Automated Day Trading

Using Reinforcement Learning to make stock trading decisions every minute.

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Pitch

Agenda

- Background
- Reinforcement Learning
- Data and Tools
- Model
- Results
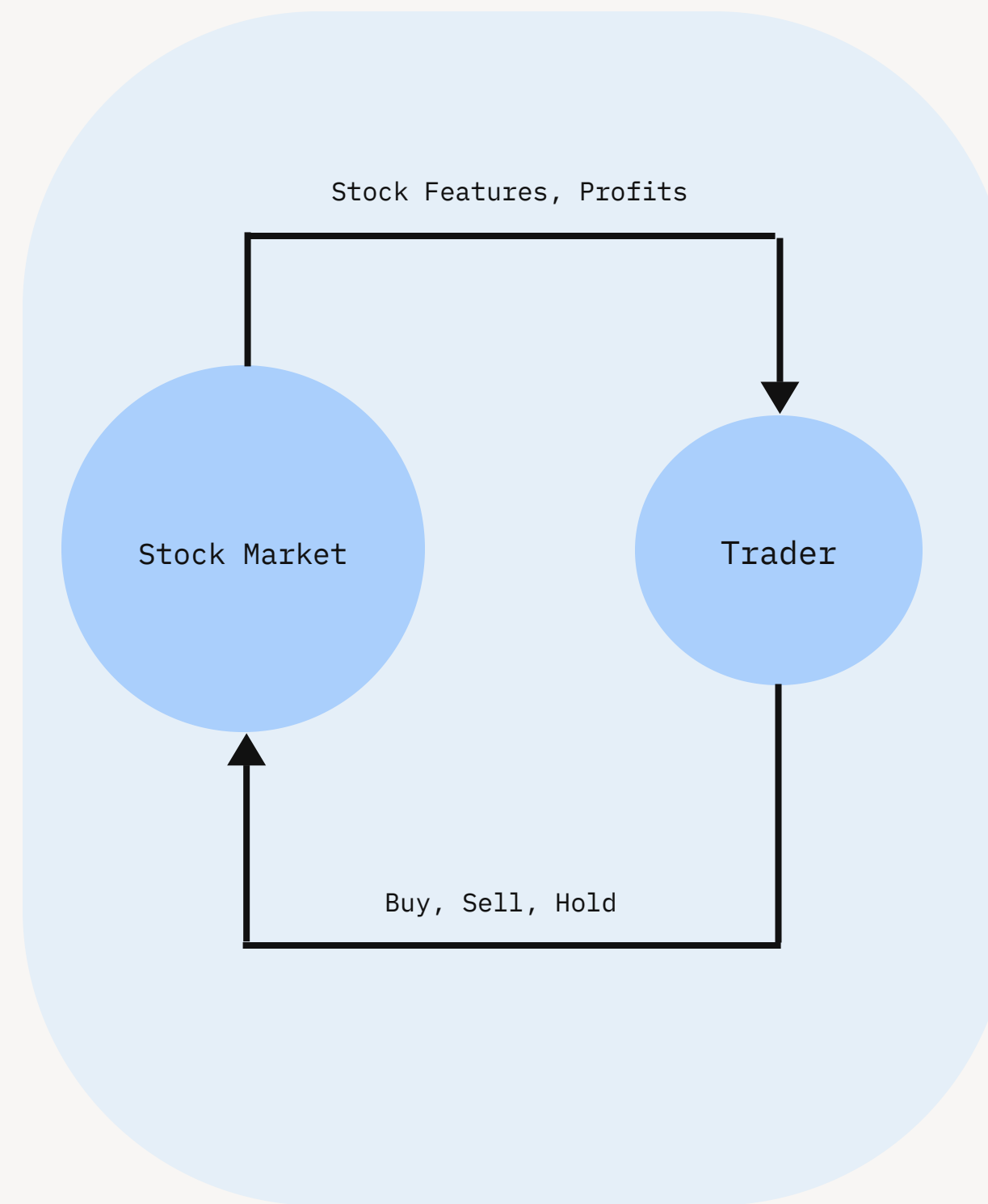- Next Steps

