

# Chapter 7

## A Novel Fuzzy Associative Memory Architecture for Stock Market Prediction and Trading

**Chai Quek**

*Nanyang Technological University, Singapore*

**Zaiyi Guo**

*Nanyang Technological University, Singapore*

**Douglas L. Maskell**

*Nanyang Technological University, Singapore*

### ABSTRACT

*In this paper, a novel stock trading framework based on a neuro-fuzzy associative memory (FAM) architecture is proposed. The architecture incorporates the approximate analogical reasoning schema (AARS) to resolve the problem of discontinuous (staircase) response and inefficient memory utilization with uniform quantization in the associative memory structure. The resultant structure is conceptually clearer and more computationally efficient than the Compositional Rule Inference (CRI) and Truth Value Restriction (TVR) fuzzy inference schemes. The local generalization characteristic of the associative memory structure is preserved by the FAM-AARS architecture. The prediction and trading framework exploits the price percentage oscillator (PPO) for input preprocessing and trading decision making. Numerical experiments conducted on real-life stock data confirm the validity of the design and the performance of the proposed architecture.*

### INTRODUCTION

Financial engineering is a rapidly expanding research area. Trading systems based on computational intelligence techniques for financial asset management, notably in the areas of equities trading and risk management for derivatives like

options and swaps has received considerable interest from both researchers and financial traders. Neural networks (NN) have been used extensively for market forecasting (White, 1988; Chiang et al., 1996). More recently, time-delay, recurrent and probabilistic NNs have been used to analyze the predictive capability of the networks using “live

DOI: 10.4018/978-1-4666-1870-1.ch007

data” for several highly volatile and consumer stocks (Saad et al., 1998; Moody & Saffell, 2001; Chen et al., 2003).

Trading systems using a chaos-based modeling procedure to construct alternative price prediction models based on technical, adaptive, and statistical models have been proposed (Wilson, 1994). An intelligent stock trading decision support system has been developed (Chou et al., 1996), that can forecast buying and selling signals for the prediction of short-term and long-term trends using rule-based NNs. NNs and genetic algorithms were used in Baba et al. (2000) to construct an intelligent decision support system (DSS) to analyze the Tokyo Stock Exchange Stock Price Index (TOPIX). The DSS was able to project the high and low TOPIX values four weeks into the future and suggested buy/sell decisions based on the average value. Similar techniques were adapted to perform “bull flag” pattern recognition and to learn the trading rules from price and volume of the New York Stock Exchange Composite Index (NYSE-CI) (Leigh et al., 2002). Predictor attributes, including financial statement variables and macroeconomic variables, were used with a back-propagation NN to integrate fundamental and technical analysis for financial performance prediction (Lam, 2004).

Fuzzy logic and neural networks are both motivated by human learning and interpretation. Fuzzy Logic gives a framework for approximate reasoning and allows qualitative knowledge about the problem to be translated into an executable set of rules, but by itself cannot automatically construct or acquire the rules used to make those decisions. NNs are known for their computational power, fault tolerance and learning capabilities, but are inadequate for explaining how they arrive at their decisions. Fuzzy neural networks (FNNs) are hybrid systems that attempt to combine the advantages of both techniques. Numerous approaches to integrate fuzzy systems and NNs have been proposed. An extensive bibliography on FNNs can be found in (Buckley & Hayashi,

1995). In recent years, there has been an increasing emphasis on neuro-fuzzy systems in financial engineering (Trippi & Turban, 1993) and stock price forecasting (Thammano, 1999; Wang, 2003; Ang & Quek, 2006).

This paper examines the application of a neuro-fuzzy associative memory (FAM) architecture which incorporates the approximate analogical reasoning schema (AARS). This novel fuzzy neural network architecture, referred to as FAM-AARS, is applied to the stock prediction and trading problem. The rest of the paper is organized as follows. The following section presents the details of the proposed FAM-AARS architecture and introduces the direct-output FAM-AARS. The prediction and trading framework which exploits the price percentage oscillator (PPO) for input preprocessing and trading decision making is presented. The performance of the direct-output FAM-AARS network is evaluated based on experiments conducted on real-life stock data.

## **THE FAM-AARS ARCHITECTURE**

Associative memory (AM) is a class of neural networks which forms a content-addressable structure which is able to map a set of input patterns to a set of output patterns and is characterized by its excellent storage, recall and error correction properties. The cerebellar model articulation controller (CMAC) (Albus, 1975) is a sub-class of AM inspired by the neuro-physiological theory of the cerebellum (Albus, 1972, 1975). The CMAC neural network is an alternative to the well-known backpropagation-trained multi-layer NN which has disadvantages of: requiring many iterations to converge; requiring a large amount of computation so that the algorithm runs slowly unless implemented in expensive custom hardware; having an error surface which can have relative minima; not allowing successful incremental learning if one has finite time to train, etc (Glanz et al., 1991; Miller et al., 1990). The CMAC structure is at-

16 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/chapter/novel-fuzzy-associative-memory-architecture/67484](http://www.igi-global.com/chapter/novel-fuzzy-associative-memory-architecture/67484)

## Related Content

---

### The Human Condition in a Technological Era: Redefining Existence in Society 5.0

Sooraj Kumar Maurya (2026). *Advancing Society 5.0 Through AI-Driven Curriculum Innovation* (pp. 1-26).

[www.irma-international.org/chapter/the-human-condition-in-a-technological-era/386458](http://www.irma-international.org/chapter/the-human-condition-in-a-technological-era/386458)

### AI-Driven Media Influence on Consumer Behavior: Algorithmic Personalization, Trust, and Attention

Burak Pekun (2026). *Reshaping Journalism and Communications With AI* (pp. 63-92).

[www.irma-international.org/chapter/ai-driven-media-influence-on-consumer-behavior/399726](http://www.irma-international.org/chapter/ai-driven-media-influence-on-consumer-behavior/399726)

### Covering Rough Clustering Approach for Unstructured Activity Analysis

Prabhavathy Panneerand B.K. Tripathy (2016). *International Journal of Intelligent Information Technologies* (pp. 1-11).

[www.irma-international.org/article/covering-rough-clustering-approach-for-unstructured-activity-analysis/152302](http://www.irma-international.org/article/covering-rough-clustering-approach-for-unstructured-activity-analysis/152302)

### Integrating Sensor Nodes into a Middleware for Ambient Intelligence

Holger Klusand Dirk Niebuhr (2009). *International Journal of Ambient Computing and Intelligence* (pp. 1-11).

[www.irma-international.org/article/integrating-sensor-nodes-into-middleware/37472](http://www.irma-international.org/article/integrating-sensor-nodes-into-middleware/37472)

### Digital Twins in Renewable Energy Systems: Enhancing Efficiency Projecting Sustainability

Vaishali Rahate, Puja S. Agrawal, Maajid Mohi Ud Din Malik, Prashant Balwantrao Thakare, Saurabh Chandraand Bhupinder Singh (2025). *Leveraging AI for Innovative Sustainable Energy: Solar, Wind and Green Hydrogen* (pp. 123-138).

[www.irma-international.org/chapter/digital-twins-in-renewable-energy-systems/380463](http://www.irma-international.org/chapter/digital-twins-in-renewable-energy-systems/380463)