NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

School of Computer Science and Engineering
College of Engineering

Evolving Data-driven Interpretable Fuzzy Deep Neural Networks with Applications in Algorithmic Finance

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Objectives

This project proposes a data-driven Interpretable Fuzzy Deep Neural Network (IFDNN) model that incorporates neural network inferences, which provide highly accurate predictions, with fuzzy logic, which provides interpretability. A dynamic rule tagging system is created, with fuzzy rules mapping to the hidden units in the parallel deep neural network. The forecasts from IFDNN will be incorporated into a momentum indicator, Moving Average Convergence Divergence (MACD), to reduce the time lag and detect trend reversals within financial markets.
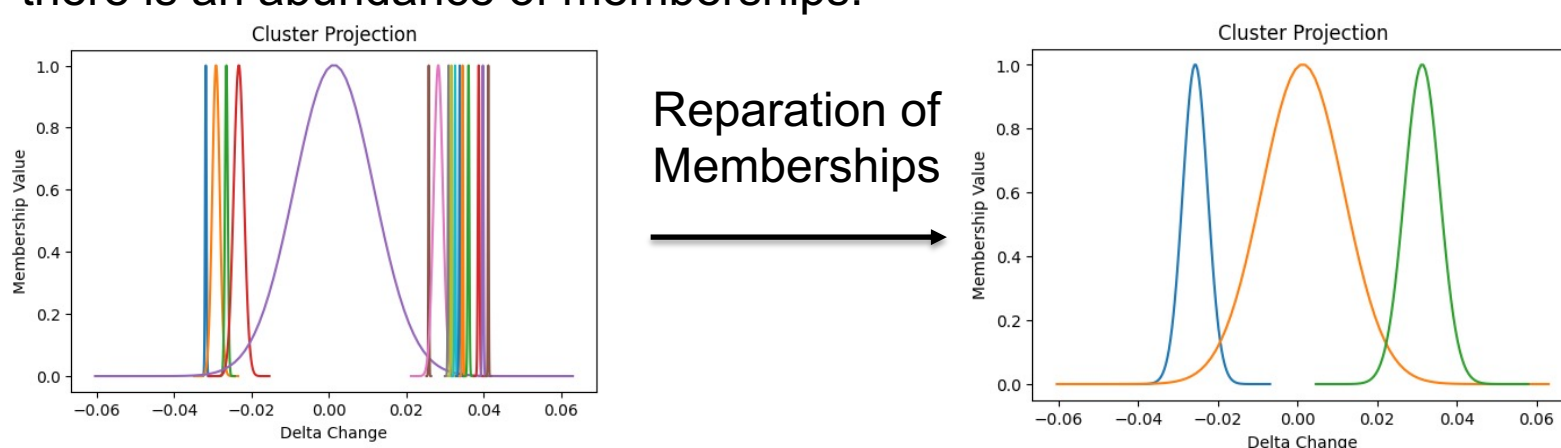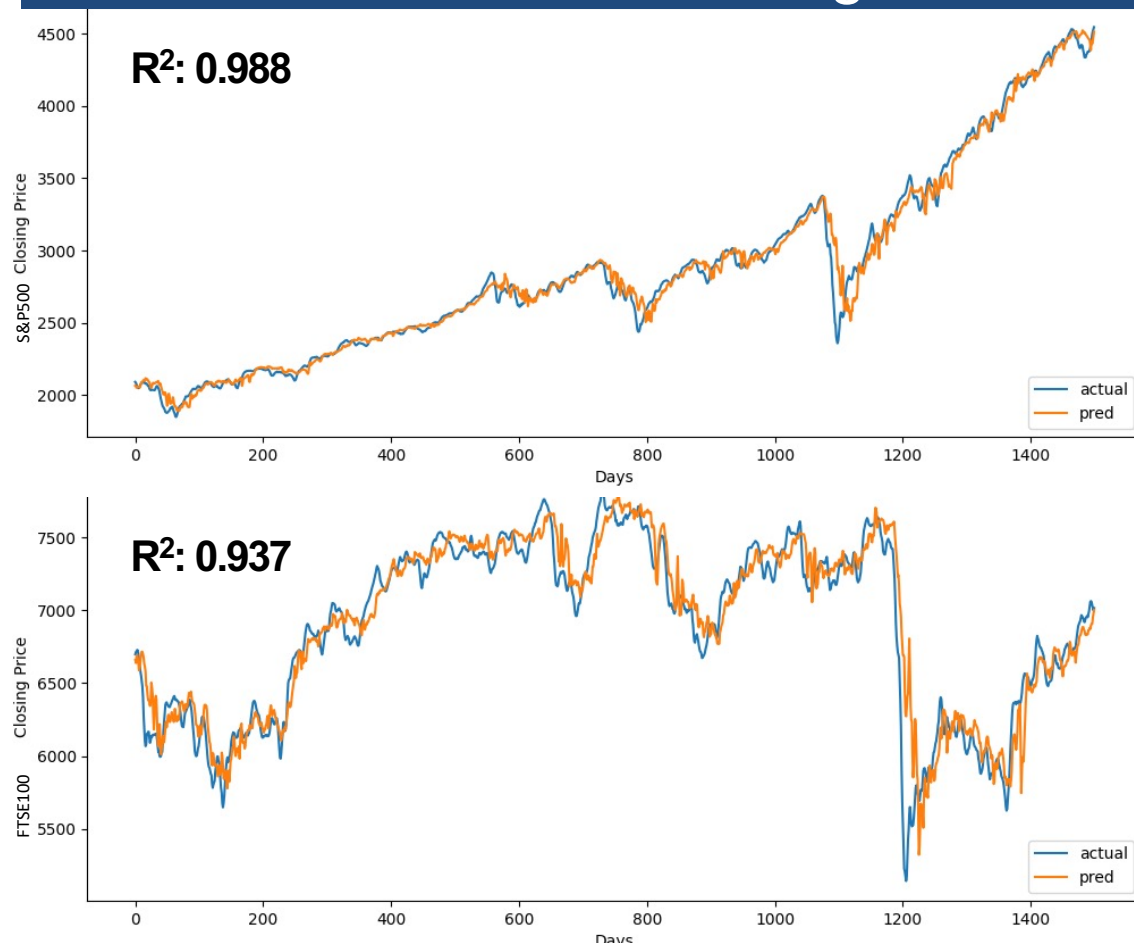
Proposed IFDNN Architecture
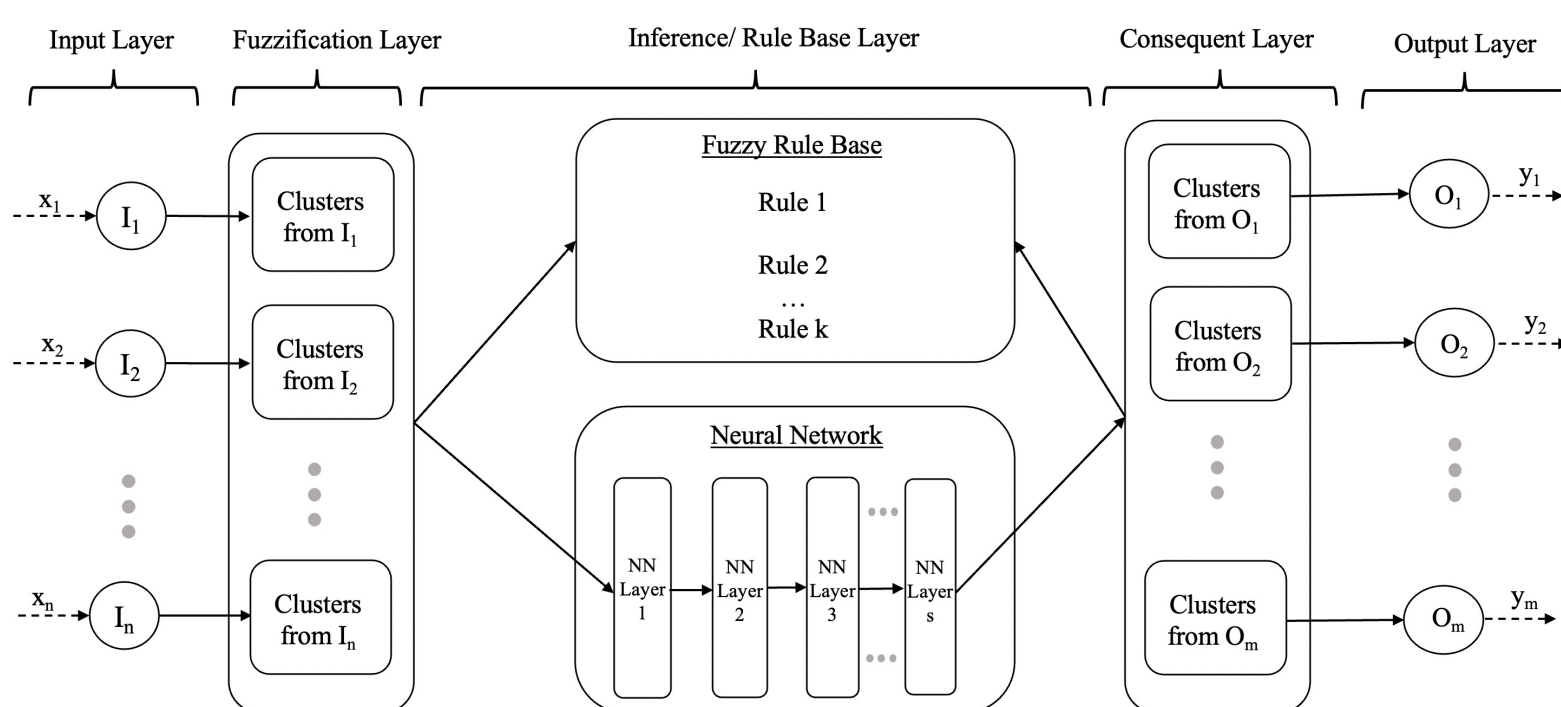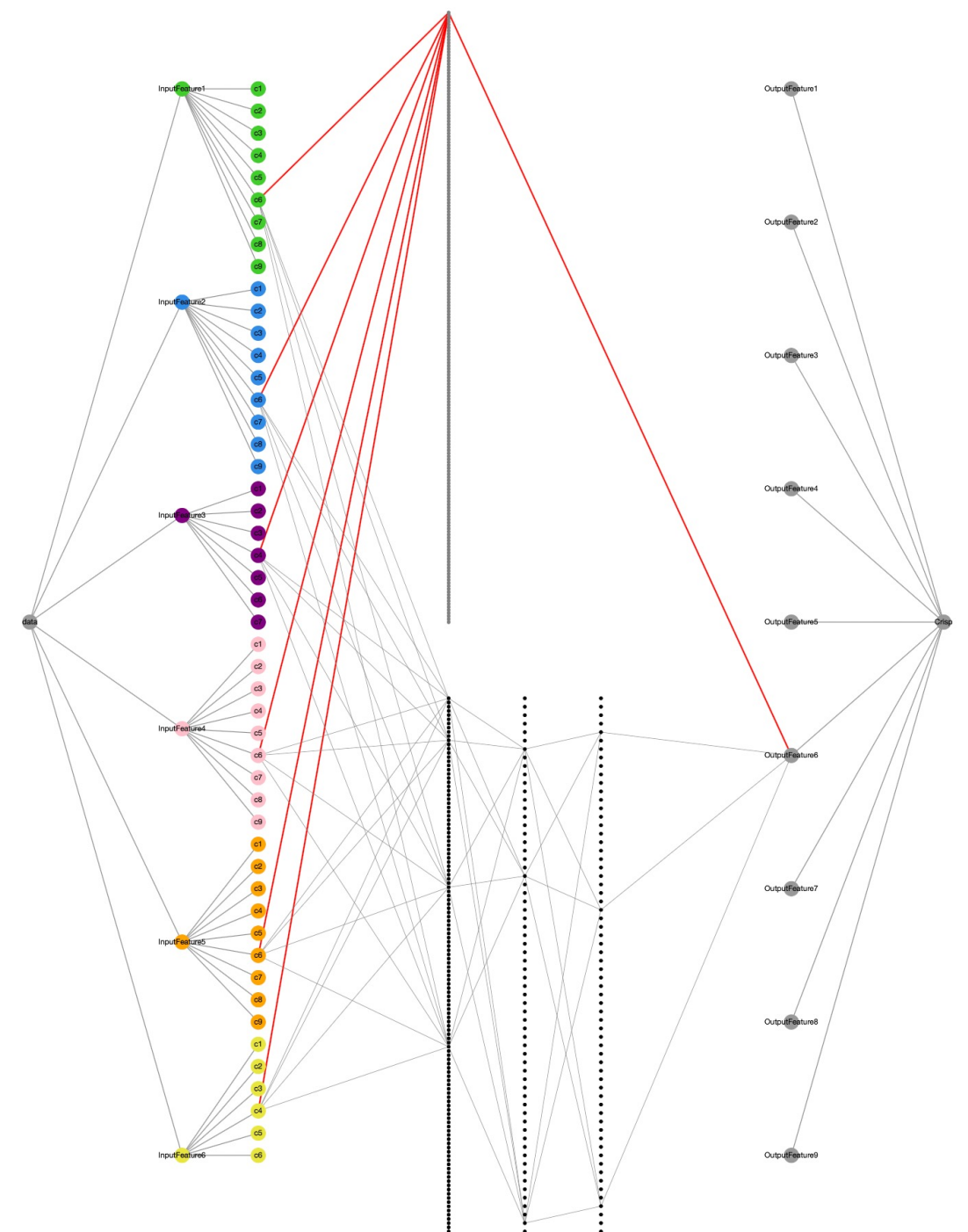
Concept Generation

To handle concept drift, delta change in price across different timesteps are computed. They are fuzzified using DBSCAN clustering. A custom merge and repair function was created to account for cases where there is an abundance of memberships.

Reparation of Memberships

Forecasting Results

R^2: 0.988

R^2: 0.937

IFDNN managed to follow the general market trend of the test data, even in the presence of large shifts.

Tagging Results

An interactive visualisation of IFDNN was created to allow users to select rules and observe changes in connections between nodes across layers.

MACD Results

	Vanilla-MACD	Improved-MACD	Improvement
S&P500	0.5564	**0.6510**	17.00%
FTSE100	0.5286	**0.6501**	22.99%
CAC40	0.5337	**0.6608**	23.81%

Incorporating IFDNN predictions improved the MACD by having R^2 closer to hindsight.

Trading Results

	Vanilla-MACD Returns	Improved-MACD Returns
S&P500	23.3%	**50.2%**
FTSE100	20.5%	**21.6%**
CAC40	52.1%	**67.3%**

The improved MACD strategy provided higher returns in all cases.