Machine learning

Machine learning (**ML**) is a field of study in artificial intelligence concerned with the development and study of statistical algorithms that can learn from data and generalize to unseen data, and thus perform tasks without explicit instructions.[1] Recently, artificial neural networks have been able to surpass many previous approaches in performance.[2][3]

Machine learning approaches have been applied to many fields including natural language processing, computer vision, speech recognition, email filtering, agriculture, and medicine.[4][5] ML is known in its application across business problems under the name predictive analytics. Although not all machine learning is statistically based, computational statistics is an important source of the field's methods.

The mathematical foundations of ML are provided by mathematical optimization (mathematical programming) methods. Data mining is a related (parallel) field of study, focusing on exploratory data analysis (EDA) through unsupervised learning.[7][8]

From a theoretical viewpoint, probably approximately correct (PAC) learning provides a framework for describing machine learning.

History

The term *machine learning* was coined in 1959 by Arthur Samuel, an IBM employee and pioneer in the field of computer gaming and artificial intelligence.[9][10] The synonym *self-teaching computers* was also used in this time period.[11][12]

Although the earliest machine learning model was introduced in the 1950s when Arthur Samuel invented a program that calculated the winning chance in checkers for each side, the history of machine learning roots back to decades of human desire and effort to study human cognitive processes.[13] In 1949, Canadian psychologist Donald Hebb published the book *The Organization of Behavior*, in which he introduced a theoretical neural structure formed by certain interactions among nerve cells.[14] Hebb's model of neurons interacting with one another set a groundwork for how AIs and machine learning algorithms work under nodes, or artificial neurons used by computers to communicate data.[13] Other researchers who have studied human cognitive systems contributed to the modern machine learning technologies as well, including logician Walter Pitts and Warren McCulloch, who proposed the early mathematical models of neural networks to come up with algorithms that mirror human thought processes.[13]

By the early 1960s an experimental "learning machine" with punched tape memory, called Cybertron, had been developed by Raytheon Company to analyze sonar signals, electrocardiograms, and speech patterns using rudimentary reinforcement learning. It was repetitively "trained" by a human operator/teacher to recognize patterns and equipped with a "goof" button to cause it to re-evaluate incorrect decisions.[15] A representative book on research into machine learning during the 1960s was Nilsson's book on Learning Machines, dealing mostly with machine learning for pattern classification.[16] Interest related to pattern recognition