

# Self-Evolving Neural Fuzzy System

## with Application in Portfolio Management

Student: Yap Jia Le

Supervisor: A/P Quek Hiok Chai

### Project Goals:

This project proposes a Self-Evolving Neural Fuzzy System which aims to improve the interpretability of the deep neural network by integrating the fuzzy system with the neural network. The system is tested on financial market data to evaluate its prediction accuracy and a trading strategy is devised for portfolio management.

### Design & Implementation:

#### Layer 1: Input Layer

Takes in the input data and transmit the crisp input values to next layer

#### Layer 2: Condition Layer

Fuzzify input features using DenStream and the fuzzified input data will be fed as input to Layer 3

#### Layer 3: Inference Layer

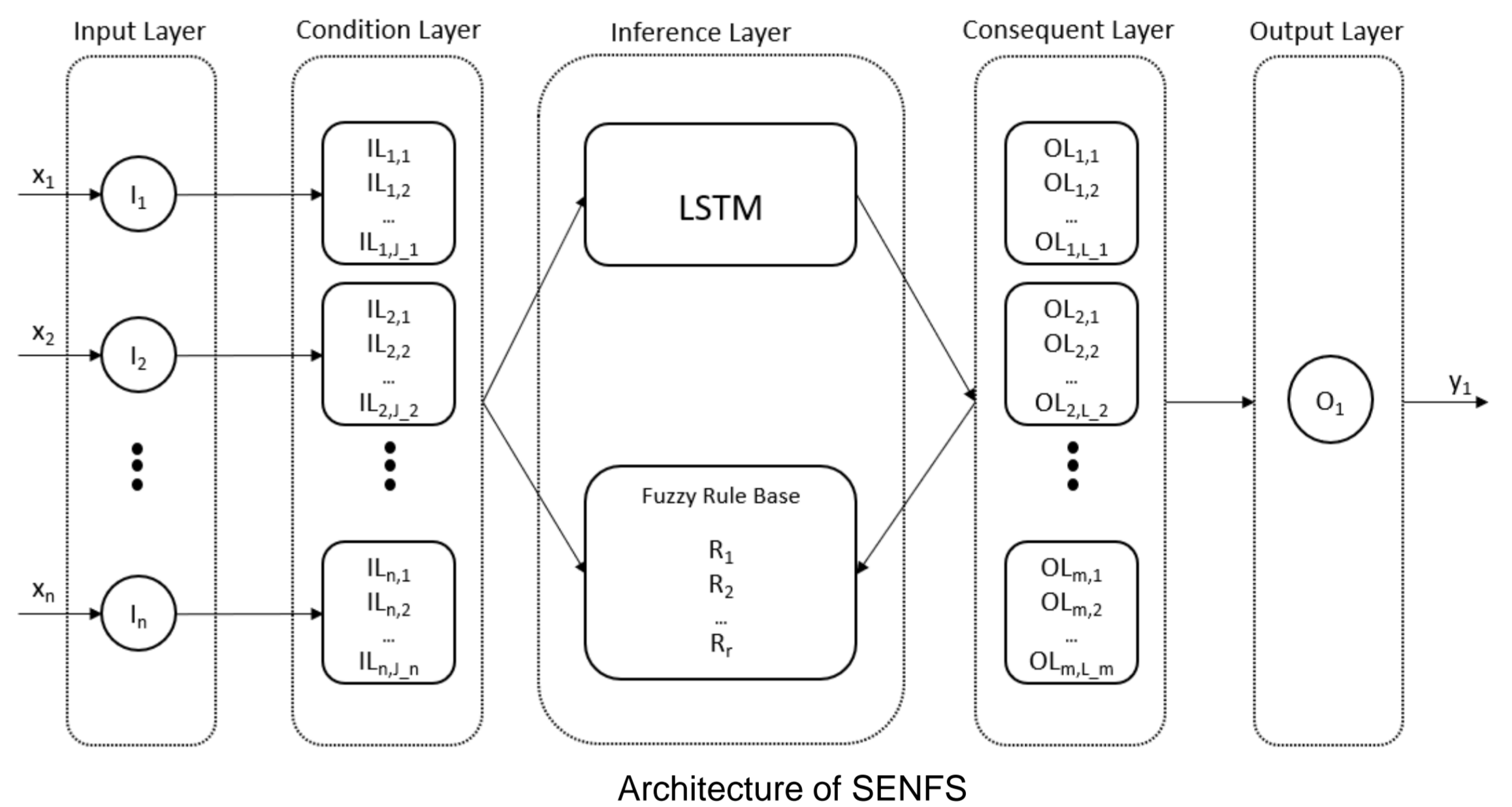
LSTM network to perform supervised training and fuzzy rule base to maintain rules for inferencing