Background

Technical Trading

Day Traders attempt to make profits by trading stocks using technical factors and indicators, often up to the minute level. Fundamental company valuation is less important here.
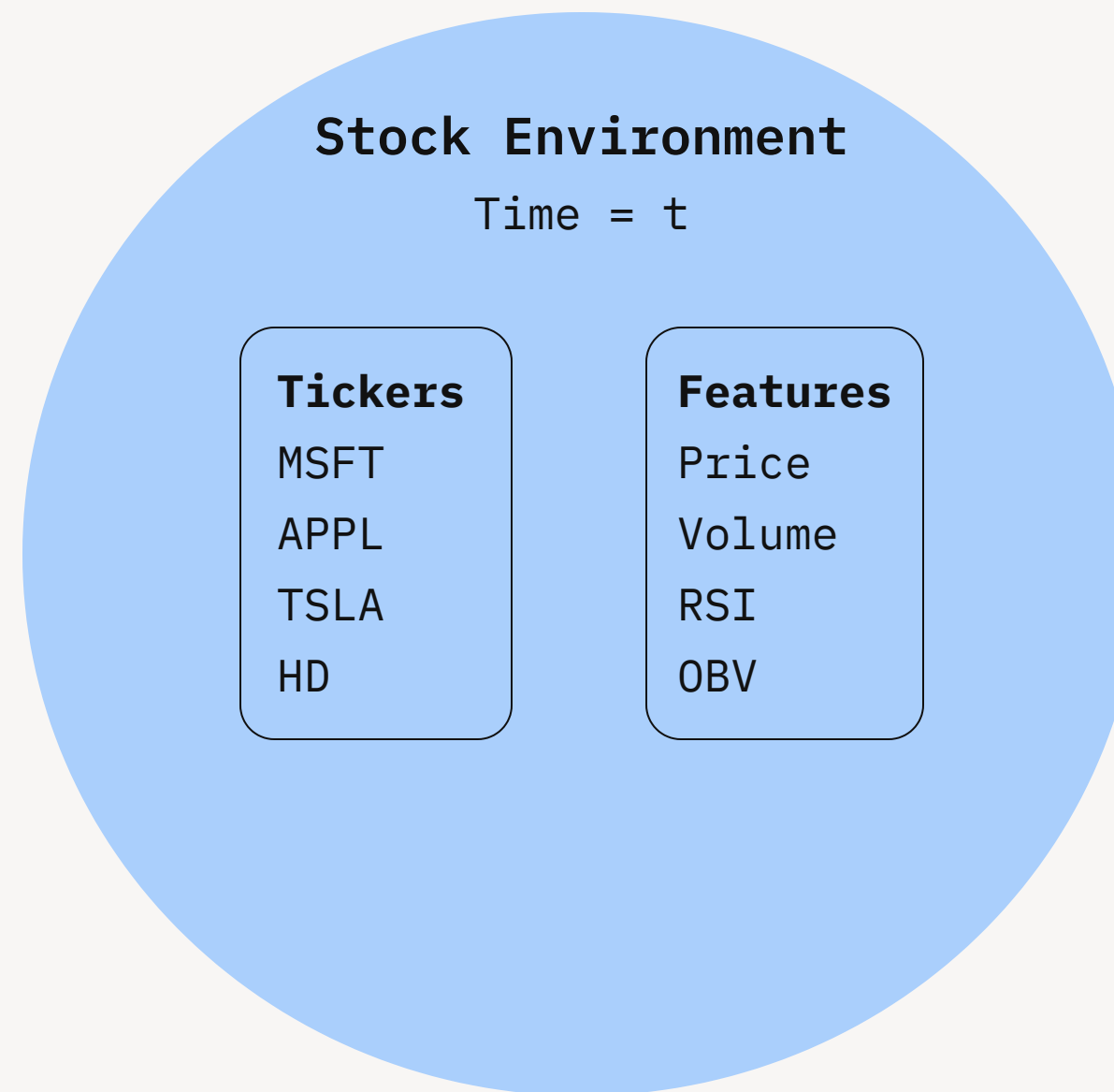
Trader Imitation

Could we build a trading engine to imitate the information that a trader receives and outperform them?

