Machine Learning

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What is Machine Learning

machine learning is a field of computer science that uses statistical techniques to give computer systems the ability to "learn" with data, without being explicitly programmed. In simpler terms, it is the process of learning from data.

- **Explicit Programming:** In a conventional software development approach, a human writes the logic (code) for specific scenarios. You provide the input to this logic, and it produces an output. If the scenario changes, the human must manually rewrite the logic.
- **Machine Learning:** The flow is reversed. You provide the system with data (which contains both the input and the desired output) and an algorithm. The algorithm explores the data, identifies patterns, and generates the logic itself,.

Key Characteristics and Use Cases

Machine learning is particularly powerful in scenarios where traditional programming falls short:

- **Dynamic Rules (e.g., Spam Classifiers):** In tasks like email spam detection, hard-coding rules (e.g., flagging the word 'huge') is inefficient because spammers change their tactics (e.g., using 'big' or 'massive' instead),. A machine learning model learns from the data; if the data changes, the logic updates automatically without human intervention.
- **Complex Scenarios (e.g., Image Classification):** For tasks like identifying a dog in a photograph, it is impossible to explicitly code for every breed, colour, and angle. Machine learning mimics the human cognitive process of learning by "tagging" and recognising patterns across vast amounts of data.

- **Data Mining:** Machine learning acts as a crucial tool for data mining, which involves extracting hidden patterns or information from data that cannot be easily identified through simple data analysis or graphing,.

AI vs ML vs DL

1. Artificial Intelligence (AI)

- **Definition:** AI is the broad goal of incorporating intelligence into machines so they can mimic human capabilities.
- **Symbolic AI (The Past):** In the 1950s and following decades, the approach was "Symbolic AI" or "Expert Systems." This involved humans hard-coding knowledge and strict logic (rules) into a system.
- **Limitations:** While successful in games like Chess, Symbolic AI failed in "fuzzy" or complex scenarios, such as recognizing a dog in an image. It is impossible for a human to explicitly write code defining every possible angle, breed, or variation of a dog.

2. Machine Learning (ML)

- **The Solution to Symbolic AI:** ML emerged to solve the limitations of hard-coded rules. It is a subset of AI that uses statistical techniques to find patterns in data.
- **How it Works:** Instead of a human writing the rules (explicit programming), the system is fed data (in puts and outputs). The algorithm analyzes the data and generates the rules or logic itself.
- **Feature Dependency:** A key characteristic (and limitation) of ML is that it often relies on manually defined "features." For example, to predict a student's placement, a human must decide that "CGPA" and "IQ" are the relevant inputs (features) to feed the model.

3. Deep Learning (DL)

- **Why it Exists:** Deep Learning is a specialized subset of ML designed to solve the problem of manual feature extraction. In complex tasks (like image

recognition), it is difficult for humans to determine exactly which features define an object.

- **Automatic Feature Extraction:** The primary advantage of DL is that it automatically learns and extracts features from raw data. As you add more layers to the model, it learns increasingly complex representations (e.g., edges, then shapes, then the object) without human intervention.

- **Biological Inspiration:** DL is inspired by the structure of the human brain (neurons), though the speaker clarifies that it is ultimately a mathematical model and does not function exactly like a biological brain.

- **Data Scaling:** DL models perform significantly better as the volume of data increases. While ML performance tends to plateau after a certain point, DL continues to improve with more data.
Conclusion The video concludes that while DL is powerful for unstructured data (images, audio) and massive datasets, it is not always the best tool. For scenarios with smaller datasets or structured tabular data (common in banking or insurance), Machine Learning remains the preferred and more efficient choice.

Types Of Machine Learning

1. Supervised Machine Learning

Definition:
Supervised learning uses labeled data, meaning each input has a known output.

a) Regression

Goal: Predict a continuous numeric value.

Examples:

- House price prediction (₹ value)
- Salary prediction based on experience
- Temperature forecasting

Algorithms:

- Linear Regression

- Ridge / Lasso Regression
- Decision Tree Regressor

b) Classification

Goal: Predict a discrete class or label.

Examples:

- Email spam detection (Spam / Not Spam)
- Disease detection (Positive / Negative)
- Sentiment analysis (Positive / Neutral / Negative)

Algorithms:

- Logistic Regression
- KNN
- SVM
- Random Forest
- XGBoost

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