Interpretable Fuzzy Deep Neural System for Stock Price Modelling with Applications in Algorithmic Finance

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Project Objectives

This project proposes the Interpretable Fuzzy Deep Transformer Neural Network (IFDTNN) which aims to improve interpretability of deep neural network models. The architecture features a deep transformer neural network to leverage on its predictive strengths and incorporates the Mamdani Fuzzy Inference System that allows for interpretability to conduct stock price prediction. Prediction outcomes from the IFDTNN are explored for its applications in algorithmic finance and portfolio management.

IFDTNN Architecture
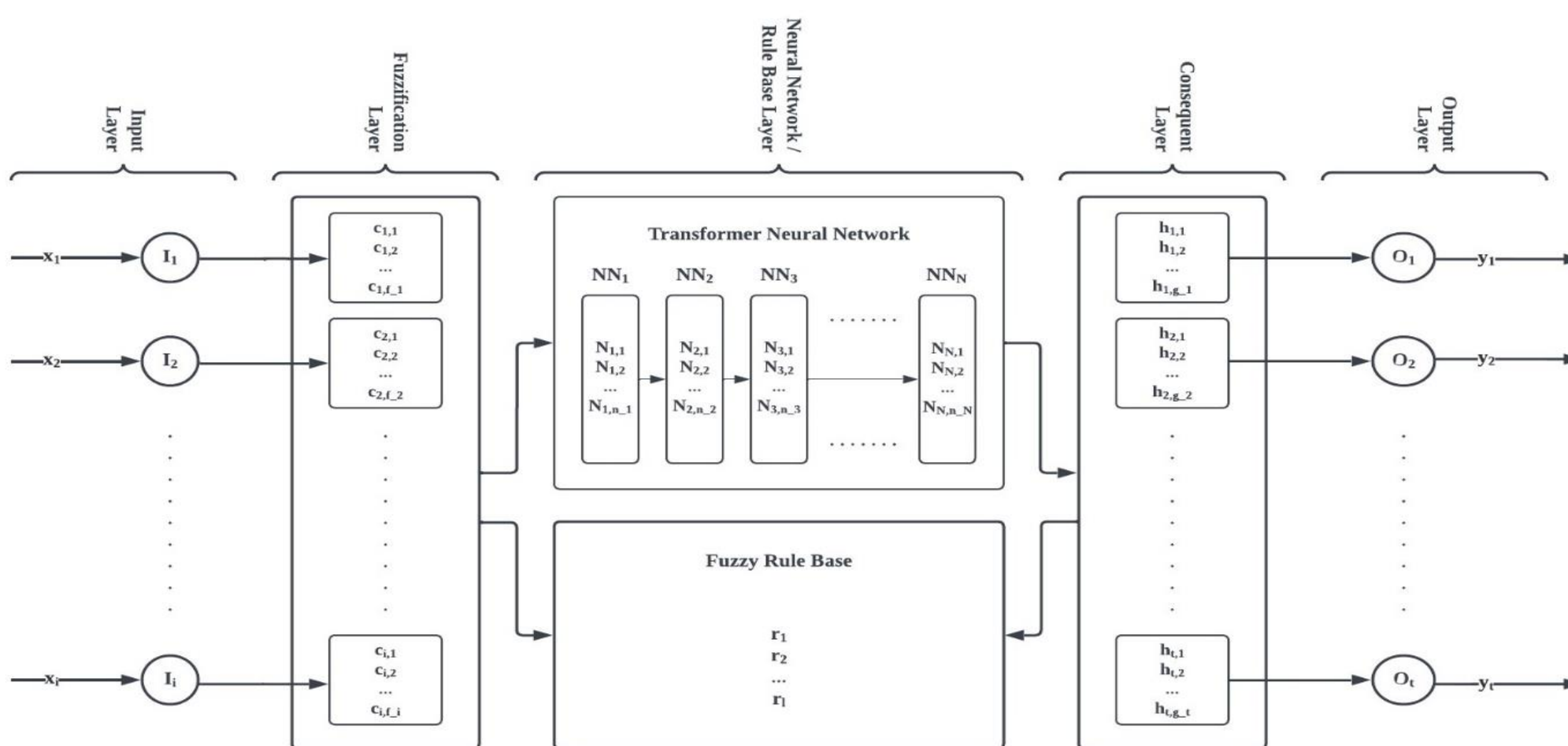
Motivation

Deep learning neural networks trades off interpretability for predictive performance. The black box nature of deep neural networks is a significant shortcoming especially in domains where model interpretability is valued for business functions.

Outcomes

Predictive Performance
IFDTNN predictions generally follows the prevailing market trends and produced promising prediction performance.

Day	R^2	RMSE	Day	R^2	RMSE
t+1	0.991	2.477	t+4	0.983	3.354
t+2	0.988	2.818	t+5	0.980	3.680
t+3	0.986	3.049	t+6	0.978	3.866

IFDTNN Prediction Performance Up Till t+6 (XOM)

Improved Interpretability
Fuzzy inputs (antecedents) are mapped to fuzzy outputs (consequents) constituting sets of fuzzy rules that allows for interpretability.

Applications

Modified MACD (fMACD) Trading Indicator
Conventional moving average convergence/divergence (MACD) indicator modified to incorporate IFDTNN prediction to reduce lag.

Portfolio Optimization Using fMACD
fMACD indicator included in observed environment for reinforcement learning portfolio rebalancing that outdo rebalancing where conventional MACD was used.

Portfolio Management with Dividend
Portfolio optimization outcomes were used for portfolio management utilizing observations for distribution and reinvestment decisions.