Trading Process

Trading Process

Stock Environment

Time = t

Tickers	Features
MSFT	Price
APPL	Volume
TSLA	RSI
HD	OBV

Trading Process

Trader

> **Policy**
> Buy 30% if price < $200

> **Value Table**
> Expect $500 profit if
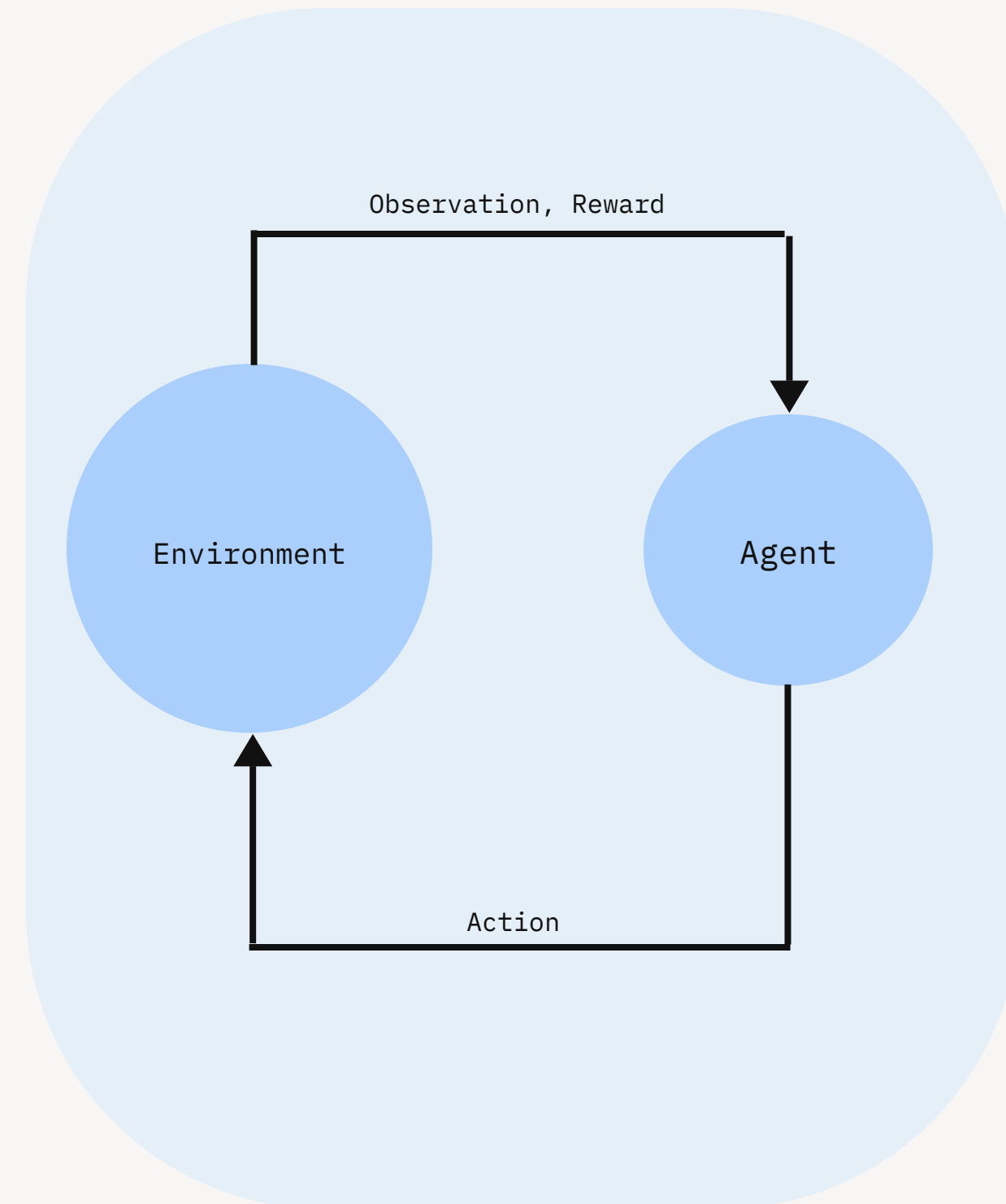> buying when price < $200

