Induction of Decision Trees

The paper, Induction of Decision Trees, briefly discusses the history of machine learning algorithms, the decision tree family of algorithms and their various use cases before giving an in-depth explanation of the ID3 algorithm.

The field of artificial intelligence gained in popularity during the twentieth century, accompanying the rise in ubiquity of computers. During this time, the main goal of research was to use computers to solve problems in an intelligent manner. In other words, researchers sought to develop algorithms that learn how to solve problems. Quinlan mentions that one group of researchers focused on creating programs that learn through a feedback cycle of self-testing and "adjusting internal parameters." A good example of this would be a program written to play checkers against itself many thousands of times.

 This paper focuses on one microcosm of machine learning and on a family of learning systems that have been used to build knowledge-based systems of a simple kind and on two novel initiatives that give some idea of the directions in which the family may grow.

Carbonell, Michalski and Mitchell (1983) identify three principal dimensions along which machine learning systems can be classified: the underlying learning strategies used; the representation of knowledge acquired by the system; and the application domain of the system.

The basis is a universe of objects that are described in terms of a collection of attributes. In order to correctly classify each object, the decision tree must capture some meaningful relationship between an object's class and its values of the attributes.

One approach to the induction task above would be to generate all possible decision trees that correctly classify the training set and to select the simplest of them. A subset of the training set called the window is chosen at random and a decision tree formed from it; this tree correctly classifies all objects in the window. This potential limitation has not yet arisen in practice. A straightforward method of assessing this predictive accuracy is to use only 'part of the given set of objects as a training set, and to check the resulting decision tree on the remainder.