

Automated Stock Trading Agent

IDS 705 Final Project

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The background of the left side of the image is a collage of US dollar bills. A \$100 bill is prominent at the top, showing the Federal Reserve seal and the serial number HF 06764 F6. Below it, a \$20 bill is visible with the serial number HC 64872193 A. The bills are slightly out of focus, creating a textured, financial backdrop.

The Problem

The Stock Market can be
unpredictable

A man with dark hair, wearing a dark blue button-down shirt, is shown from the chest up. He is looking upwards with a slightly open mouth, as if he is speaking or reacting to something. The background is an office setting with a whiteboard and a window with blinds.

IT'S GOING UP!

The same man from the top panel is shown in the same office setting. He is now looking directly at the camera with a slight smile. The text "IT'S GOING DOWN!!!" is overlaid on the bottom of the image.

IT'S GOING DOWN!!!

What's Wrong with Human Intuition?



Let's Try Automated Trading!

- Algorithms have many advantages over human traders.
- Automated trading is a completely passive form of earning money.
- Algorithms are detached from emotions.



Our Solution: A Stock Trading Agent

Stock Trading Agent

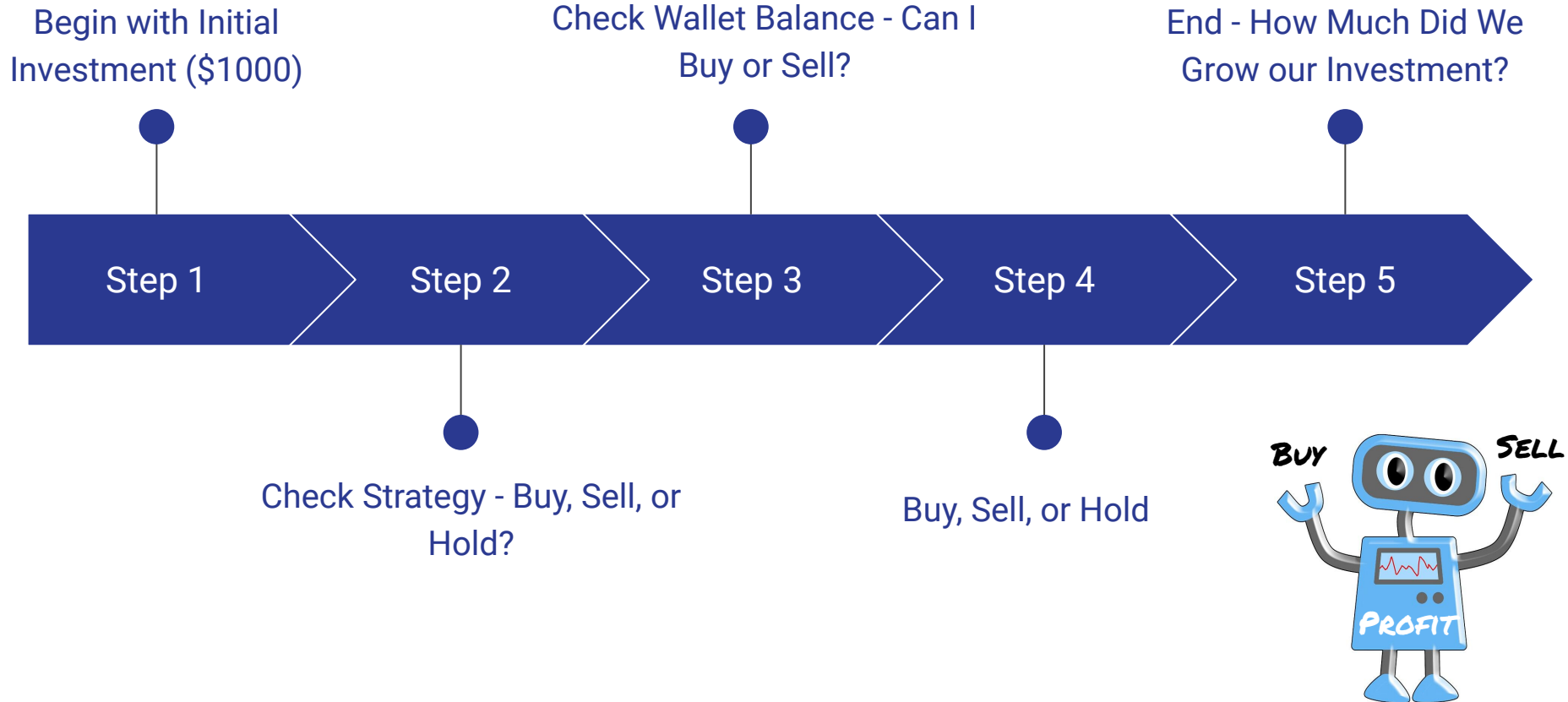
- **Goal:** Maximize return of investment over time.
- Interacts with the stock market to make buy or sell **decisions**.
- Buy-sell decisions are made based on different sets of **strategies**.

