

# **NELION: A Non-Linear Stock Prediction and Portfolio Management System**

Am Fachbereich Mathematik und Informatik  
der Freien Universität Berlin  
eingereichte Dissertation  
zur Erlangung des akademischen Grades  
eines Doktors der Naturwissenschaften

vorgelegt von Thomas Schwerk  
Berlin, 2001

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Tag der Disputation: 13. Februar 2001

This dissertation is dedicated to Victoria Malaika Bonnekamp

## Preface

This thesis presents a unified Internet-based portfolio management tool, NELION<sup>1</sup>, that combines non-linear stock predictions and suggests the optimal portfolio for multiple investors, based on their specific preferences.

There exist a variety of publications on different approaches to time series analysis, especially as it pertains to financial data, including stock prices. The bulk of the work, however, optimized a certain technique to a specific set of data. There also exists a wide consensus on portfolio management theory, which describes how stocks in a portfolio should be distributed so that it conforms to the risk and return requirements of an investor. Until now, however, these two approaches have not been connected to form an automated and integrated stock prediction and portfolio management tool.

NELION connects to the Internet on a daily basis and downloads stock prices and transaction volumes to a local database. With this information at hand, it determines the volatility of the stock and the correlation between any two

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<sup>1</sup> At 5188 m, Nelion is the second of the twin peaks of Mount Kenya, the highest mountain in this East-African country. The silhouette of the mountain is reminiscent of a local maximum of a stock chart.

stocks that are tracked on the database. The system then calculates numerous mathematical predictor models to forecast the stock price one day, one week and one month into the future. These models are continually refined through a genetic algorithm that uses the available processing power of the computer to search the model parameter space for improved configurations whenever no other tasks are awaiting execution.

Investors benefit from these models through personalized transaction suggestions, which take both their current portfolio and their risk adversity and other preferences into account. They can be notified by e-mail at defined intervals of the current state of their portfolio and receive suggestions on how to reduce its risk, while maintaining a defined return on investment. In order to limit expensive excess trades, it takes the minimum transaction value as defined by the investor into account. In case NELION identifies that a particular stock has undergone a dramatic change in stock price, the system generates an alert for all investors who own shares in the company by sending a short message via mobile phone.

NELION provides a Test Investor function that simulates trades based on historic data for any number of investor profiles. This function is designed for use with all combinations of the adjustable parameters so that the results of these trials can be analyzed and different categories of investors recommended for different risk adversity levels.

Additionally, the system has an Auto Investor module that acts like an autonomous trader on real data and automatically executes unsupervised, simulated trades at defined intervals. These functions base all purchases and sales on the current stock price and include transaction costs in an effort to provide a fair measure of the success of the system.

The experiment allowed the agent to perform unlimited transactions once every weekend with no human intervention and ran for one year starting May 15, 1999 for a conservative and a high-risk investor configuration. The algorithm merely restricted negative ownership of stocks or “short” positions and was not permitted to use more cash than the US\$ 10,000 initial investment.

The results show that NELION is an effective advisor alerting a private investor to promising opportunities and showing him alternatives to reduce the risk of his portfolio while maintaining a defined level of return. The portfolio management tools provide the user with relevant information both on the portfolio history and the recommendations for the future.

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