Reinforcement Learning

Algorithm

- Take action
- Receive reward
- Update value table, policy
- Take action

Value / Policy

- Approximate value table and policy using neural networks

Observation, Reward

Environment

Agent

Action

Tools

StableBaselines: PPO2 Learning Algorithm

OpenAI Gym: Interface for RL algorithms

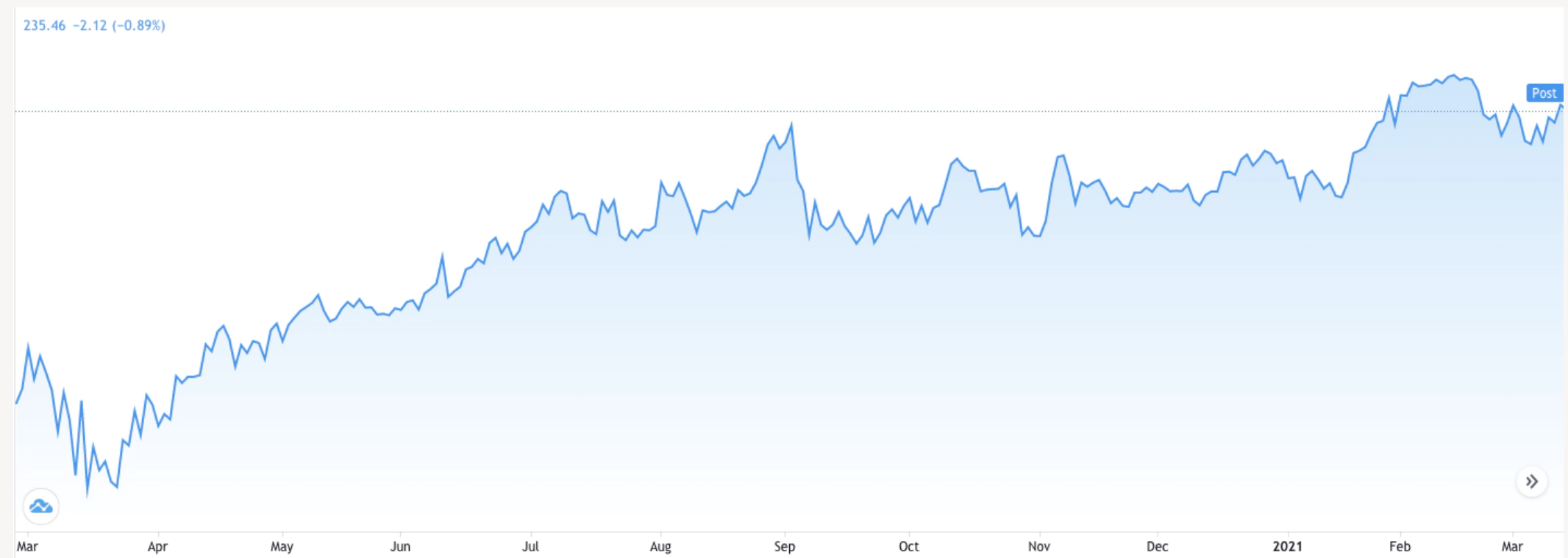**Alpha Vantage:** Ticker by minute

**TA-Lib:** Technical analysis implementations

Data

Ticker: MSFT ticker

Technical Features: Close,
Volume, SMA, OBV, RSI, TEMA,
Bollinger Bands (upper, mid,
and low), Momentum

235.46 -2.12 (-0.89%)