Strategies we implemented

Indicators	Time Series	Reinforcement Learning
SMA MACD RSI ADX	ARIMA LSTM	Deep Q-network Natural evolution strategy



The Flow of An Agent



Performance: Technical Indicators Agents

S&P 500

8/7/20 - 4/16/21

Baseline ROI: 24 %

SMA

Smooth Moving
Average



+14%

MACD

Moving Average
Convergence
Divergence



+4%

RSI

Relative
Strength Index



+6%

ADX

Average
Directional Index



+6%

Performance: Machine Learning Agents

S&P 500

8/7/20 - 4/16/21

Baseline ROI: 24 %

LSTM

Long Short -Term
Memory

+17%

ARIMA

Autoregressive
Integrated Moving
Average

+8%

**Natural
Evolution**

+43%

**Deep Q-
Learning**

+7%

Decision Plots

Buy-sell Decision Plots on Test Dataset
for Natural Evolution



Performance Rankings

1. **Natural Evolution: + 43%**
2. **LSTM: + 17%**
3. SMA: + 14%
4. **ARIMA: + 8%**
5. **Deep Q-Learning : + 7%**
6. ADX: + 6%
7. RSI: + 6%
8. MACD: + 4%

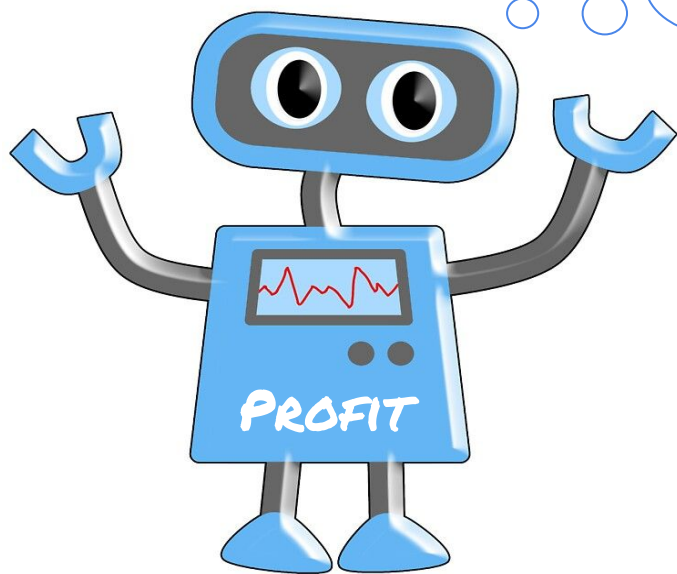
Baseline : +24 %

Conclusions

- 4 indicator agents, 4 ML agents
- Stock Market Is Highly Volatile
- Far from perfect

Future Directions

1. Model stacking: combine different strategies based on different market situation
2. Include more inputs other than opening prices: volume, indicators etc.
3. RL: Stability issue not yet solved



THANK YOU !