

Lecture 4

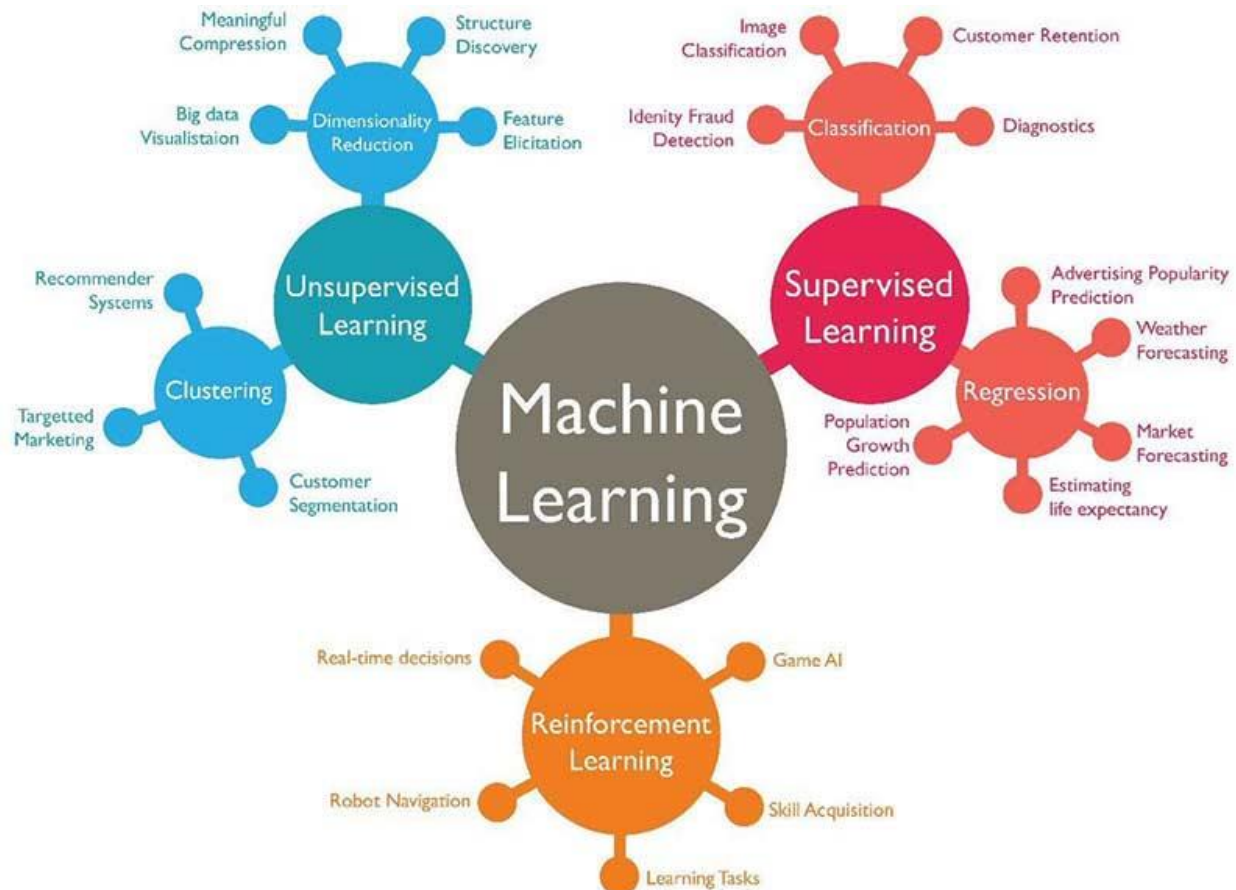
Types of Machine Learning

Learning

Learning is acquiring new knowledge, behaviors, skills, values, preferences or understanding, and may involve synthesizing different types of information. The ability to learn is possessed by humans, animals and some machines. Progress over time tends to follow learning curves.

