Applying Artificial Intelligence to Financial Investing

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INTRODUCTION

Artificial intelligence (AI) techniques have long been applied to financial investing scenarios to determine market inefficiencies, criteria for credit scoring, and bankruptcy prediction, to name a few. While there are many subfields to artificial intelligence this work seeks to identify the most commonly applied AI techniques to financial investing as appears in academic literature. Techniques identified in this work include fuzzy systems, swarm intelligence, case-based reasoning, hybrid systems, genetic algorithms, neural networks, and machine learning. AI techniques, such as knowledge-based, machine learning, and natural language processing, are integrated into systems that simultaneously address data identification, asset valuation, and risk management. Frequently, machine learning is applied to technical financial indicators in order to make predictions about the direction of stock prices. Financial investing requires data identification, asset valuation, and risk management. One such example of applying AI techniques to financial investing is the application of knowledge-based techniques for credit risk assessment and machine learning techniques for stock valuation. Future trends will continue to integrate hybrid artificial intelligence techniques into financial investing, portfolio optimization, and risk management. The remainder of this article summarizes key contributions of applying AI to financial investing as appears in the academic literature.

BACKGROUND

What Is Artificial Intelligence?

In the early days of computing, a typical task for a computer program was a numerical computation, such as computing the trajectory of a bullet. In modern days, a typical task for a computer program may involve supporting many people in important decisions backed by a massive database across a global network. As the tasks that computers typically perform have become more complex and more closely intertwined with the daily decisions of people, the behavior of the computer programs increasingly assumes characteristics that people associate with intelligence. When exactly a program earns the label of 'artificial intelligence' is unclear. The classic test for whether a program is intelligent is that a person would not be able to distinguish a response from an intelligent program from the response of a person. This famous Turing Test is dependent on factors not easily standardized, such as what person is making the assessment under what conditions.

A range of computer programming techniques that are currently, popularly considered artificial intelligence techniques includes (Rada, 2008):

- Knowledge-based techniques, such as in expert systems.
- Machine learning techniques, such as genetic algorithms and neural networks.

- Sensory or motor techniques, such as natural language processing and image processing.

These methods may apply to investing. For instance, expert systems have been used to predict whether a company will go bankrupt. Neural networks have been used to generate buy and sell decisions on stock exchange indices. Natural language processing programs have been used to analyze corporate news releases and to suggest a buy or sell signal for the corporate stock.

While artificial intelligence (AI) could apply to many areas of investing, much of what happens in computer-supported investing comes from non-AI areas. For instance, computational techniques not considered primarily AI techniques include numerical analyses, operations research, and probabilistic analyses. These non-AI techniques are routinely used in investing.

Investing and Data

The process of investing has 3-stages of:

1. Data Identification,
2. Asset Valuation, and
3. Risk Management.

AI has been most often applied to asset valuation but is also applicable to data identification and risk management.

Two, high-level types of data used in financial investing are technical data and fundamental data. The price of an asset across time is technical data and lends itself to various computations, such as the moving average or the standard deviation (volatility). Fundamental data should support cause-and-effect relationships between an asset and its price. For instance, the quality of management of a company should influence the profitability of a company and thus the price of its stock.

The universe of fundamental data is infinite. Many streams of data that might be relevant, such as corporate earnings or corporate debt, might also

be related to one another. Various non-AI tools, such as linear regression analysis and principal components analysis, might be used in identifying what sets of data are more likely to be useful than what other sets. Such non-AI, computational techniques can be combined with AI techniques in experimenting with various combinations of data and choosing what data to use in asset valuation.

ARTIFICIAL INTELLIGENCE APPLIED TO FINANCIAL INVESTING

AI Trends

A multi-agent architecture for an integrated system that considers data identification, asset valuation, and risk management has been proposed by researchers at Carnegie Mellon University. The system is called WARREN which refers to the first name of the famous investor Warren Buffet (Sycara, Decker, Pannu, Williamson, & Zeng, 1996). The WARREN system design includes components for collecting large amounts of real-time data, both numeric and textual. The data would be pre-processed and then fed to various asset valuation agents that would, in turn, feed their assessments to a portfolio management agent. The portfolio management agent would interact with clients of WARREN. Systems with various features of WARREN are available from commercial vendors and are developed in-house by large investing companies, but more research is needed on how to develop integrated, AI systems that support investing.

Natural language processing systems may include large bodies of domain knowledge and parse free text so as to make inferences about the content of the text. However, such natural language processing systems do not seem as popular in investing applications as much simpler natural language processing techniques. The natural language processing work that has been applied to investing seems to be largely of the sort in which the distribution of word frequencies in a

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