

Non-Stationary Fuzzy Transformer

with Applications in Reinforcement-based Portfolio Rebalancing

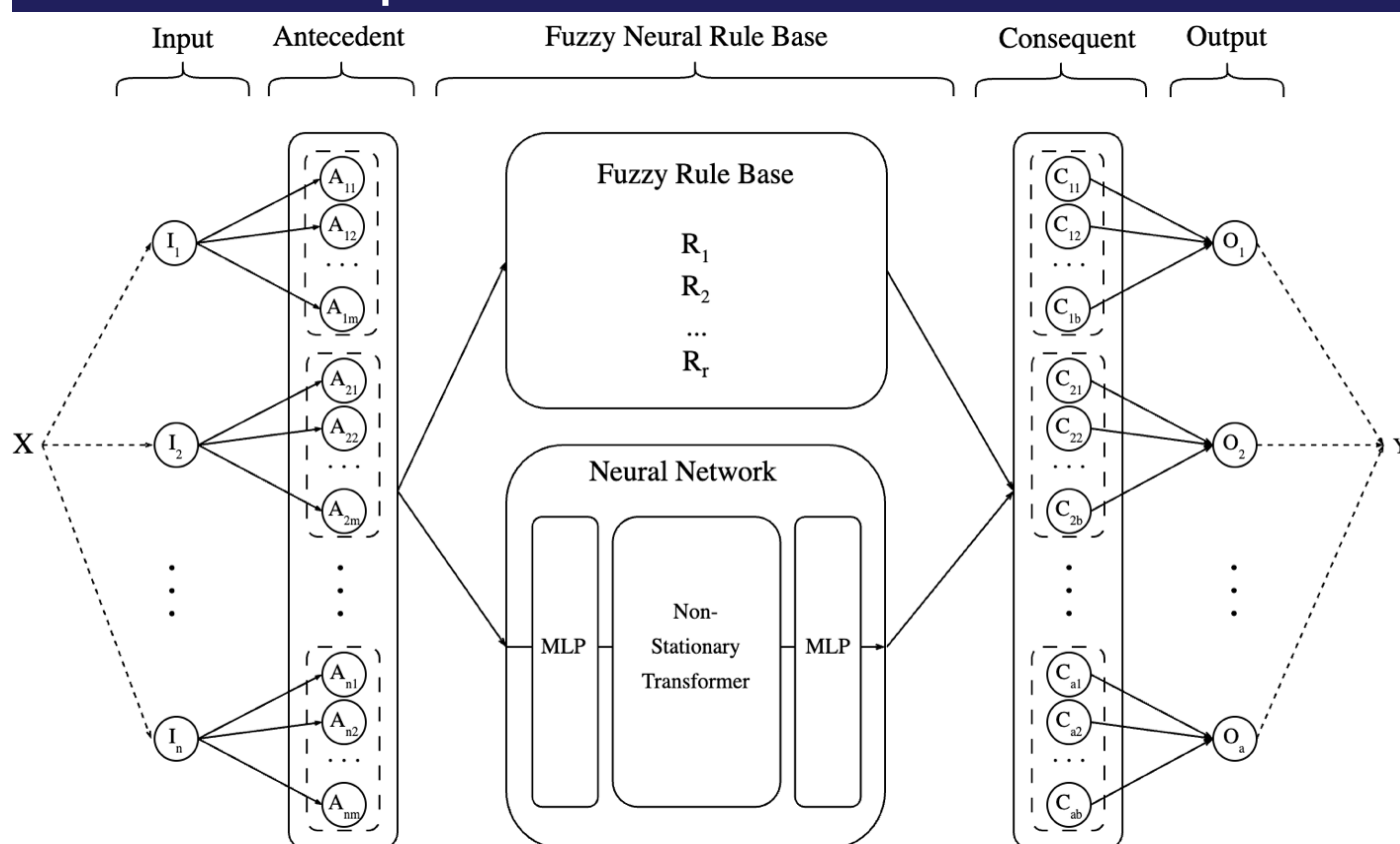
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Objectives

In this project, a neural fuzzy system known as Non Stationary Fuzzy Transformer (NSFT) is proposed to validate the effectiveness of Non-Stationary Transformer as a time-series forecasting methodology, while introducing semantic interpretations to the deep learning network through the embedding of a parallel fuzzy network. NSFT is adapted to mitigate the effects of concept drift inherent in financial data over long time horizon.

