Buy or “Bye”

Development and Optimization of Investment Strategies Using Python

EMA Crossover and Machine Learning Models

Introduction

- Objective: Develop, optimize, and test investment strategies.
- Compare EMA crossover strategy with Machine Learning models.
- Data Source: NVIDIA daily stock prices (Jan 2018 - Jan 2024).

Literature Review

Technical Indicators:

- EMA crossovers identify market trends (Brown & Jennings, 1989; Murphy, 1999).

Machine Learning:

- Captures complex data relationships (Prado, 2018; Patel et al., 2015).

Hybrid Approaches:

- Combining EMA with ML enhances accuracy (Huang et al., 2009; Zhang & Wang, 2017).

Practical Applications and Limitations:

- Overfitting risks and parameter tuning (Lopez de Prado, 2018; Kearns & Nevmyvaka, 2013).

Dataset Desription

Data Source: Yahoo Finance

Time Span: January 2018 - January 2024

Key Metrics:

- Open, Close, High, Low, Volume

Data Split:

- 80% Training
- 20% Testing

Data Preprocessing:

- Checked for missing values, anomalies
- Ensured data consistency and synchronization

Methodology

Two Strategies:

- EMA12 and EMA26 Crossover
- Machine Learning (Random Forest, XGBoost)

EMA Crossover Strategy:

- Technical Setup: EMA12, EMA26
- Signals: Buy (EMA12 > EMA26), Sell (EMA12 < EMA26)
- Implementation: Python's pandas library
- Optimization: In-sample testing, backtesting on out-of-sample data

Machine Learning Strategy:

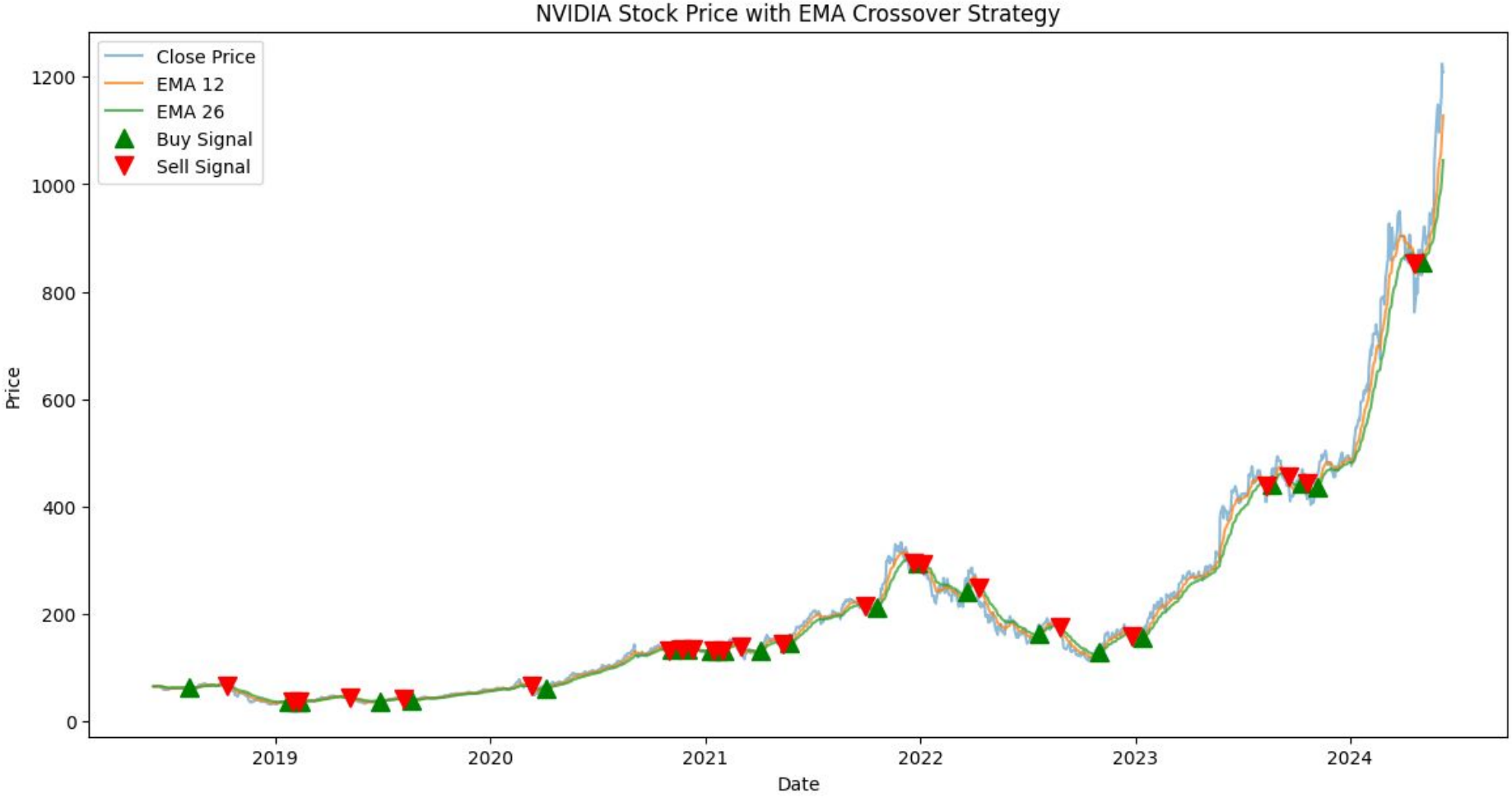
- Features: SMA, EMA, Momentum, RSI, Bollinger Bands, MACD, ADX, Stochastic, ATR
- Models: Random Forest, XGBoost
- Implementation: Python's sklearn and xgboost libraries
- Training and Validation: Cross-validation, grid search for hyperparameter tuning

