Machine Learning

***Unit-1***

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Machine Learning

# Introduction to Machine Learning:

* Machine learning (ML) is a type of artificial intelligence (AI) that allows computers to learn without being explicitly programmed. This article explores the concept of machine learning, providing various definitions and discussing its applications. The article also dives into different classifications of machine learning tasks, giving you a comprehensive understanding of this powerful technology.

## Definition of Learning:

* + A computer program is said to *learn* from experience E concerning some class of tasks T and performance measure P, if its performance at tasks T, as measured by P, improves with experience E.

## Classification of Machine Learning:

* + Machine learning implementations are classified into four major categories, depending on the nature of the learning “signal” or “response” available to a learning system which are as follows:

# History:

* + Machine learning (ML) is an important tool for the goal of leveraging technologies around artificial intelligence. Because of its learning and decision-making abilities, machine learning is often referred to as AI, though, in reality, it is a subdivision of AI. Until the late 1970s, it was a part of AI’s evolution. Then, it branched off to evolve on its own. Machine learning has become a very important response tool for cloud computing and e-commerce, and is being used in a variety of cutting-edge technologies. Below is a brief history of machine learning and its role in data management.

# Relationships to other fields:

## Artificial intelligence:

* As a scientific endeavor, machine learning grew out of the quest for artificial intelligence (AI). In the early days of AI as an academic discipline, some researchers were interested in having machines learn from data

## Data compression:

* There is a close connection between machine learning and compression. A system that predicts the posterior probabilities of a sequence given its entire history can be used for optimal data compression (by using arithmetic coding on the output distribution). Conversely, an optimal compressor can be used for prediction (by finding the symbol that compresses best, given the previous history)

# Theory:

* A core objective of a learner is to generalize from its experience. Generalization in this context is the ability of a learning machine to perform accurately on new, unseen examples/tasks after having experienced a learning data set. The training examples come from some generally unknown probability distribution (considered representative of the space of occurrences) and the learner has to build a general model about this space that enables it to produce sufficiently accurate predictions in new cases.

# Approaches:

* Machine learning approaches are traditionally divided into three broad categories, which correspond to learning paradigms, depending on the nature of the "signal" or "feedback" available to the learning system

## Supervised learning:

* Supervised learning (SL) is a paradigm in [machine learning](https://en.wikipedia.org/wiki/Machine_learning) where input objects (for example, a vector of predictor variables) and a desired output value (also known as a human-labeled *supervisory signal*) train a model.
* The training data is processed, building a function that maps new data to expected output values
* An optimal scenario will allow for the algorithm to correctly determine output values for unseen instances

## Unsupervised learning:

* Unsupervised learning algorithms find structures in data that has not been labeled, classified or categorized. Instead of responding to feedback, unsupervised learning algorithms identify commonalities in the data and react based on the presence

# Models:

* machine learningmodel is a type of [mathematical model](https://en.wikipedia.org/wiki/Mathematical_model) that, after being "trained" on a given dataset, can be used to make predictions or classifications on new data. During training, a learning algorithm iteratively adjusts the model's internal parameters to minimize errors in its predictions. By extension, the term "model" can refer to several levels of specificity, from a general class of models and their associated learning algorithms to a fully trained model with all its internal parameters tuned

# Applications:

## Precision agriculture:

* Precision agriculture (PA) is a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability.[2] It is used in both crop and livestock production.
* Precision agriculture often employs technologies to automate agricultural operations, improving their diagnosis, decision-making or performing.

# Limitations:

* Although machine learning has been transformative in some fields, machine-learning programs often fail to deliver expected results.[114][115][116] Reasons for this are numerous: lack of (suitable) data, lack of access to the data, data bias, privacy problems, badly chosen tasks and algorithms, wrong tools and people, lack of resources, and evaluation problems
* The "black box theory" poses another yet significant challenge. Black box refers to a situation where the algorithm or the process of producing an output is entirely opaque, meaning that even the coders of the algorithm cannot audit the pattern that the machine extracted out of the data.[118] The House of Lords Select Committee, which claimed that such an "intelligence system" that could have a "substantial impact on an individual's life" would not be considered acceptable unless it provided "a full and satisfactory explanation for the decisions" it makes.

# Ethics:

The ethics of artificial intelligence covers a broad range of topics within the field that are considered to have particular ethical stakes.This includes algorithmic biases, fairness, automated decision-making, accountability, privacy, and regulation. It also covers various emerging or potential future challenges such as machine ethics (how to make machines that behave ethically), lethal autonomous weapon systems,

# Hardware:

* Since the 2010s, advances in both machine learning algorithms and computer hardware have led to more efficient methods for training deep neural networks (a particular narrow subdomain of machine learning) that contain many layers of nonlinear hidden units.[155] By 2019, graphics processing units (GPUs), often with AI-specific enhancements, had displaced CPUs as the dominant method of training large-scale commercial cloud AI.[156] OpenAI estimated the hardware compute used in the largest deep learning projects from AlexNet (2012) to AlphaZero (2017), and found a 300,000-fold increase in the amount of compute required, with a doubling-time trendline of 3.4 months.

## Neuromorphic computing:

* Neuromorphic computing refers to a class of computing systems designed to emulate the structure and functionality of biological neural networks. These systems may be implemented through software-based simulations on conventional hardware or through specialized hardware architectures.

# Journals:

## Journal of Machine Learning Research:

* The Journal of Machine Learning Research is a peer-reviewed open access scientific journal covering machine learning. It was established in 2000 and the first editor-in-chief was Leslie Kaelbling.[1] The current editors-in-chief are Francis Bach (Inria) and David Blei (Columbia University).

## Machine Learning (journal):

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# Ethics:

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* Some application areas may also have particularly important ethical implications, like healthcare, education, criminal justice, or the military.

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* The training data is processed, building a function that maps new data to expected output values
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## Unsupervised learning:

* Unsupervised learning algorithms find structures in data that has not been labeled, classified or categorized. Instead of responding to feedback, unsupervised learning algorithms identify commonalities in the data and react based on the presence or absence of such commonalities in each new piece of data. Central applications of unsupervised machine learning include clustering, [dimensionality reduction](https://en.wikipedia.org/wiki/Dimensionality_reduction),[[7]](https://en.wikipedia.org/wiki/Machine_learning#cite_note-Friedman-1998-7) and [density estimation](https://en.wikipedia.org/wiki/Density_estimation)

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