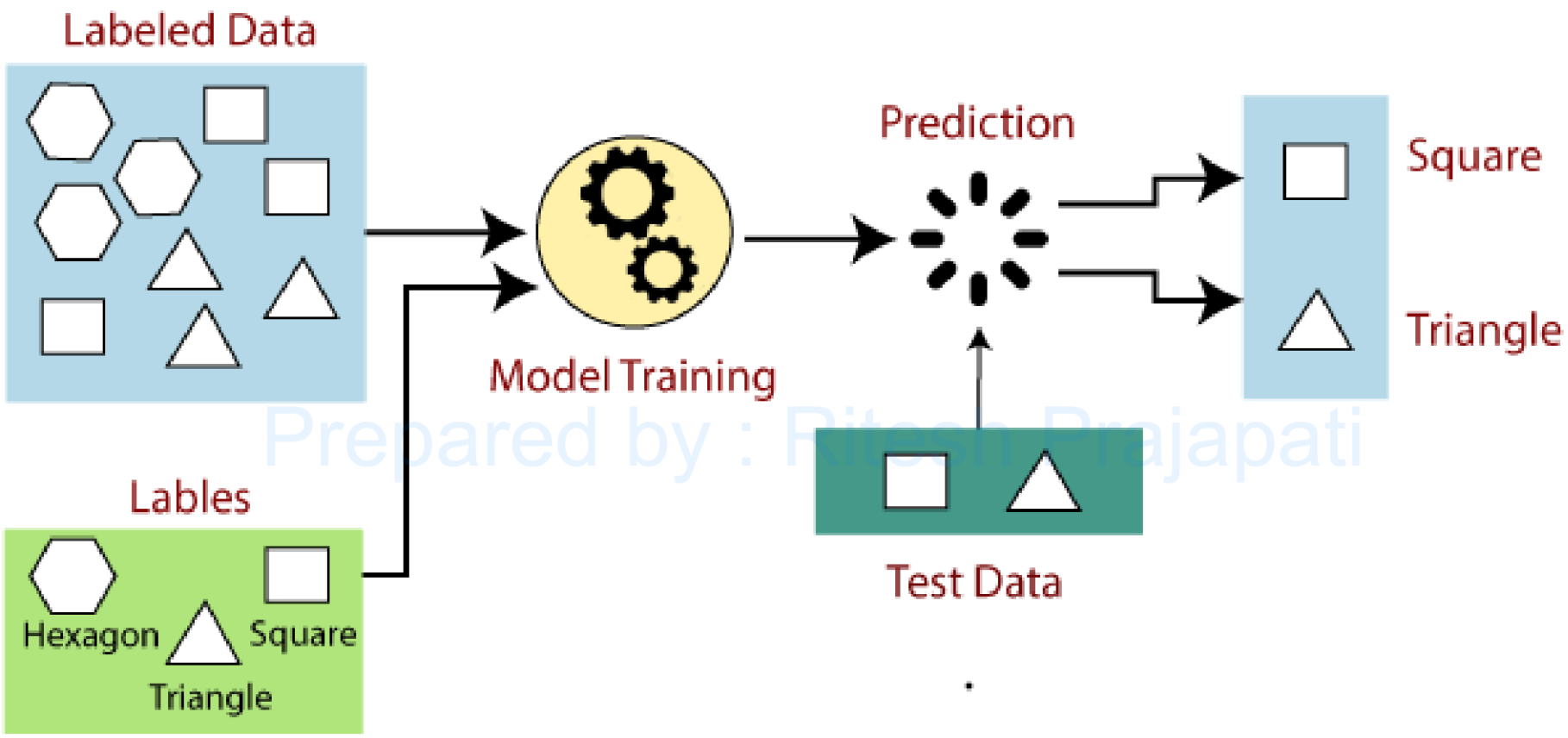
- Predicting game results
- Predicting tumour malignancy
- Predicting the price of domains like real estate or stocks
- Fraud Detection
- Spam filtering
- Risk Assessment