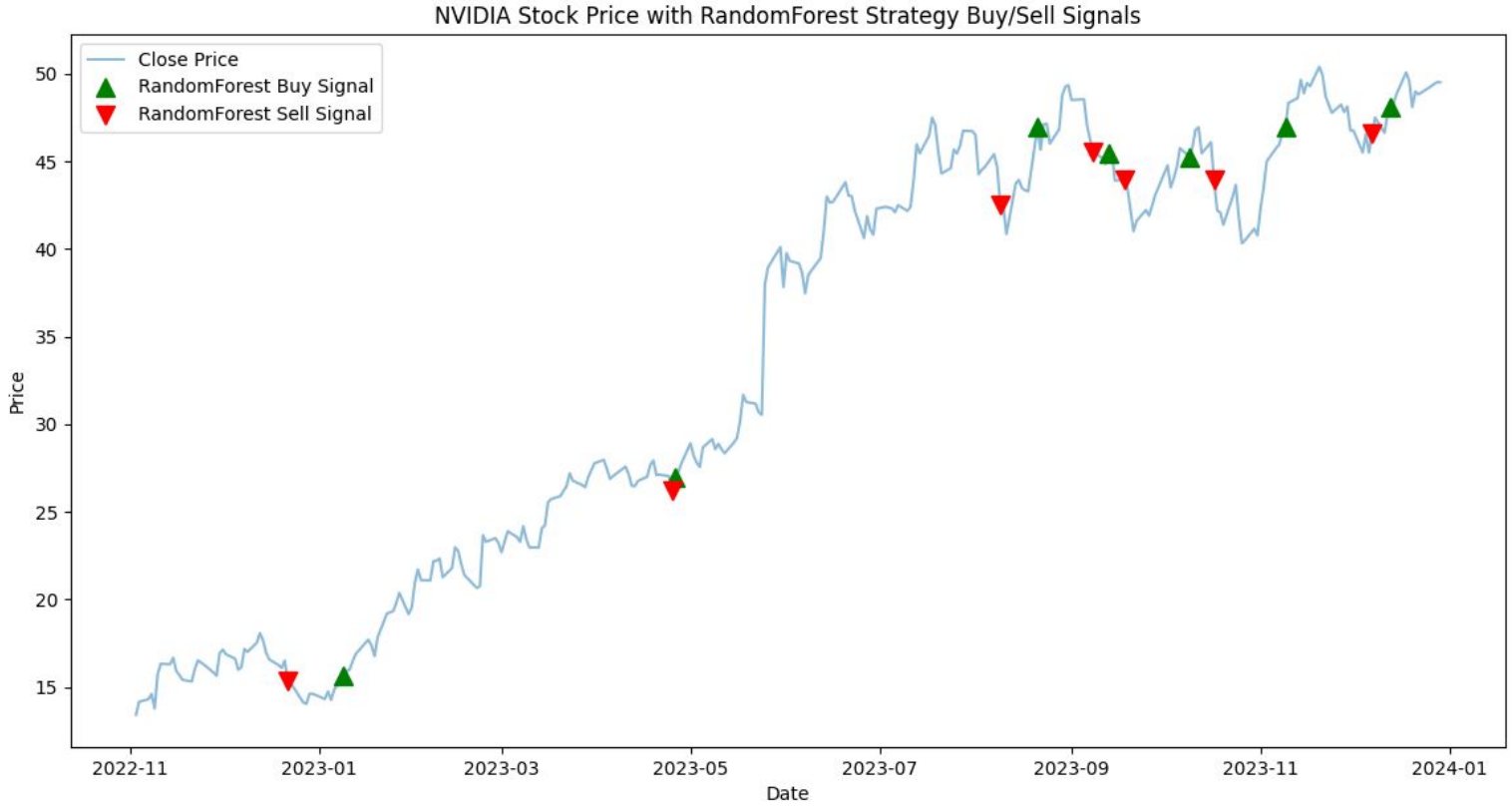
Results

EMA Crossover Strategy	Machine Learning Models	
Buy and Sell Signals: Clear signals coinciding with key market turning points	**Random Forest**	**XGBoost**
Performance Metrics: Sharpe Ratio: 0.74 Total Return: 236%	Training Accuracy: 0.90 Testing Accuracy: 0.91 Sharpe Ratio: 2.06 Total Return: 170% Trades Executed: 14	Training Accuracy: 0.83 Testing Accuracy: 0.87 Sharpe Ratio: 1.88 Total Return: 145% Trades Executed: 18

Comparative Analysis:

- EMA: Simplicity, Moderate Returns
- ML: Higher Complexity, Higher Returns


NVIDIA Stock Price with EMA Crossover Strategy
Close Price
EMA 12
EMA 26
Buy Signal
Sell Signal
Price
Date
0
200
400
600
800
1000
1200
2019
2020
2021
2022
2023
2024