Proposed NSFT Architecture

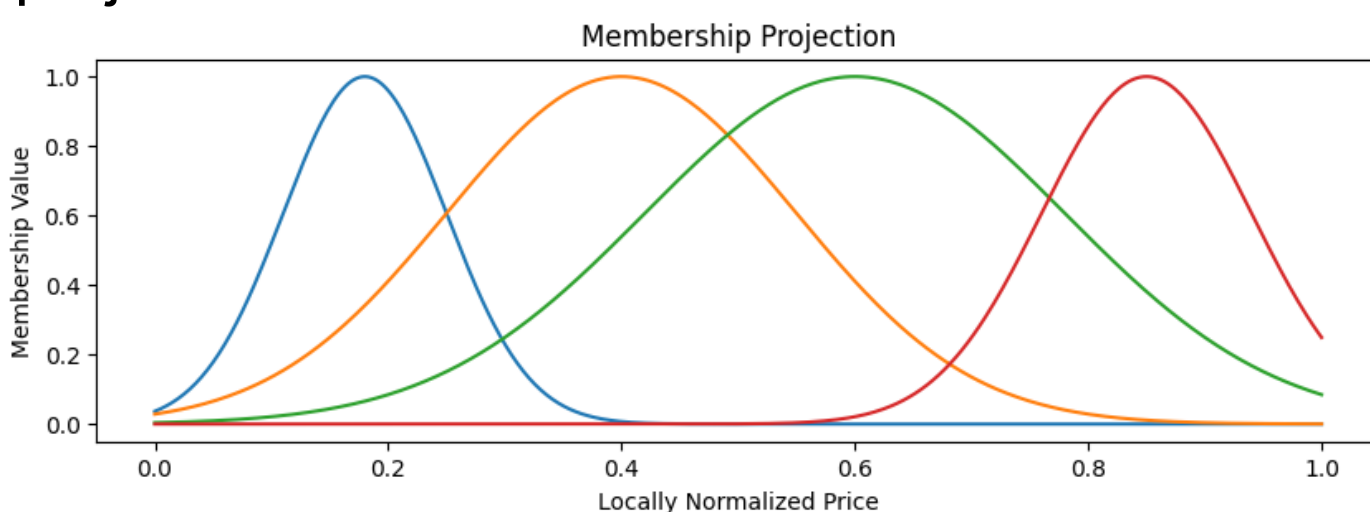


Motivation

The project integrates forecasts from NSFT with the MACD momentum indicator to enhance trend reversal signals, providing more precise entry/exit strategies for investors. To validate the performance of the signals, two types of reinforcement learning (RL) agents are employed: a) a lag-accounting agent to mitigate lag in the generated signals and b) a rebalancing agent to dynamically re-allocate positions across the sectoral indices in a portfolio.

Membership Projection

Fuzzification of the input data is required to integrate semantic interpretations. This is done in two steps: 1) clustering with BanditPAM, a novel k-medoid clustering algorithm and 2) projection with Gaussian function.



Lag-Accounting Agent Results

Returns across Different Indices			
Strategy	Energy	REIT	Technology
Buy and Hold	13431	6805	16848
Vanilla MACD	12950	10987	15653
Predicted MACD	12080	8425	12070
RL Agent using Predicted MACD	18031	11137	21083
Improvement over Vanilla MACD	39.23%	1.36%	34.68%

Forecasting Results

R ² score of Predicted Prices			
timestep	Energy	REIT	Technology
t1	0.93695	0.97981	0.97707
t2	0.91793	0.96646	0.96727
t3	0.89453	0.95936	0.95374
t4	0.87558	0.95044	0.94790
t5	0.85386	0.94062	0.93989

Portfolio Rebalancing Results