Supervised Machine Learning -Example



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Supervised Machine Learning -Example

- Suppose we have a dataset of different types of shapes which includes square, rectangle, triangle, and Polygon. Now the first step is that we need to train the model for each shape.
- If the given shape has four sides, and all the sides are equal, then it will be labelled as a **Square**.
- If the given shape has three sides, then it will be labelled as a **triangle**.
- If the given shape has six equal sides then it will be labelled as **hexagon**.
- Now, after training, we test our model using the test set, and the task of the model is to identify the shape.
- The machine is already trained on all types of shapes, and when it finds a new shape, it classifies the shape on the bases of a number of sides, and predicts the output.

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Supervised Machine Learning -Types

- Classification :
- Used when the output variable is categorical, which means there are two classes such as Yes-No, Male-Female, True-false, etc.
- The algorithm learns to classify input data into predefined classes.
- Examples
  - Email spam detection
  - Medical diagnosis
- Algorithms
  - Random Forest
  - Decision Tree
  - k-Nearest Neighbours
  - Logistic Regression
  - Support vector Machines

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Supervised Machine Learning -Types

- **Regression:**
- Used for the prediction of continuous variables
- In regression tasks, the output is a continuous numerical value. The algorithm learns to map input features to a continuous target variable.
- Examples
  - Weather forecasting
  - Market Trends housing prices, stock prices prediction
- Algorithms
  - Linear Regression
  - Regression Trees
  - Non-Linear Regression
  - Bayesian Linear Regression
  - Polynomial Regression

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Unsupervised Machine Learning

- No training dataset.
- Algorithm learns from unlabeled data, without explicit guidance.
- Models itself find the hidden patterns and insights from the given data.
- ***Unsupervised learning is a type of machine learning in which models are trained using unlabeled dataset and are allowed to act on that data without any supervision.***
- We have the input data but no corresponding output data.
- Similar as a human learns to think by their own experiences.
- *More close to real AI.*

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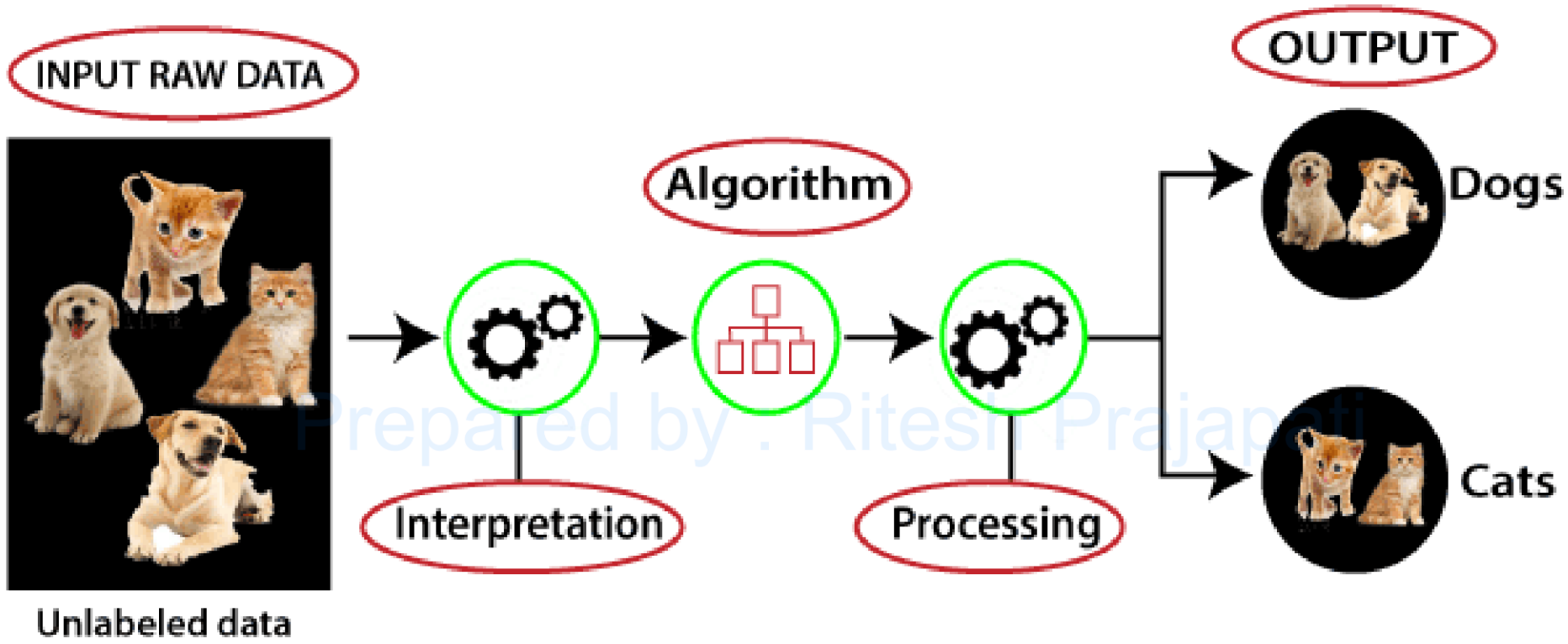
Unsupervised Machine Learning -Example