NVIDIA Stock Price with RandomForest Strategy Buy/Sell Signals
Close Price
RandomForest Buy Signal
RandomForest Sell Signal
Price
Date
50
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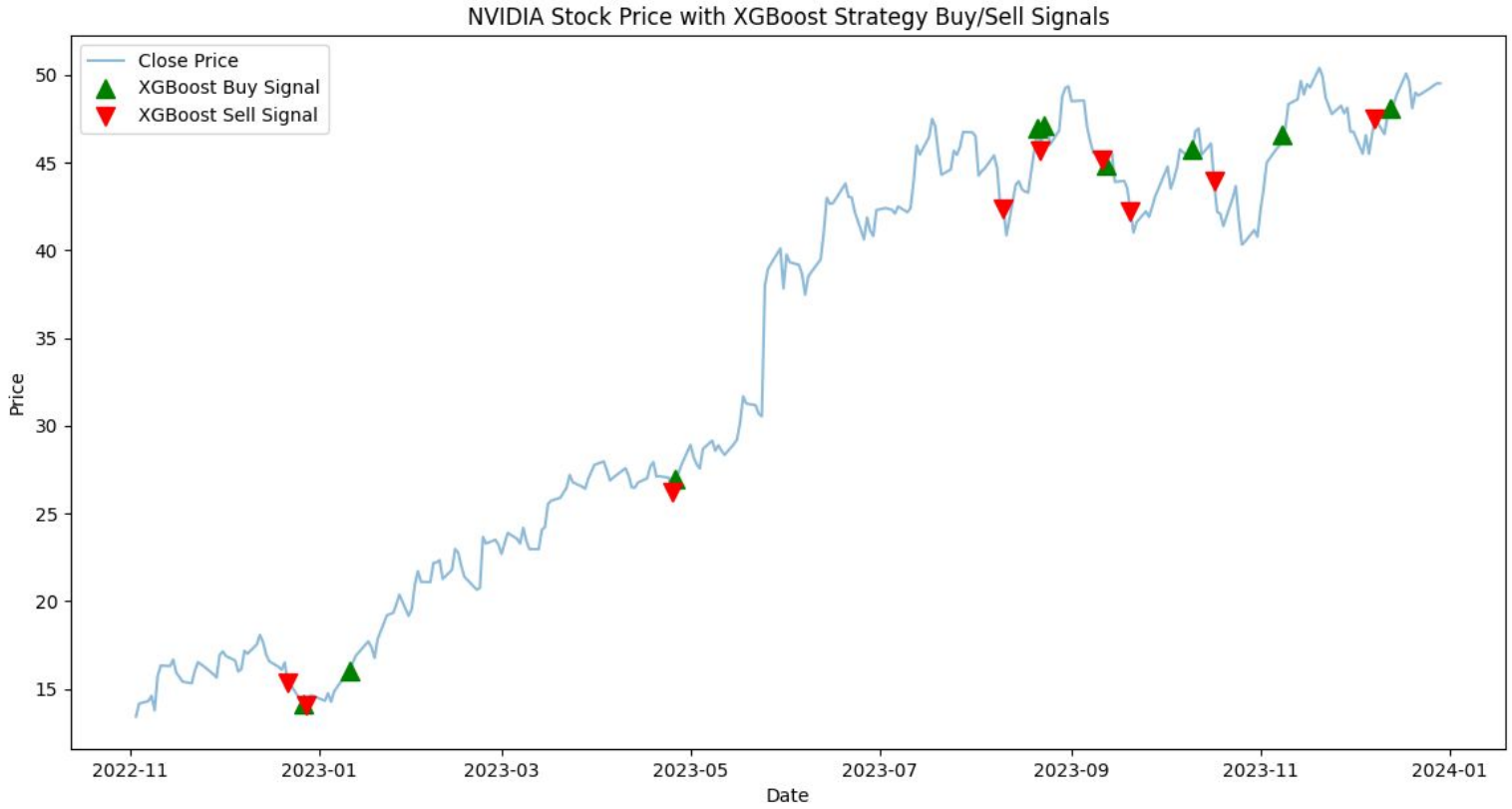
25
20
15
2022-11
2023-01
2023-03
2023-05
2023-07
2023-09
2023-11
2024-01


