What are the main differences between supervised and unsupervised learning?

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Supervised and unsupervised learning are two distinct approaches to machine learning. The main difference between the two lies in the availability of labeled data. In supervised learning, the algorithm is provided with a labeled dataset, where the desired output is already known. The algorithm then learns to predict the correct output for new, unseen data based on its previous training.

On the other hand, unsupervised learning does not have access to labeled data. Instead, the algorithm is tasked with finding patterns and relationships within the data on its own. It does this by grouping similar data points together, without any prior knowledge of the desired output.

Additionally, the goal of supervised learning is to minimize the error between the predicted and actual output, while unsupervised learning aims to discover hidden patterns and structures within the data.

Moreover, supervised learning is often used for classification and regression tasks, while unsupervised learning is more commonly used for clustering and anomaly detection.

In summary, the main differences between supervised and unsupervised learning lie in the availability of labeled data, the purpose and goal of the learning process, and the types of tasks they are commonly used for.

A Quick Introduction to Supervised vs. Unsupervised Learning

The field of machine learning contains a massive set of algorithms that can be used for understanding data. These algorithms can be classified into one of two categories:

1. Supervised Learning Algorithms: Involves building a model to estimate or predict an output based on one or more inputs.

2. Unsupervised Learning Algorithms: Involves finding structure and relationships from inputs. There is no "supervising" output.

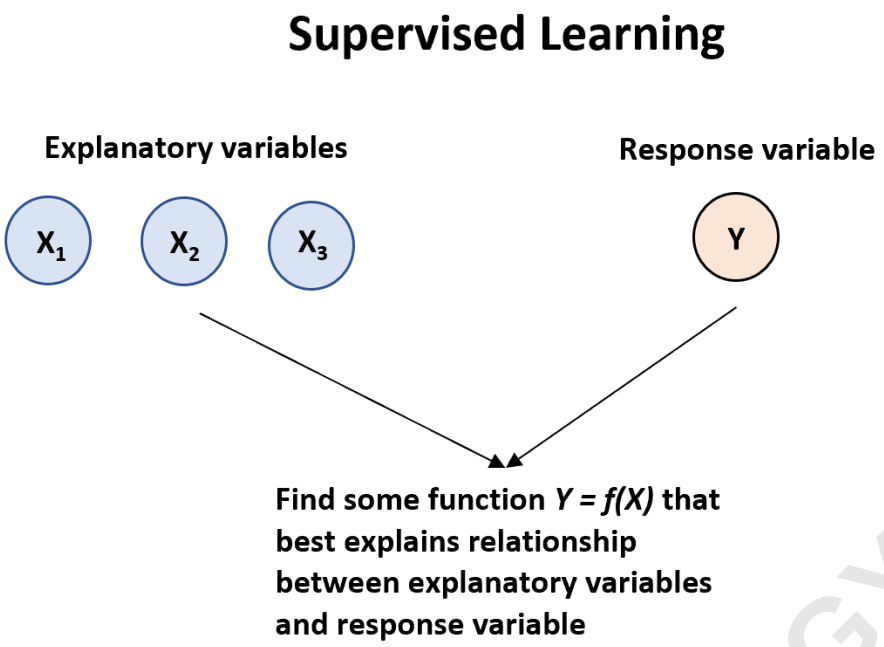
This tutorial explains the difference between these two types of algorithms along with several examples of each.

Supervised Learning Algorithms

A supervised learning algorithm can be used when we have one or more explanatory variables (X1, X2, X3, ..., Xp) and a response variable (Y) and we would like to find some function that describes the relationship between the explanatory variables and the response variable:

$$Y = f(X) + \varepsilon$$

where *f* represents systematic information that X provides about Y and where ε is a random error term independent of X with a mean of zero.



There are two main types of supervised learning algorithms:

1. Regression: The output variable is continuous (e.g. weight, height, time, etc.)

2. Classification: The output variable is categorical (e.g. male or female, pass or fail, benign or malignant, etc.)

There are two main reasons that we use supervised learning algorithms:

1. Prediction: We often use a set of explanatory variables to predict the value of some response variable (e.g. using *square footage* and *number of bedrooms* to

predict *home price*)

2. Inference: We may be interested in understanding the way that a response variable is affected as the value of the explanatory variables change (e.g. how much does home price increase, on average, when the number of bedrooms increases by one?)

Depending on whether our goal is inference or prediction (or a mix of both), we may use different methods for estimating the function *f*. For example, linear models offer easier interpretation but non-linear models that are difficult to interpret may offer more accurate prediction.

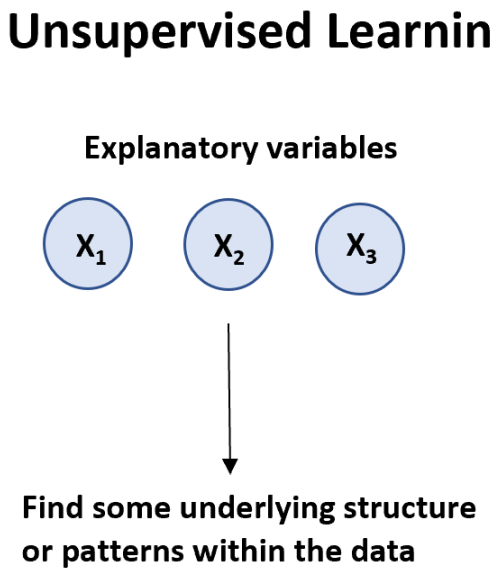
Here is a list of the most commonly used supervised learning algorithms:

Linear regressionLogistic regressionLinear discriminant analysisQuadratic discriminant analysisDecision treesNaive bayesSupport vector machinesNeural networks

Unsupervised Learning Algorithms

An unsupervised learning algorithm can be used when

we have a list of variables (X1, X2, X3, ..., Xp) and we would simply like to find underlying structure or patterns within the data.



There are two main types of unsupervised learning algorithms:

1. Clustering: Using these types of algorithms, we attempt to find "clusters" of in a dataset that are similar to each other. This is often used in retail when a company would like to identify clusters of customers who have similar shopping habits so that they can create specific marketing strategies that target certain clusters of customers.

2. Association: Using these types of algorithms, we attempt to find "rules" that can be used to draw associations. For example, retailers may develop an association algorithm that says "if a customer buys product X they are highly likely to also buy product Y."

Here is a list of the most commonly used unsupervised learning algorithms:

Principal component analysisK-means clusteringK-medoids clusteringHierarchical clusteringApriori algorithm

Summary: Supervised vs. Unsupervised Learning

The following table summarizes the differences between supervised and unsupervised learning algorithms:

	Supervised Learning	Unsupervised Learning
Description	Involves building a model to estimate or predict an output based on one or more inputs.	Involves finding structure and relationships from inputs. There is no "supervising" output.
Variables	Explanatory and Response variables	Explanatory variables only
End goal	Develop model to **(1)** predict new values or **(2)** understand existing relationship between explanatory and response variables	Develop model to **(1)** place observations from a dataset into a specific cluster or to **(2)** create rules to identify associations between variables.
Types of algorithms	**(1)** Regression and **(2)** Classification	**(1)** Clustering and **(2)** Association

And the following diagram summarizes the types of machine learning algorithms: