

In machine learning, **supervised learning (SL)** is a type of machine learning paradigm where an algorithm learns to map input data to a specific output based on example input-output pairs. This process involves training a statistical model using labeled data, meaning each piece of input data is provided with the correct output. For instance, if you want a model to identify cats in images, supervised learning would involve feeding it many images of cats (inputs) that are explicitly labeled "cat" (outputs).

The goal of supervised learning is for the trained model to accurately predict the output for new, unseen data. This requires the algorithm to effectively generalize from the training examples, a quality measured by its generalization error.

Supervised learning is commonly used for tasks like classification (predicting a category, e.g., spam or not spam) and regression (predicting a continuous value, e.g., house prices).

Steps to follow

To solve a given problem of supervised learning, the following steps must be performed:

Algorithm choice

A wide range of supervised learning algorithms are available, each with its strengths and weaknesses. There is no single learning algorithm that works best on all supervised learning problems .

There are four major issues to consider in supervised learning:

Bias-variance tradeoff

A first issue is the tradeoff between *bias* and *variance*. Imagine that we have available several different, but equally good, training data sets. A learning algorithm is biased for a particular input x if, when trained on each of these data sets, it is systematically incorrect when predicting the correct output for x . A learning

algorithm has high variance for a particular input x if it predicts different output values when trained on different training sets. The prediction error of a learned classifier is related to the sum of the bias and the variance of the learning algorithm. Generally, there is a tradeoff between bias and variance. A learning algorithm with low bias must be "flexible" so that it can fit the data well. But if the learning algorithm is too flexible, it will fit each training data set differently, and hence have high variance. A key aspect of many supervised learning methods is that they are able to adjust this tradeoff between bias and variance (either automatically or by providing a bias/variance parameter that the user can adjust).