Post

Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec   2021   Feb   Mar

Model Specifications

Environment: Stock Market

- **Observation**: Ticker, features, portfolio

- **Reward**: Portfolio value

- **Actions**:
  - Buy, sell, or hold
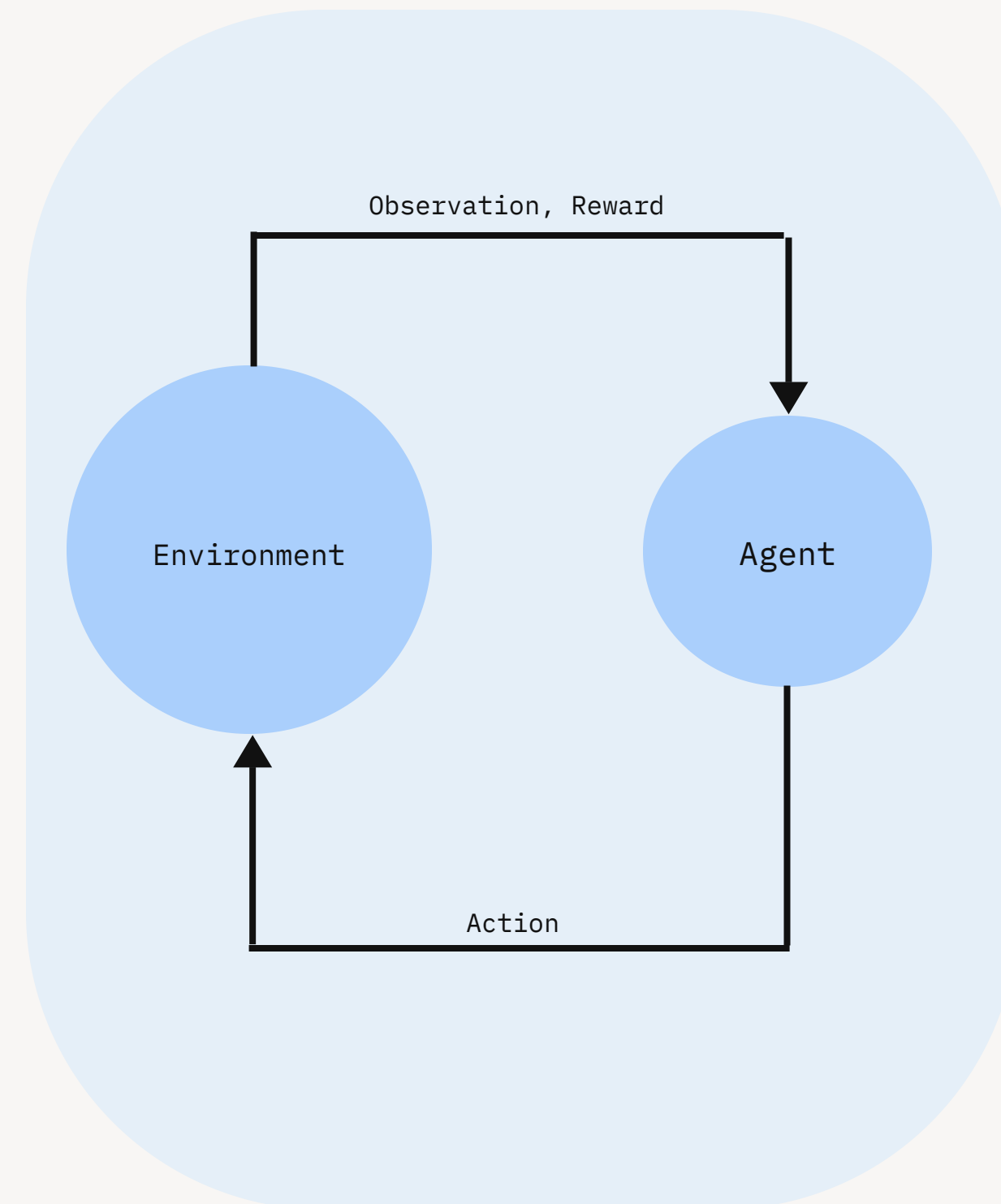 - Percentage of available to buy or sell