There are three most regularly listed categories of Machine Learning:

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning



Supervised learning

The computer is presented with example inputs and their desired outputs, given by a "teacher", and the goal is to learn a general rule that maps inputs to outputs.

When an algorithm learns from example data and associated target responses that can consist of numeric values or string labels, such as classes or tags, in order to later predict the correct response when posed with new examples comes under the category of Supervised learning. This approach is indeed similar to human learning under the supervision of a teacher. The teacher provides good examples for the student to memorize, and the student then derives general rules from these specific examples.

This type of learning includes classification, regression, and ranking.

Unsupervised learning

No labels are given to the learning algorithm, leaving it on its own to find structure in its input. Unsupervised learning can be a goal in itself (discovering hidden patterns in data).

Whereas when an algorithm learns from plain examples without any associated response, leaving to the algorithm to determine the data patterns on its own. This type of algorithm tends to restructure the data into something else, such as new features that may represent a class or a new series of un-correlated values. They are quite useful in providing humans with insights into the meaning of data and new useful inputs to supervised machine learning algorithms. 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.

This type of learning includes: clustering, dimensionality reduction.

Difference b/w Supervised and Unsupervised Learning :

	SUPERVISED LEARNING	UNSUPERVISED LEARNING
Input Data	Input and output variable is given. Uses Known and Labeled Data as input	Only input variable is given. Uses Unknown Data as input
Computational Complexity	Very Complex	Less Computational Complexity
Real Time	Uses off-line analysis	Uses Real Time Analysis of Data

Number of Classes	Number of Classes are known	Number of Classes are not known
Accuracy of Results	Accurate and Reliable Results	Moderate Accurate and Reliable Results

Supervised and unsupervised learning with a real-life example



- Suppose you had a basket and filled it with different kinds of fruits.
- Your task is to arrange them into groups.
- For understanding let me explain the names of the fruits in our basket.
- We have four types of fruits. They are-



APPLE



BANANA



GRAPE



CHERRIES

Supervised Learning Example:

- You already learn from your previous work about the physical characters of fruits
- So arranging the same type of fruits at one place is easy now
- In data mining terminology the earlier work is called as **training the data**
- You already learn the things from your train data. This is because of **response variable**
- Response variable means just a **decision variable**
- You can observe response variable below (**FRUIT NAME**)

No.	SIZE	COLOR	SHAPE	FRUIT NAME
1	Big	Red	Rounded shape with depression at the top	Apple
2	Small	Red	Heart-shaped to nearly globular	Cherry
3	Big	Green	Long curving cylinder	Banana
4	Small	Green	Round to oval, Bunch shape Cylindrical	Grape

- Suppose you have taken a new fruit from the basket then you will see the size, color, and shape of that particular fruit.
- If size is Big, color is Red, the shape is rounded shape with a depression at the top, you will confirm the fruit name as apple and you will put in apple group.
- Likewise for other fruits also.
- The job of grouping fruits was done and the happy ending.
- You can observe in the table that a column was labeled as “**FRUIT NAME**“. This is called as a response variable.

- If you learn the thing before from training data and then applying that knowledge to the test data (for new fruit), This type of learning is called as **Supervised Learning**.

Unsupervised Learning Example:

- Suppose you have a basket and it is filled with some different types of fruits and your task is to arrange them as groups.
- This time, you don't know anything about the fruits, honestly saying this is the first time you have seen them. You have no clue about those.
- So, how will you arrange them?
- What will you do first???
- You will take a fruit and you will arrange them by considering the physical character of that particular fruit.
- Suppose you have considered color.
 - Then you will arrange them on considering base condition as **color**.
 - Then the groups will be something like this.
 - RED COLOR GROUP: apples & cherry fruits.
 - GREEN COLOR GROUP: bananas & grapes.
- So now you will take another physical character such as **size**.
 - RED COLOR AND BIG SIZE: apple.
 - RED COLOR AND SMALL SIZE: cherry fruits.
 - GREEN COLOR AND BIG SIZE: bananas.
 - GREEN COLOR AND SMALL SIZE: grapes.
- The job has done, the happy ending.
- Here you did not learn anything before, means no train data and no response variable.
- In data mining or machine learning, this kind of learning is known as ***unsupervised learning***.