#### Layer 4: Consequent Layer

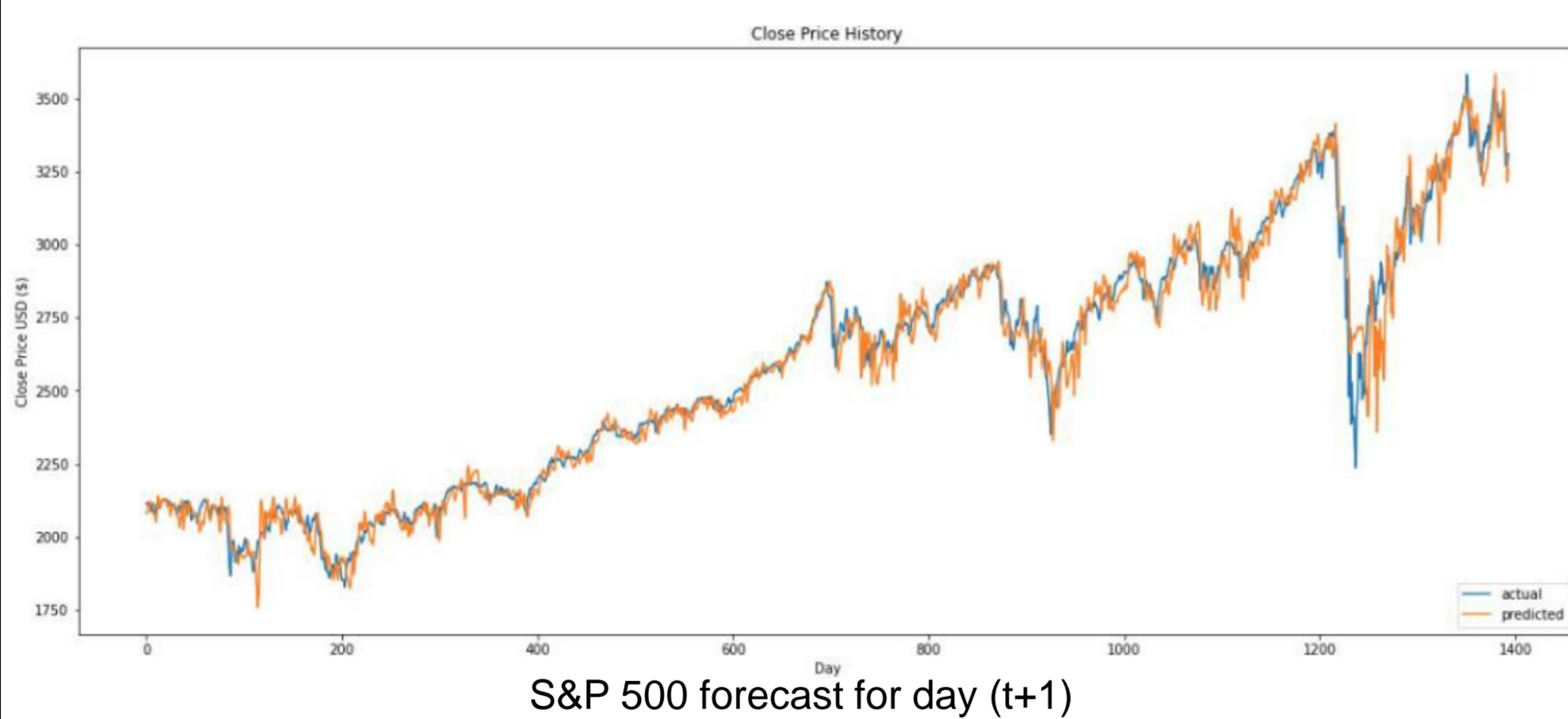
Fuzzify output features, similar to Layer 2

#### Layer 5: Output Layer

Defuzzify using center-of-area method to retrieve crisp value



### Stock Market Forecasting:



Predicted Day	RMSE	$R^2$
t+1	65.996	0.975
t+2	84.395	0.959
t+3	93.418	0.950
t+4	105.577	0.937
t+5	119.006	0.920

Forecasting results up to day (t+5)

SENFs performed well for lookahead day of (t+1), with a relatively high  $R^2$  score of 0.975.

### Trading Strategy:

Proposed forecasted MACD strategy that incorporates forecasted stock price

#### Bull Market

Trading Strategy	Profit (\$)	Profit Return (%)	Final Balance (\$)
Buy and Hold	73,494.59	73.49	173,494.59
<i>VMACD</i>	21,317.27	21.32	121,317.27
<i>fMACDH%</i>	63,941.84	63.94	163,941.84

#### Bear Market

Trading Strategy	Profit (\$)	Profit Return (%)	Final Balance (\$)
Buy and Hold	-21,231.41	-21.23	78,768.59
<i>VMACD</i>	-5,022.19	-5.02	94,977.81
<i>fMACDH%</i>	4,630.98	4.63	104,630.98

#### Volatile Market

Trading Strategy	Profit (\$)	Profit Return (%)	Final Balance (\$)
Buy and Hold	-21,231.41	-21.23	78,768.59
<i>VMACD</i>	-5,022.19	-5.02	94,977.81
<i>fMACDH%</i>	4,630.98	4.63	104,630.98

Proposed strategy outperforms the other strategies in bear and volatile market.