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Unsupervised Machine Learning -Example

- Input dataset containing images of different types of cats and dogs.
- The algorithm is never trained upon the given dataset, which means it does not have any idea about the features of the dataset.
- **The task of the unsupervised learning algorithm is to identify the image features on their own.**
- Firstly, it will interpret the raw data to find the hidden patterns from the data and then will apply suitable algorithms such as k-means clustering, Decision tree, etc.
- Once it applies the suitable algorithm, the algorithm divides the data objects into groups according to the similarities and difference between the objects.

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Unsupervised Machine Learning -Types

Clustering:

- Grouping **the objects into clusters** such that objects with most similarities remains into a group and has less or no similarities with the objects of another group.
- The goal of clustering is to discover inherent **groupings** in unlabelled data and form clusters.

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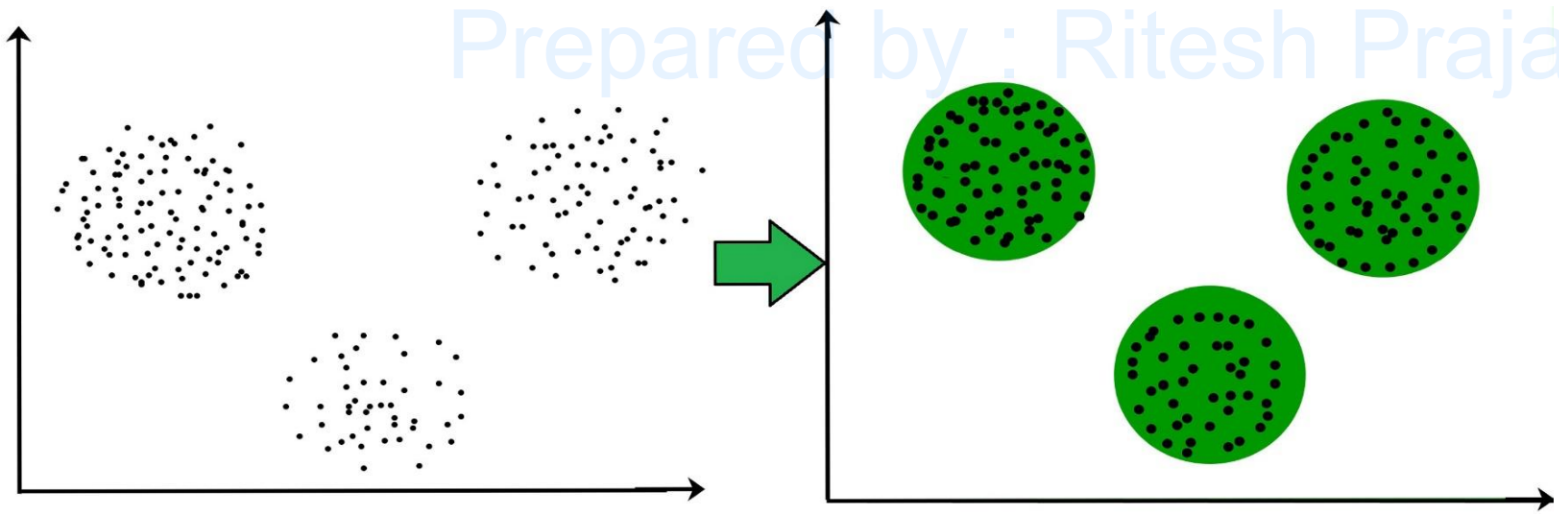

