NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

School of Computer Science and Engineering
College of Engineering

# Opportunistic Tactical Portfolio Management
## using Genetic Algorithm (GA) and Reinforcement Learning (RL)

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## Motivation

Market trend reversals are what allow investors to capture profits, but stock trading comes with risks. **Portfolio management** helps to diversify risk and maximize returns. However, despite its theoretical effectiveness, there exists challenges in maximizing portfolio returns that may be attributed to the following reasons:
**A) Base rates B) Commission Rate Loss and C) Exchange Rate Loss.**

## Objective and Methodology

The project aims to investigate the impact of the above reasons using 3 algorithms:

**1. Opportunistic Tactical Buy-and-Hold Strategy:** Proposed a dynamic opportunistic rule-based TAA strategy that rebalances according to the risk level of each market.

**II. GA Rebalancing Strategy:** A novel risk portfolio algorithm optimized using GA with risk algorithm. It accounts for Market Condition, Market Risk and Market Swing Potential.

**III. RL Rebalancing Strategy:** Proposed a RL strategy using Q-learning for policy optimization that considers commission loss.

$$Commission\_Reward = \lambda \times \frac{(Changed\ NAV) \times Commission\ Rate}{(Changed\ NAV - Passive\ NAV)}$$

Portfolio rebalances when trend reversal signal is detected by MACD Signal/Hist.

## Results & Conclusion

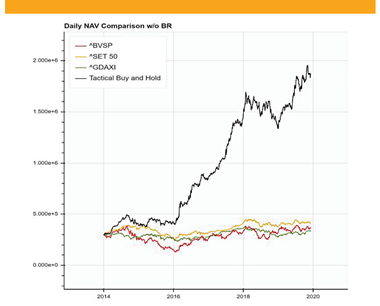
**↑224.04%** in final returns (Avg). Performs 148.76% better without base rates.

**↑7.95%** in final returns (Avg). Performs 3.57% better with base rates.

**↑4.02%** in final returns with adapted policy. Performs 38.03% better without base rates.

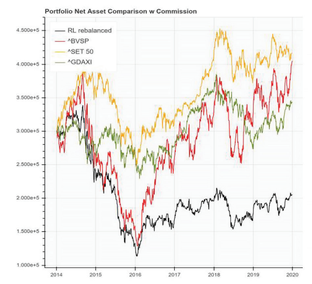
**Reduction** in percentage (%) of exchange rate loss and commission rate loss (%) if portfolio is constructed with stocks of highly correlated currency pairs.

Opportunistic Tactical Buy-and-Hold w/o Base Rate

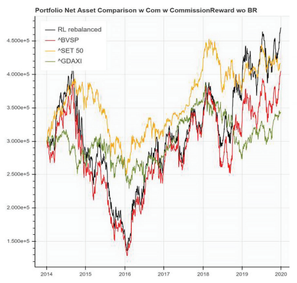



GA with Base Rate

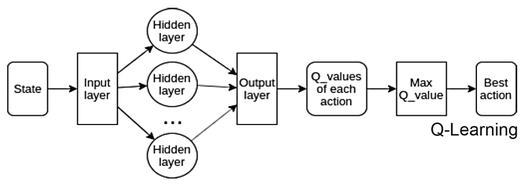

Before Commission Loss Policy




After Commission Loss Policy




**Total % Returns**
NAESX: 40.5% (Benchmark)
Opportunistic Tactical Buy and Hold: 525%
GA Rebalancing Strategy: 48.6%RL Rebalancing Strategy: 40.74%.




$$NAV\ Change\ Reward = \frac{Changed\ NAV - Passive\ NAV}{Passive\ NAV} \times (Time\ Scaling\ Factor) - Commission\_Reward$$

Note: All % increase in finals returns refer to the difference between buy and hold indexes' final net asset value vs respective portfolios.