Observation, Reward

Environment
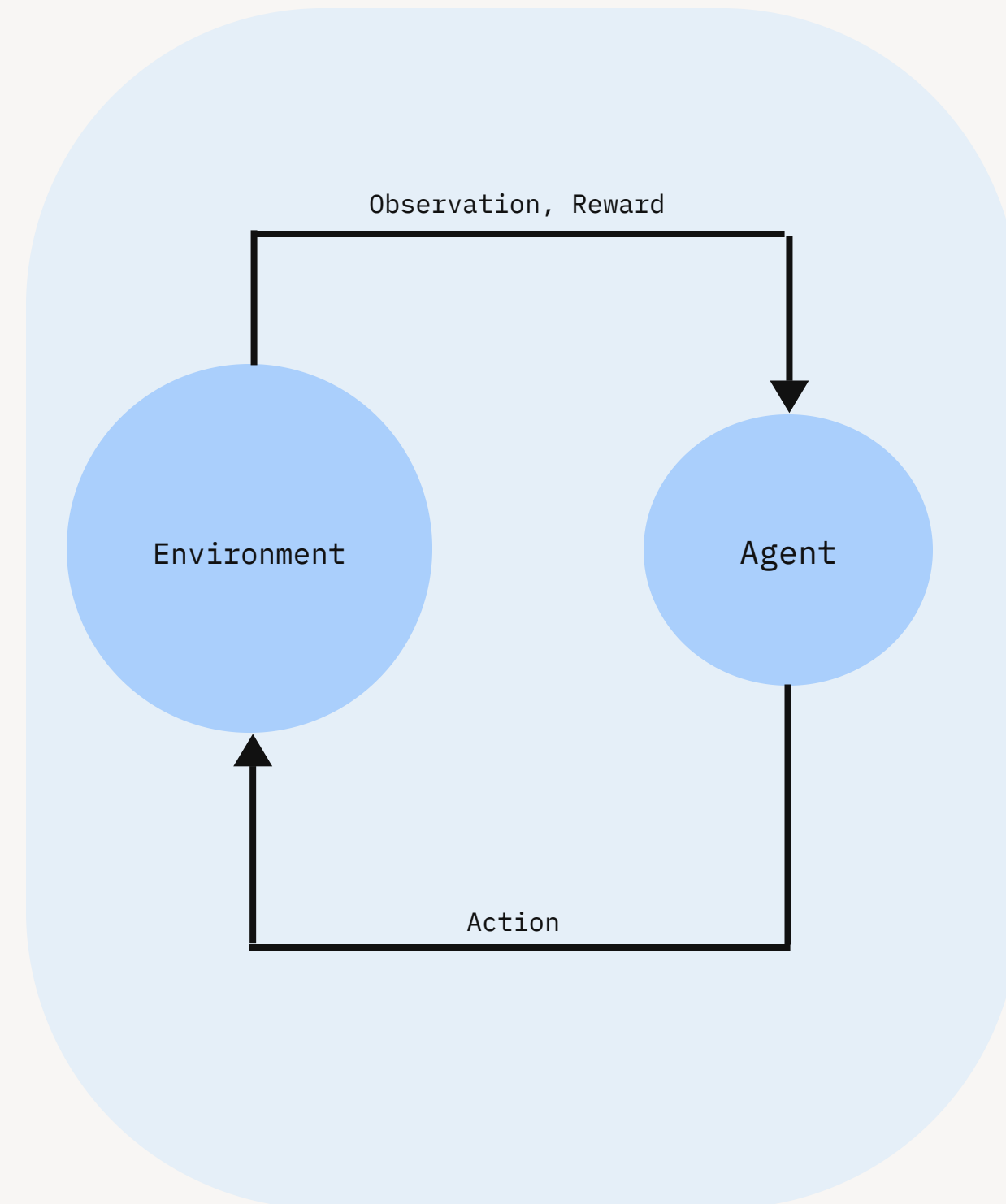
Agent

Action

Model Specifications

Agent: Proximal Policy Optimization (PPO2)

