

Preface

The financial markets move vast amounts of capital around the world. This fact and the easy access to trading in a manual or automatic way that creates a more accessible way to participate in the markets activity attracted the interest of all types of investors, from the “man on the street” to academic researchers. This type of new investors and the automatic trading systems influence the market behavior. In order to adapt to this new reality, the domain of computational finance has received an increasing attention by people from both finance and computational intelligence domains.

The main driving force in the field of computational finance, with application to financial markets, is to define highly profitable and less risky trading strategies. In order to accomplish this main objective, the defined strategies must process large amounts of data which include financial markets time series, fundamental analysis data, technical analysis data, etc., and produce appropriate buy and sell signals for the selected financial market securities. What may appear, at a first glance, as an easy problem is, in fact, a huge and highly complex optimization problem, which cannot be solved analytically. Therefore, this makes the soft computing and in general the computational intelligence domains especially appropriate for addressing the problem.

The use of chart patterns is widely spread among traders as an additional tool for decision making. The Chartists, as these analysts are known, try to identify some known pattern formations and based on previous appearances try to predict future market trends. The visual pattern identification is hard and largely subject to errors, patterns in the financial time series are not as clean and high as the images in the books, so the need to create some solution that helps on this task will always be welcomed.

This work presents a new computational finance approach, combining a Symbolic Aggregate approXimation (SAX) technique together with an optimization kernel based on genetic algorithms (GA). The SAX representation is used to describe the financial time series, so that, relevant patterns can be efficiently identified. The evolutionary optimization kernel is here used to identify the most relevant patterns and generate investment rules. The SAX technique uses an alphabetic symbolic representation of data defined by adjustable parameters.

In order to capture and preserve the essence of the explored financial time series, a search for the optimal combination of SAX parameters is presented. The proposed approach considers several different chromosomes structures in order to achieve better results on the trading platform, first, it begins with a basic fixed structure and starts to evolve to an extended one that allows a more accurate use of the SAX representation, and finally finishes with a multi-chromosome structure to capture the trading potential that this approach has to offer. This approach was tested using real data from S&P500 and was also compared with another state-of-the-art approach which uses a template pattern-based method to detect patterns. The achieved results show that the proposed approach outperforms both B&H and other state-of-the-art solutions.

This book is organized into five chapters as follows:

Chapter 1 presents a brief description on the problems addressed by this book, namely the investment optimization based on pattern discovery techniques. Additionally, the main goals for the work presented in this book, as well as the document's structure are also highlighted in this chapter.

In **Chap. 2**, some fundamental concepts necessary to understand the developed work are addressed, particularly, the domain relative to financial markets and time series analysis. Furthermore, several methodologies applied to market investment and especially to pattern detection are presented. Finally, an introduction to the SAX representation method will be presented and previous works using this methodology will be discussed.

Chapter 3 presents an innovative methodology for pattern discovery in financial time series. The combination of SAX representation method with the use of GA to optimize the search and creation of new investment strategies will be explored. Taking advantage of the symbolic representation and dimensional reduction provided by SAX, several financial time series will be analyzed in order to search for meaningful patterns to reveal periods of time to invest on the stock market. The search and investment criteria will be defined and optimized by the use of GA, several chromosomes structures were considered in order to provide more accurate results.

Chapter 4 presents and compares the results from the approaches described in **Chap. 3**. The several chromosome structures were tested in real market conditions, where in all transactions the costs were considered. In order to test this new approach of investment based on pattern discovery in financial time series, two major experiences were made. The first test is based on the discovery of patterns to invest Long presented like "SAX-GA Uptrend Pattern Discovery". The second test is a method that invests Long and Short, to do this it tries to discover patterns to enter and exit Long and another set of patterns to enter and exit Short, described later on "SAX-GA Multi-Chromosome Pattern Discovery".

Chapter 5 summarizes the provided book and supplies the respective conclusions and future work.

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Investment Strategies Optimization based on a SAX-GA
Methodology

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