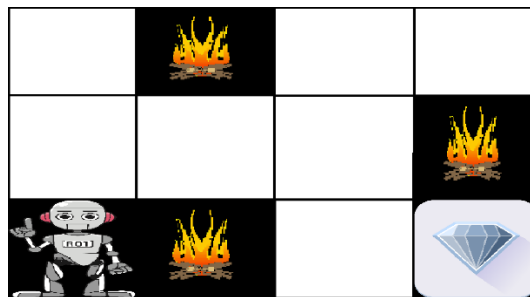
Reinforcement learning

This is somewhere between supervised and unsupervised learning. The algorithm gets told when the answer is wrong but does not get told how to correct it. It has to explore and try out different possibilities until it works out how to get the answer right. Reinforcement learning is sometime called learning with a critic because of this monitor that scores the answer but does not suggest improvements.

A computer program interacts with a dynamic environment in which it must perform a certain goal (such as driving a vehicle or playing a game against an opponent). The program is provided feedback in terms of rewards and punishments as it navigates its problem space.

It is about taking suitable action to maximize reward in a particular situation. It is employed by various software and machines to find the best possible behavior or path it should take in a specific situation. Reinforcement learning differs from the supervised learning in a way that in supervised learning the training data has the answer key with it so the model is trained with the correct answer itself whereas in reinforcement learning, there is no answer but the reinforcement agent decides what to do to perform the given task. In the absence of training dataset, it is bound to learn from its experience.

Example : The problem is as follows: We have an agent and a reward, with many hurdles in between. The agent is supposed to find the best possible path to reach the reward. The following problem explains the problem more easily.



The above image shows robot, diamond and fire. The goal of the robot is to get the reward that is the diamond and avoid the hurdles that is fire. The robot learns by trying all the possible paths and then choosing the path which gives him the reward with the least hurdles. Each right step will give the robot a reward and each wrong step will subtract the reward of the robot. The total reward will be calculated when it reaches the final reward that is the diamond.

Main points in Reinforcement learning –

- Input: The input should be an initial state from which the model will start
- Output: There are many possible output as there are variety of solution to a particular problem
- Training: The training is based upon the input, The model will return a state and the user will decide to reward or punish the model based on its output.
- The model keeps continues to learn.
- The best solution is decided based on the maximum reward.

Difference between Reinforcement learning and Supervised learning:

REINFORCEMENT LEARNING	SUPERVISED LEARNING
Reinforcement learning is all about making decisions sequentially. In simple words we can say that the out depends on the state of the current input and the next input depends on the output of the previous input.	In Supervised learning the decision is made on the initial input or the input given at the start
In Reinforcement learning decision is dependent, So we give labels to sequences of dependent decisions.	Supervised learning the decisions are independent of each other so labels are given to each decision.
Example: Chess game	Example: Object recognition

Types of Reinforcement: There are two types of Reinforcement:

1. **Positive** —

Positive Reinforcement is defined as when an event, occurs due to a particular behavior, increases the strength and the frequency of the behavior. In other words it has a positive effect on the behavior.

Advantages of reinforcement learning are:

- Maximizes Performance
- Sustain Change for a long period of time

Disadvantages of reinforcement learning:

- Too much Reinforcement can lead to overload of states which can diminish the results

2. **Negative** —

Negative Reinforcement is defined as strengthening of a behavior because a negative condition is stopped or avoided.

Advantages of reinforcement learning:

- Increases Behavior
- Provide defiance to minimum standard of performance

Disadvantages of reinforcement learning:

- It Only provides enough to meet up the minimum behavior

Types of Machine Learning – At a Glance

