

# An introduction to Machine Learning

Arthur Samuel, an early American leader in the field of computer gaming and artificial intelligence, coined the term “Machine Learning ” in 1959 while at IBM. He defined machine learning as “the field of study that gives computers the ability to learn without being explicitly programmed “. However, there is no universally accepted definition for machine learning. Different authors define the term differently. We give below two more definitions.

- Machine learning is programming computers to optimize a performance criterion using example data or past experience. We have a model defined up to some parameters, and learning is the execution of a computer program to optimize the parameters of the model using the training data or past experience. The model may be predictive to make predictions in the future, or descriptive to gain knowledge from data.
- The field of study known as machine learning is concerned with the question of how to construct computer programs that automatically improve with experience.

Machine learning is a subfield of artificial intelligence that involves the development of algorithms and statistical models that enable computers to improve their performance in tasks through experience. These algorithms and models are designed to learn from data and make predictions or decisions without explicit instructions. There are several types of machine learning, including supervised learning, unsupervised learning, and reinforcement learning. Supervised learning involves training a model on labeled data, while unsupervised learning involves training a model on unlabeled data. Reinforcement learning involves training a model through trial and error. Machine learning is used in a wide variety of applications, including image and speech recognition, natural language processing, and recommender systems.

Definition of learning:

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

## Examples

- Handwriting recognition learning problem
  - Task T : Recognizing and classifying handwritten words within images
  - Performance P : Percent of words correctly classified
  - Training experience E : A dataset of handwritten words with given classifications
- A robot driving learning problem
  - Task T : Driving on highways using vision sensors
  - Performance P : Average distance traveled before an error
  - Training experience E : A sequence of images and steering commands recorded while observing a human driver

Definition: A computer program which learns from experience is called a machine learning program or simply a learning program .

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## 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:

### A. Supervised learning:

Supervised learning is the machine learning task of learning a function that maps an input to an output based on example input-output pairs. The given data is labeled. Both *classification* and *regression* problems are supervised learning problems.

- Example — Consider the following data regarding patients entering a clinic . The data consists of the gender and age of the patients and each patient is labeled as “healthy” or “sick”.

Gend er	A g e	Label
M	48	sick
M	67	sick
F	53	healt hy
M	49	sick
F	32	healt hy
M	34	healt hy
M	21	healt hy

## B. Unsupervised learning:

Unsupervised learning is a type of machine learning algorithm used to draw inferences from datasets consisting of input data without labeled responses. In unsupervised learning algorithms, classification or categorization is not included in the observations. Example: Consider the following data regarding patients entering a clinic. The data consists of the gender and age of the patients.

Gend er	A g e
M	48
M	67
F	53

M	49
F	34
M	21

As a kind of learning, it resembles the methods humans use to figure out that certain objects or events are from the same class, such as by observing the degree of similarity between objects. Some recommendation systems that you find on the web in the form of marketing automation are based on this type of learning.

*To know more about supervised and unsupervised learning refer to:*

**<https://www.geeksforgeeks.org/supervised-unsupervised-learning/>**.

#### C. Reinforcement learning:

Reinforcement learning is the problem of getting an agent to act in the world so as to maximize its rewards.

A learner is not told what actions to take as in most forms of machine learning but instead must discover which actions yield the most reward by trying them. For example — Consider teaching a dog a new trick: we cannot tell him what to do, what not to do, but we can reward/punish it if it does the right/wrong thing.

When watching the video, notice how the program is initially clumsy and unskilled but steadily improves with training until it becomes a champion.

*To know more about Reinforcement learning refer to:*  
**<https://www.geeksforgeeks.org/what-is-reinforcement-learning/>**.

#### D. Semi-supervised learning:

Where an incomplete training signal is given: a training set with some (often many) of the target outputs missing. There is a special case of this principle known as Transduction where the entire set of problem instances is known at learning time, except that part of the targets are missing. Semi-supervised learning is an approach to machine learning that combines small labeled data with a large amount of unlabeled data during

training. Semi-supervised learning falls between unsupervised learning and supervised learning.

### Categorizing based on Required Output

Another categorization of machine-learning tasks arises when one considers the desired output of a machine-learned system:

- 1.**Classification:** When inputs are divided into two or more classes, the learner must produce a model that assigns unseen inputs to one or more (multi-label classification) of these classes. This is typically tackled in a supervised way. Spam filtering is an example of classification, where the inputs are email (or other) messages and the classes are “spam” and “not spam”.
- 2.**Regression:** Which is also a supervised problem, A case when the outputs are continuous rather than discrete.
- 3.**Clustering:** When a set of inputs is to be divided into groups. Unlike in classification, the groups are not known beforehand, making this typically an unsupervised task.

Machine Learning comes into the picture when problems cannot be solved using typical approaches. ML algorithms combined with new computing technologies promote scalability and improve efficiency. Modern ML models can be used to make predictions ranging from outbreaks of disease to the rise and fall of stocks.