

# What is Machine Learning?

**Def:-** Machine learning is a part of Data science in which machine learn from data

## **Examples of ML**

- Movie or Music Recommendations
- Voice Assistants (like Alexa or Siri)
- Online Shopping Suggestions

# ML Algorithm Categories

## Supervised Learning

- **Definition:-** Supervised learning is a type of machine learning where the model is trained on a labeled dataset
- **Characteristics of Supervised Learning**
  - Mainly used in classification and regression
  - Common models include Linear Regression, Decision Trees, SVM, k-NN

# Unsupervised Learning

- **Definition:**-Unsupervised learning is a type of machine learning where the model is trained on **unlabeled data**
- **Characteristics of Supervised Learning**
  - Mainly used in Clustering and Dimensionality Reduction
  - K-Means Clustering, Hierarchical Clustering, DBSCAN, PCA

# Reinforcement Learning

- Definition:-Reinforcement learning (RL) is a type of machine learning where an agent learns to take actions in an environment to maximize cumulative rewards
- **Characteristics of Reinforcement Learning**  
Game playing (e.g., AlphaGo), robotics, self-driving cars, automated trading

# Limitations of Programming Scripting Languages for Machine Learning

- Importance of selecting the right language for ML projects
- Scope: Comparison of Python, R, Java, C++ and others.

# Python

## Advantages:

- Rich ML libraries (ScikitLearn, TensorFlow, PyTorch).
- Easy syntax and large community.

## Limitations:

- Slower execution for largescale applications.
- High memory consumption.
- Not ideal for mobile or lowlatency applications.

# R

## Advantages:

- Statistical analysis and visualization
- Great for data exploration

## Limitations:

- Slower in production environments
- Limited deep learning support

# Java

## Advantages:

- Fast execution and scalability

## Limitations:

- Limited ML libraries compared to Python
- Complex syntax



# C++

## Advantages:

- High performance
- Suitable for real time systems

## Limitations:

- Complex memory management
- Difficult to debug and maintain
- Slower development cycle

# MATLAB

## Advantages:

- Strong in numerical and matrix computations
- Useful for prototyping

## Limitations:

- Expensive licenses
- Limited integration with modern ML frameworks

# What is Statistical Machine Learning?

- **Machine Learning** means a computer learns from experience (data) instead of being manually programmed
- **Statistical** means it uses ideas from **statistics**—like averages, Mean, Median, Mode To understand data and make predictions

# Goals of Statistical ML

- Predict future data
- Make informed decisions

# Applications of Statistical ML


- Healthcare diagnostics
- Financial forecasting
- Customer segmentation
- Natural Language Processing

# Need for Programming Languages in ML

- Programming enables model development, training, evaluation, and deployment in real-world applications
- Execution speed and ability to handle large datasets efficiently

# Library Support

- Availability of ML, statistical, and data visualization libraries

Category	Libraries / Tools	Use Cases	
Machine Learning (ML)	scikit-learn , TensorFlow , PyTorch	Model building, classification, regression, deep learning	
Statistical Analysis	statsmodels , SciPy , R , Pingouin	Hypothesis testing, ANOVA, t-tests, regression diagnostics	
Data Visualization	Matplotlib , Seaborn , Plotly , ggplot2	Charts, heatmaps, interactive graphs, exploratory data analysis	

# Ease of Learning and Community Size

- Beginner-friendliness and strong global community support