NVIDIA Stock Price with XGBoost Strategy Buy/Sell Signals
Close Price
XGBoost Buy Signal
XGBoost Sell Signal
Price
Date
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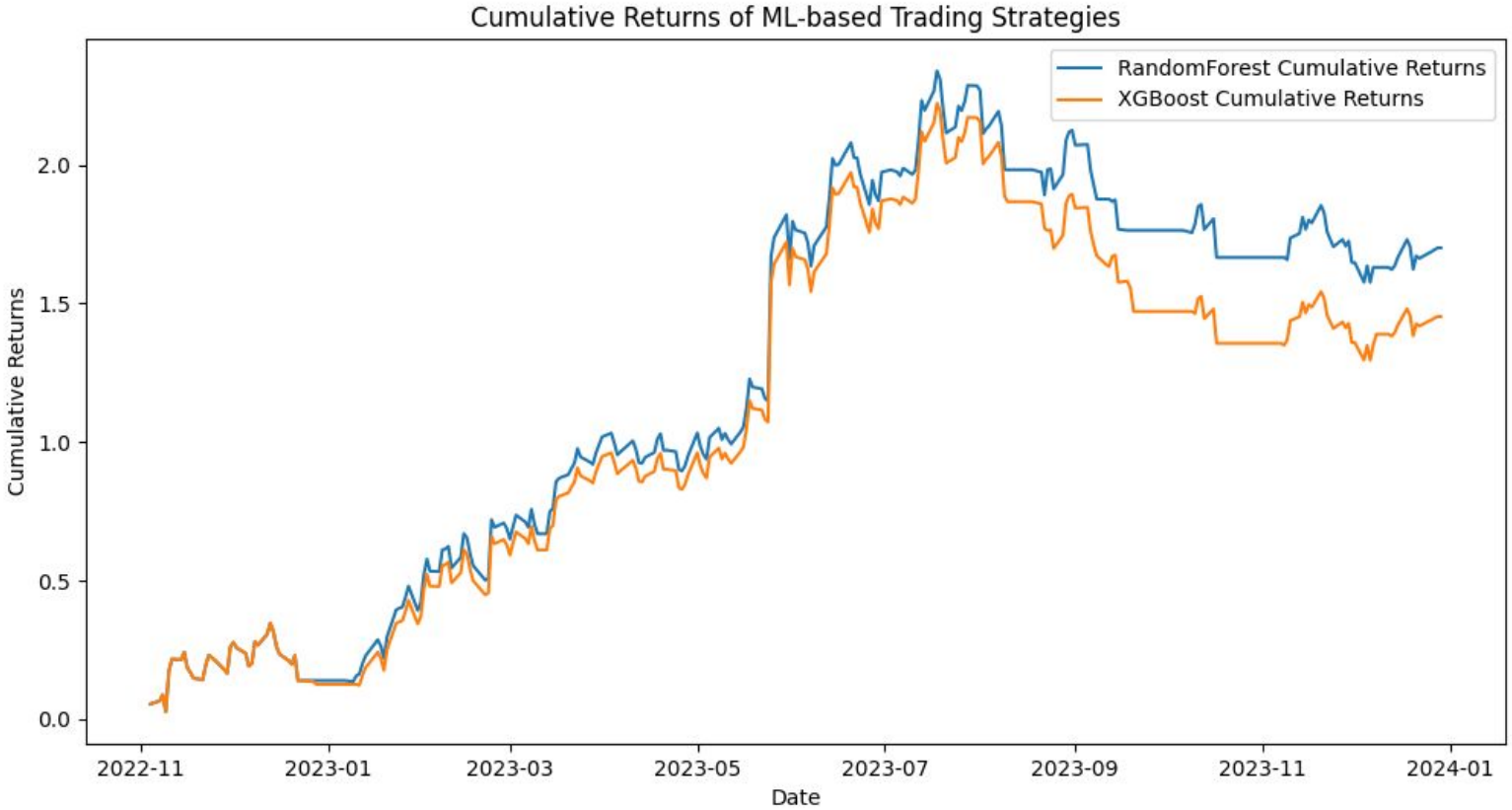
2024-01


Cumulative Returns of ML-based Trading Strategies
RandomForest Cumulative Returns
XGBoost Cumulative Returns
Cumulative Returns
0.0
0.5
1.0
1.5
2.0
2022-11
2023-01
2023-03
2023-05
2023-07
2023-09
2023-11
2024-01
Date

Conclusion

EMA Crossover Strategy:

- Simple and actionable
- Moderate returns, suitable for new traders

Machine Learning Models:

- Superior performance, higher risk-adjusted returns
- Requires deeper understanding and careful management

Strategic Recommendations:

- Hybrid strategies combining EMA and ML
- Future exploration: Sentiment analysis, macroeconomic indicators

References

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3. Kearns, M., & Nevmyvaka, Y. (2013). Machine learning for market microstructure and high-frequency trading. *Journal of Investment Strategies*, 83-105.
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Team Collaboration

Task	Assigned to
Data Loading and Preprocessing	Afet Ibadova
EDA	Daryush Ray
Strategy 1	Afet Ibadova
Strategy 2	Daryush Ray
Performance Measures Calculation	Afet Ibadova
Optimization and Backtesting	Daryush Ray

https://github.com/astronaut505/tradingtroll