- Stable
- Memory efficient
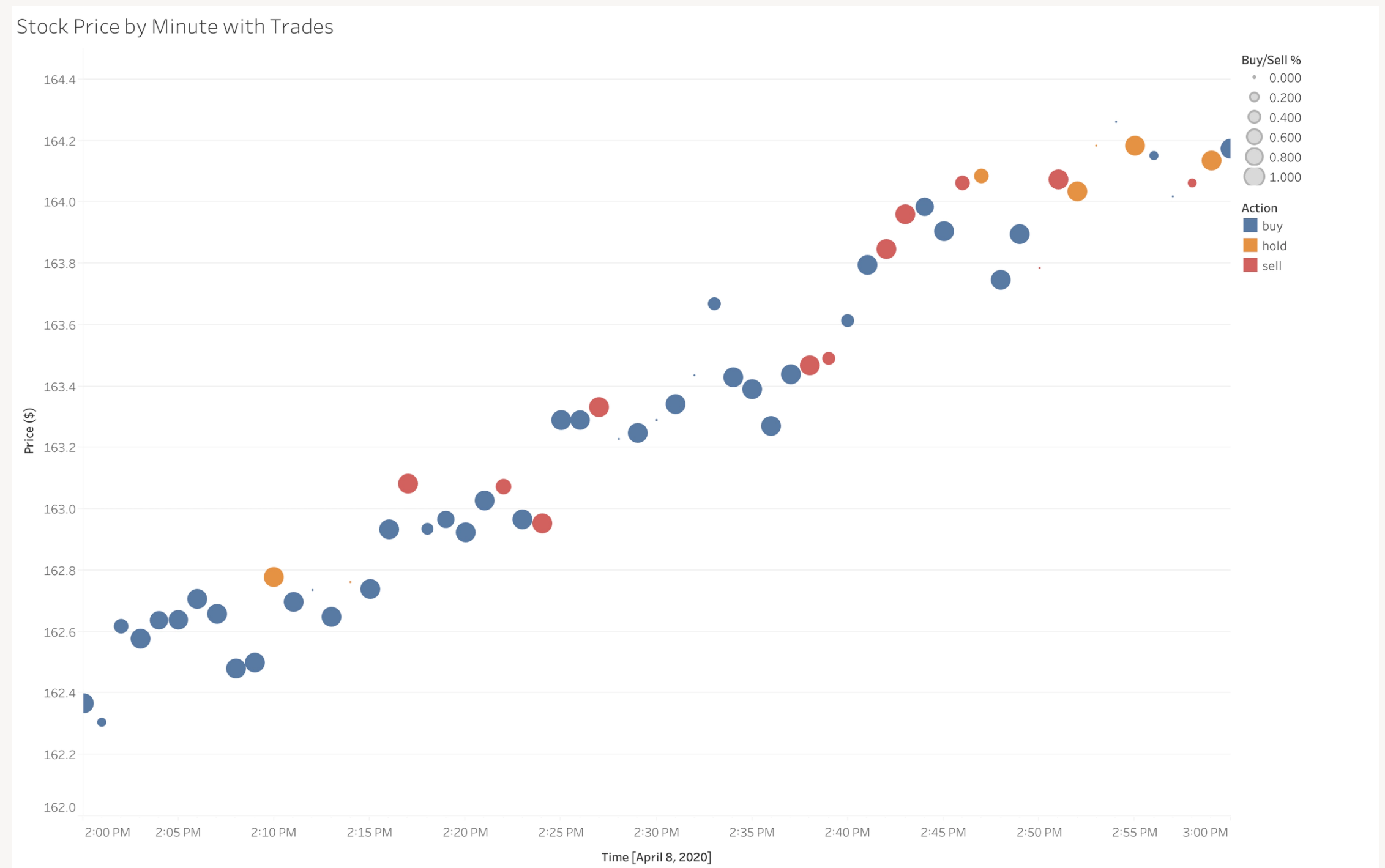- Flexible action/observation spaces

Training:

- Policy Network: 3 Dense Layers, 128 Nodes
- Value Network: 3 Dense Layers, 128 Nodes

Results

Trading Activity

- Engine frequently buys and rarely holds
- 67% of all actions were buys
- Appears to sell more often when ticker is at a peak

Stock Price by Minute with Trades

Price ($) vs Time [April 8, 2020]

Buy/Sell %
- 0.000
- 0.200
- 0.400
- 0.600
- 0.800
- 1.000

Action
- buy
- hold
- sell

Results

At tested window end:

- $9,339 profit from $100K portfolio (+9.3%)

Evaluation:

- MSFT rises about 21% in tested period
- However, engine is minimizing risk only using technical factors

