

# Chapter 6.10

## Machine Learning and Financial Investing

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### **ABSTRACT**

This chapter presents the case for knowledge-based machine learning in financial investing. Machine learning here, while it will exploit knowledge, will also rely heavily on the evolutionary computation paradigm of learning, namely reproduction with change and selection of the fit. The chapter will begin with a model for financial investing and then review what has been reported in the literature as regards knowledge-based and machine-learning-based methods for financial investing. Finally, a design of a financial investing system is described which incorporates the key features identified through the literature review. The emerging trend of incorporating knowledge-based methods into evolutionary methods for

financial investing suggests opportunities for future researchers.

### **INTRODUCTION**

The field of machine learning applied to financial investing is complicated but promises opportunities as well as challenges. The speculative financial investing problem, compared with other financial problems, such as financial accounting, attracts substantial research interest. This chapter introduces the case for machine-learning-based methods to be applied to the financial investing problem. The objective of the chapter is to be a state-of-the-art review upon which a model for research on intelligent financial investing system can be built.

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A conceptual model for financial investing is presented, and relevant literature is reviewed as regards knowledge-based and machine-learning-based methods for financial investing. The literature review reveals three patterns. Knowledge-based methods, such as expert systems, were mostly used to solve financial problems in the early 1990s, while machine-learning-based methods, such as evolutionary computation, gained the dominate position in this field in the early 2000s. The most frequently addressed financial topic is 'Asset Valuation'. The trend is to incorporate knowledge-based technologies into evolutionary computation for financial investing.

Later in this chapter the design of an intelligent financial investing system is presented which incorporates the key features identified by the literature review. More specifically, this chapter is organized as follows. The 'Background Section' introduces the problem of financial investing and presents a model for financial investing systems. The procedure used in the literature review is given in the 'Method Section'. The detailed literature review and the key features identified through the literature review are presented in the 'Results' and 'Analysis' Sections. The penultimate section contains the design of the intelligent financial investing system. The concluding remarks and future trends are contained in the 'Conclusion Section'.

## **BACKGROUND**

### **Development in the State of the Art of Machine Learning**

Machine learning can be defined as a program that based on experience  $E$  with respect to some class of tasks  $T$  and a performance measure  $P$  improves its performance at task  $T$ , as measured by  $P$ , with experience  $E$  (Mitchell, 1997). Machine learning systems are not directly programmed to solve a problem, instead they develop based on examples

of how they should behave and from trial-and-error experience trying to solve the problem.

The field of machine learning addresses the question of "how can we build computer systems which can automatically improve with experience, and what are the fundamental laws that govern all learning processes?" (Mitchell, 2006).

Different techniques are used in different subfields of machine learning, such as neural networks (Chauvin & Rumelhart, 1995), instance-based learning (Aha, Kibler & Albert, 1991), decision tree learning (Quinlan, 1993), computational learning theory (Kearns & Vazirani, 1994), genetic algorithms (Mitchell, 1996), statistical learning methods (Bishop, 1996), and reinforcement learning (Kaelbling, Littman & Moore, 1996). In recent years, machine learning has shed light on many other disciplines, such as economics, finance, and management. Many machine learning tools, including neural networks and genetic algorithms, are used in intelligent financial investing research.

### **The Problem of Financial Investing**

Financial investing systems can be seen as having three phases: 1) data collection, 2) asset valuation and 3) portfolio management. Financial investing systems should follow these steps (Kingdon, 1997):

- Identify and collect useful data which can be used to make predictions,
- Forecast assets' future value, and
- Optimize a portfolio.

The phase of data collection identifies what data might be used to predict an asset's value. The asset value is influenced by many factors. For stock valuation, quantitative factors, such as the individual company's financial attributes and historical stock price, are often used in predicting the future stock price. Wu et al (2006) use the history of stock prices and national money supply.

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