Machine Learning

Week 1 • Class 1

Introduction to Machine Learning

Definitions, Scope, and Applications

Introduction

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Current Role

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Unit Learning Outcomes

By the end of this unit, students will be able to:

LO Code	Learning Outcome Description
LO1	Analyse the theoretical foundation of machine learning to determine how an intelligent machine works
LO2	Investigate the most popular and efficient machine learning algorithms used in industry
LO3	Develop a machine learning application using an appropriate programming language or machine learning tool for solving a real-world problem
LO4	Evaluate the outcome or result of the application to determine the effectiveness of the learning algorithm used

What Is Machine Learning?

Machine Learning is a subfield of Artificial Intelligence that focuses on building systems that can:

- Learn from historical data
- Identify patterns and relationships
- Improve performance over time
- Make predictions or decisions without explicit programming

A machine learning system adapts its internal parameters based on experience.

Machine Learning vs Traditional Programming

Traditional Programming	Machine Learning
Explicit rules written by humans	Rules inferred automatically
Logic-driven	Data-driven
Static behavior	Adaptive behavior
Difficult to scale	Improves with more data

Why Machine Learning Matters

Machine learning has become essential due to:

- Massive growth of digital data
- Availability of low-cost computing power
- Need for intelligent automation
- Demand for predictive and personalized systems

Many problems today are too complex to be solved using fixed rules.

Scope of Machine Learning

Machine learning is applicable across a wide range of industries:

- Healthcare: diagnosis, medical imaging, drug discovery
- Finance: fraud detection, credit scoring, algorithmic trading
- Education: personalized learning, grading automation
- Transportation: self-driving vehicles, traffic prediction
- Law and Governance: document analysis, legal research
- Agriculture: crop yield prediction, disease detection

Real-World Applications

Examples of machine learning systems in everyday life:

- Recommendation engines (Netflix, YouTube, Spotify)
- Spam and phishing detection
- Face recognition and biometric authentication
- Voice recognition and language translation
- Chatbots and virtual assistants

Types of Machine Learning (Overview)

Supervised Learning

- Uses labeled data
- Tasks include classification and regression
- Example: email spam detection

Unsupervised Learning

- Uses unlabeled data
- Finds hidden patterns or structures
- Example: customer segmentation

Reinforcement Learning

- Learns through rewards and penalties
- Used in control and decision-making systems
- Example: game-playing agents, robotics

Common Machine Learning Tasks

- Classification
- Regression
- Clustering
- Anomaly Detection
- Recommendation

Each task requires different algorithms and evaluation techniques.

Machine Learning Workflow

A typical machine learning pipeline includes:

1. Problem Definition
2. Data Collection
3. Data Cleaning and Preprocessing
4. Feature Engineering
5. Model Selection and Training
6. Model Evaluation
7. Deployment and Monitoring

This workflow will be followed throughout the unit.

Tools and Languages Used in Machine Learning

Common tools and technologies include:

- Programming Languages: Python, R
- Libraries: NumPy, Pandas, Scikit-learn
- Deep Learning Frameworks: TensorFlow, PyTorch
- Visualization Tools: Matplotlib, Seaborn
- Platforms: Jupyter Notebook, Google Colab

Class Summary

- Understanding theoretical foundations of ML
- Gaining exposure to industry-relevant algorithms
- Quick Overview of Types of ML
- Understanding ML Pipeline

How This Unit Will Be Taught

- Concept-focused lectures
- Practical demonstrations
- Hands-on labs and coding exercises

Next Class

Core Terminologies – Features, Labels, Models, Training vs Testing