Price vs Portfolio Value - March-April 2020
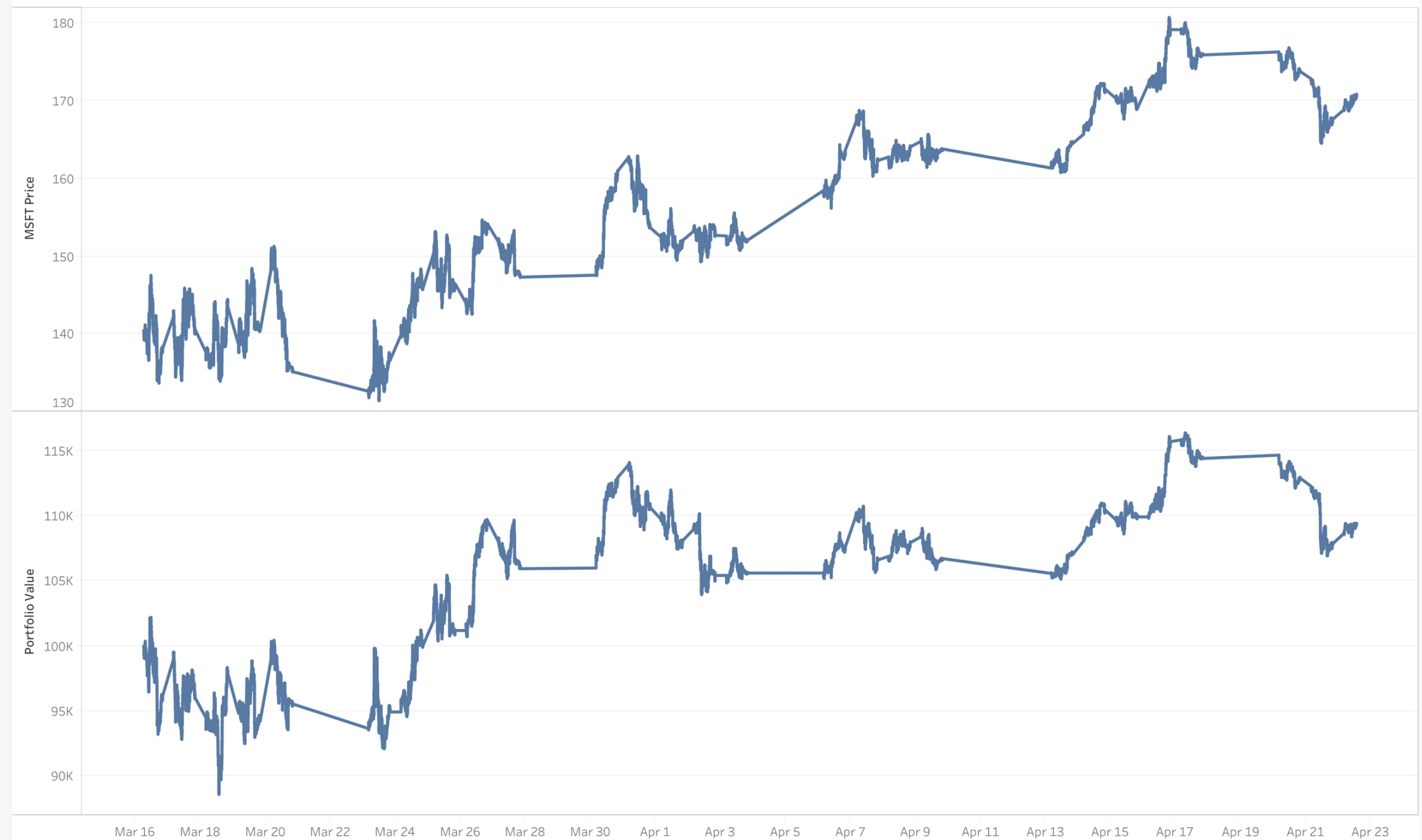
Next Steps

Real-time Model Updates: Incremental updates at each time period for instant decisions

Multi-stock portfolio: Choose optimal investments from a basket of stocks

Publish OpenAI Gym: Publishing Gym implementations to OpenAI allows a greater amount of people to experiment with the algorithm

Thank You!