Unsupervised Machine Learning -Types

- **Clustering**: Examples
  - Customer Segmentation:
  - Identification of Cancer Cells:
  - Search Engines:
  - In Biology:
- **Clustering**: Common algorithms
  - K-Means:
  - Partitioning Clustering
  - Density-Based Clustering
  - Distribution Model-Based Clustering
  - Hierarchical Clustering
  - Gaussian Mixture Models (GMM):

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Unsupervised Machine Learning -Types

Association:

- Identifying associations(relationship) between data elements
- It determines the set of items that occurs together in the dataset.

Example

- Market Basket Analysis
- Such as people who buy X item (suppose a bread) are also tend to purchase Y (Butter/Jam) item.

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Algorithms

- Apriori Algorithm
- Eclat Algorithm-Equivalence Class Transformation.
- F-P Growth Algorithm-Frequent Pattern

Reinforcement Learning

- Feedback-based Machine learning technique
- Agent(entity or system) learns to behave in an environment by performing the actions seeing the results of actions.
- Good action - positive feedback(Reward)
- Bad action - negative feedback (Penalty)
- Example: Self Driven Car

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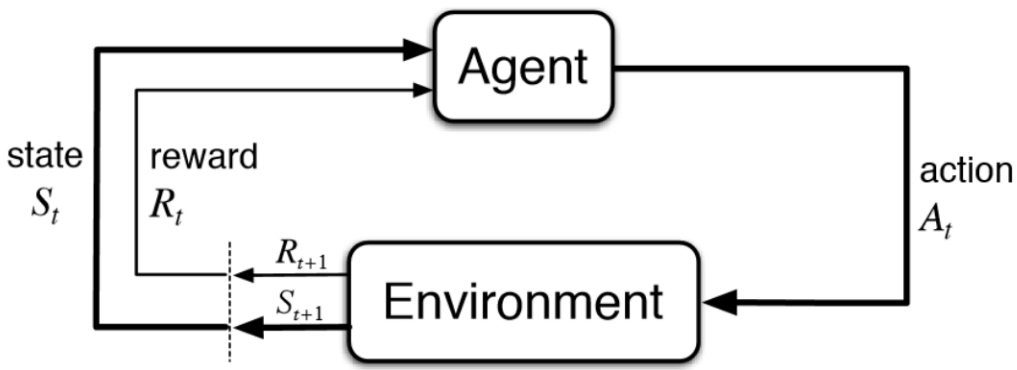

