

1. Definition and Scope

- Machine Learning (ML):

- ML is a broad field of AI that focuses on algorithms allowing computers to learn from and make predictions or decisions based on data.
- It includes a wide range of techniques like linear regression, decision trees, support vector machines, and clustering.

- Deep Learning (DL):

- DL is a subset of ML that specifically involves neural networks with many layers (hence "deep").
- It is inspired by the structure and function of the human brain, known as artificial neural networks (ANNs).

2. Structure and Algorithms

- Machine Learning:

- ML models can be simple (like linear regression) or complex (like ensemble methods).
- Common ML algorithms include decision trees, random forests, k-nearest neighbors, and support vector machines.
- ML models often require feature extraction and selection as a separate step.

- Deep Learning:

- DL models are typically neural networks with multiple hidden layers.
- Common architectures include Convolutional Neural Networks (CNNs) for image data and Recurrent Neural Networks (RNNs) for sequential data.
- DL models perform automatic feature extraction, learning hierarchical representations of data.

3. Data Requirements

- Machine Learning:

- ML algorithms generally perform well with smaller datasets.
- They require structured data and often need manual feature engineering.

- Deep Learning:

- DL algorithms typically require large amounts of data to perform well.
- They can handle unstructured data such as images, audio, and text more effectively.

4. Computational Requirements

- Machine Learning:

- ML models are generally less computationally intensive compared to DL models.
- They can be trained on standard CPUs without requiring significant hardware.

- Deep Learning:

- DL models are computationally intensive and often require specialized hardware like GPUs or TPUs for efficient training.
- The training process can be time-consuming and resource-intensive.

5. Application Examples

- Machine Learning:

- Spam detection in emails.
- Predictive maintenance.
- Customer segmentation.
- Credit scoring.

- Deep Learning:

- Image and speech recognition.
- Natural language processing (NLP) tasks like translation and sentiment analysis.
- Autonomous vehicles.
- Complex game playing (e.g., AlphaGo).

6. Model Interpretability

- Machine Learning:

- ML models are often easier to interpret and understand. For example, decision trees can be visualized and explained.
- Simpler models like linear regression provide clear insights into how predictions are made.

- Deep Learning:

- DL models are often considered "black boxes" because their decision-making processes are less transparent.
- Understanding why a deep neural network makes a particular decision can be challenging.

Summary

- Machine Learning is a broader category that includes various techniques and algorithms for data analysis, prediction, and decision-making. It is versatile and can be applied to a wide range of problems with structured data.
- Deep Learning is a specialized area within ML focused on deep neural networks capable of learning from large amounts of unstructured data, such as images and text, and performing tasks like recognition and classification with high accuracy.

Drafted By: Muhamad Daud