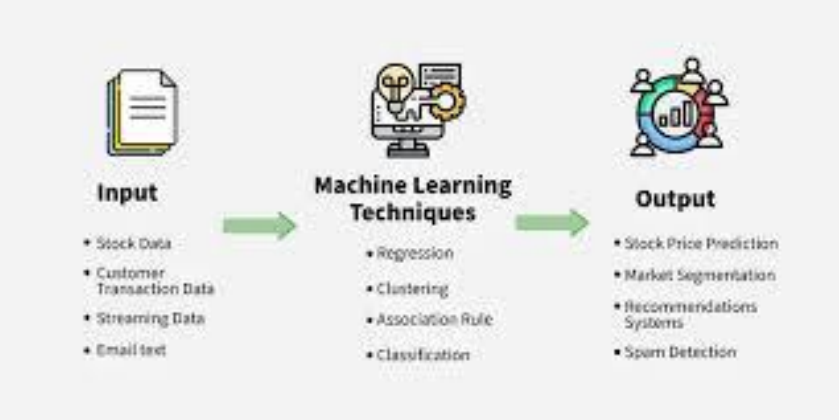
Types of Machine Learning

What is Machine Learning(ML)

Machine learning is the subset of artificial intelligence (AI) focused on algorithms that can "learn" the patterns of training data and, subsequently, make accurate *inferences* about new data. This pattern recognition ability enables machine learning models to make decisions or predictions without explicit, hard-coded instructions.

Machine learning has come to dominate the field of AI: it provides the backbone of most modern AI systems, from forecasting models to autonomous vehicles to large language models (LLMs) and other generative AI tools.



How machine learning works?

1. **Data collection: Gathering relevant and high-quality data.**
2. **Data preprocessing: Cleaning and preparing the raw data.**
3. **Model training: An algorithm is trained on the prepared data. During this iterative process, the model adjusts its internal parameters.**
4. **Model evaluation: After training, the model is tested on a separate dataset to assess its performance.**
5. **Deployment: The trained model is integrated into a real-world application.**

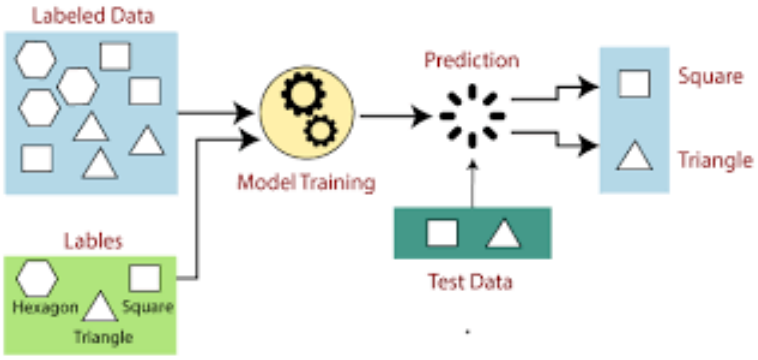
Types of Machine Learning :

1. **Supervised Learning**
2. **Unsupervised Learning**
3. **Reinforcement Learning**

1. Supervised Learning

Supervised learning is a type of machine learning that uses labelled data to train an algorithm to make predictions or classify data.

The "supervisor" is the labelled data itself, which provides correct outputs alongside inputs, allowing the algorithm to learn the relationships and patterns between them to accurately predict outcomes for new, unseen data.



How it works :

1. **Labeled Data: Each input example is paired with its correct output label.**
2. **Training: Labelled data is feed in model to learn the relationship**
3. **Model: The algorithm builds a model that captures these patterns.**
4. **Prediction: Model is used to predict the correct output for new, unlabeled input data.**

Examples of Supervised Learning :

- **Fraud Detection in Banking: Predicts legitimate vs fraudulent transactions**
- **Customer Churn Prediction: To predict customer retention effectively.**
- **Cancer cell classification: Identifying if cells are 'malignant' or 'benign.**
- **Stock Price Prediction: Predict a signal that indicates whether buying a particular stock will be helpful or not.**

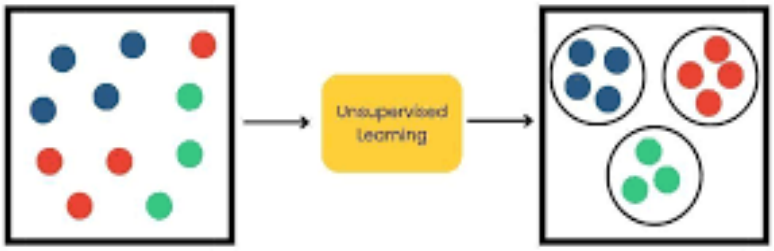
Types of Supervised Learning :

- **Classification: Goal is to assign data points to predefined categories. For example, classifying emails as spam or not spam.**
- **Regression: Goal is to predict a continuous numerical value. For example, Predicting the price of a house based on its features.**

2. Unsupervised Learning

Unsupervised learning is a type of machine learning where an algorithm learns from data that has not been labelled or pre-classified.

Instead of being given "right" answers, the algorithm identifies patterns, structures, and relationships within the raw, unlabelled data on its own, essentially discovering hidden insights without human guidance.



How it Works :

1. **Unlabelled Data: The core characteristic is the use of datasets without any corresponding output labels.**
2. **Pattern Discovery: The algorithm automatically learns the data's structure by identifying similarities, differences, and patterns.**
3. **Self-Learning: The system infers its own rules and organizes information without direct human intervention or feedback.**

Examples of Unsupervised Learning :

- **Customer segmentation: To group customers with similar purchasing behaviours.**
- **Recommendation engines: Discover trends to suggest products, movies, or music to users.**
- **Medical imaging: Identify areas of interest, such as differentiating healthy tissue from tumours.**

Types of Unsupervised Learning :

- **Clustering: Involves grouping similar data points into clusters such.**
- **Dimensionality Reduction: Reduces the number of features in a dataset while preserving essential information.**
- **Association Rule Learning: Discovers interesting relationships or associations between variables in large datasets.**

3. Reinforcement Learning

Reinforcement learning (RL) is a machine learning technique where an "agent" learns to make optimal decisions in an environment through trial and error, receiving rewards or penalties for its actions to maximize its cumulative reward over time.

It's like learning through experience, similar to how humans and animals learn.

How it works :

1. **Agent and Environment: An "agent" interacts with an "environment".**
2. **Actions and States: The agent takes an "action" within the environment, which changes the environment's "state" or situation.**
3. **Feedback: The agent receives a "reward" or a "penalty" for its action.**
4. **Learning: The agent uses this feedback to learn which actions to take.**

Examples of Reinforcement Learning :

- **Robotics: Teaching robots to walk or perform complex tasks.**
- **Self-Driving Cars: Helping autonomous vehicles learn how to navigate.**
- **Generative AI: Used to align AI models with human preferences and goals.**

Types of Reinforcement Learning :

- **Model-Based vs. Model-Free: Model-Based builds a model of the environment to understand its rules and how actions affect outcomes whereas, Model-Free learns directly from experience through trial and error.**
- **Value-Based vs. Policy-Based : Value-Based learns a "value function" that estimates the expected long-term reward from a given state whereas, Policy-Based directly learns a policy, which is a mapping from states to actions**