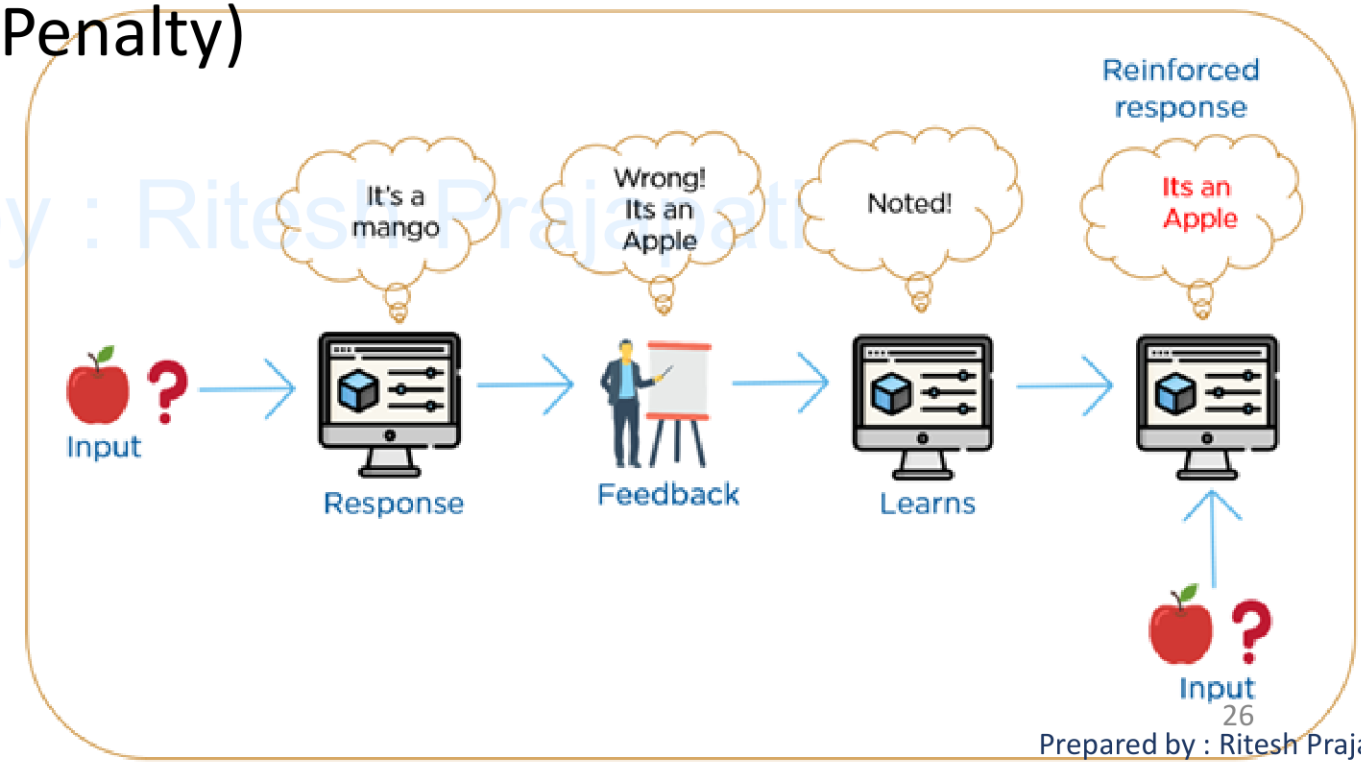

Applications of Machine Learning

- Natural Language Processing (NLP):
  - Chatbots, virtual assistants, language translation and speech recognition systems.
- Image and Video Recognition
  - object detection, facial recognition, self driven cars, and medical image analysis.
- Fraud Detection
  - detect fraudulent activities in finance, insurance, online transactions, and cybersecurity
- Recommender Systems:
  - Ecommerce platforms, streaming services, and social media platforms
- Healthcare:
  - medical imaging, disease diagnosis, personalized treatment recommendations.
- Finance:
  - algorithmic trading, credit scoring, fraud detection

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Tools and Technology for Machine Learning

- Programming Languages:
  - Python, R
- Machine Learning Libraries and Frameworks:
  - TensorFlow, PyTorch, Scikit-learn, Keras, MXNet
- Data Visualization:
  - Matplotlib, Seaborn, Plotly
- Cloud-based Machine Learning Platforms:
  - Google Cloud AI Platform, Amazon Web Services (AWS), Microsoft Azure
- Data Preprocessing Tools :
  - Pandas, Numpy, SciPy
- AutoML (Automated Machine Learning) Platforms:
  - Google AutoML, H2O.ai
- Model Deployment Tools :
  - Kubernates, Docker, Flask

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