

Automated Algorithmic Stock Trading System using Machine Learning



Group 8

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Abstract

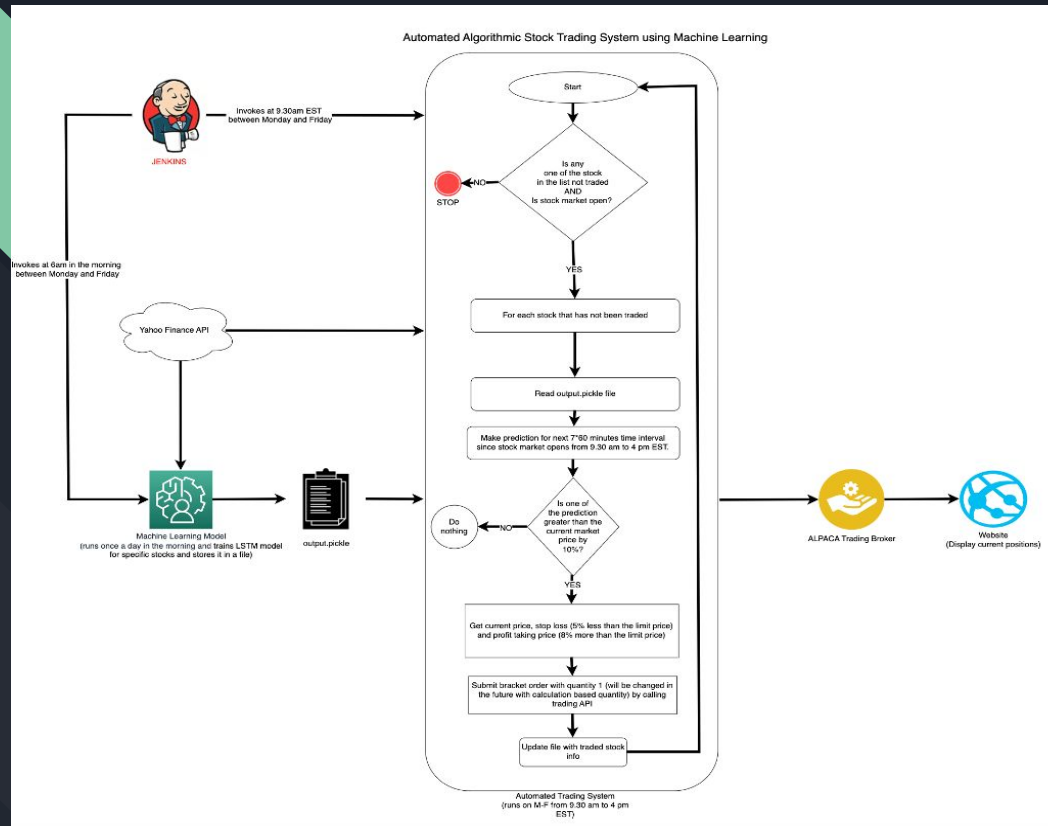
Why?

- Stock Market is dynamic and volatile
- For short-term trading, need to spend lot of time during technical analysis
- Automated Algorithmic Trading System will perform technical analysis and buy/sell stock automatically without human effort

How?

- Use historical stock price data
- Build Machine Learning model to make predictions
- Build Trading System to use those predictions and buy/sell stock automatically

Design and Workflow



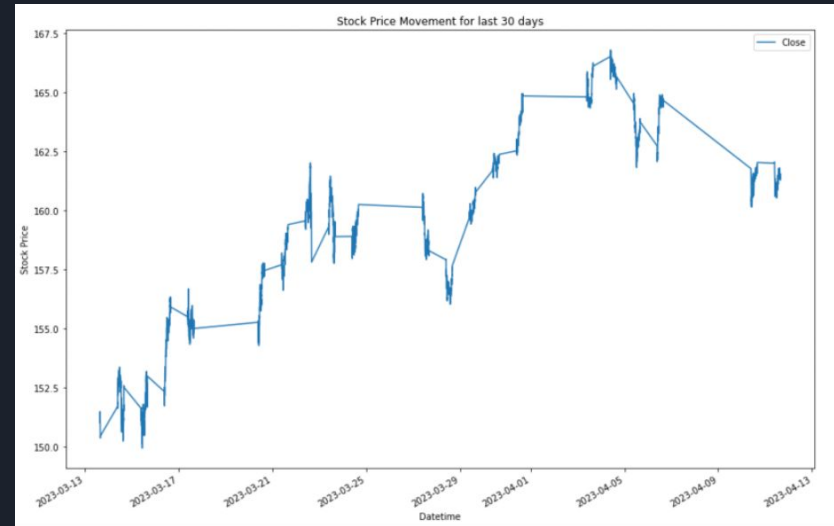
Dataset Used

- Used the data provided by Yahoo Finance API
- Interested in short term trading, so we extracted the data in minute range
- Used last 30 days of stock price data, as Yahoo Finance API do not provide data for more than 30 days in minute range
- Thus, the size of dataset is 7786 which contains 6 columns

	Open	High	Low	Close	Adj Close	Volume
Datetime						
2023-03-13 15:30:00-04:00	151.050003	151.300003	151.009995	151.145004	151.145004	0
2023-03-13 15:31:00-04:00	151.139999	151.179993	151.020004	151.160904	151.160904	129968
2023-03-13 15:32:00-04:00	151.160004	151.255005	151.000000	151.009995	151.009995	191684
2023-03-13 15:33:00-04:00	151.000000	151.350006	150.980103	151.279999	151.279999	192353
2023-03-13 15:34:00-04:00	151.279999	151.360001	151.210007	151.250000	151.250000	124118

Exploratory Data Analysis

- Exploratory data analysis has been carried out to learn more about the data
- Plotted the stock price of Apple in minute range against time for last 30 days
- From this plot, we see the stock price is moving in an upward trend which means there is a high probability for this stock price to increase during short term trading



Machine Learning Model

- Used LSTM model as it can store previous prices in memory during learning
- Used 70% of dataset for training and 30% for testing
- Calculated root mean squared error
- Output the trained model into output.pickle file

`current_rmse`

`0.22673504319473453`

Trading System (1)

- Reads the output.pickle file generated by the machine learning model and makes predictions
- If one of the predictions price is more than the threshold price, then bracket order is executed by trading system

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**** Starting Automated Algorithmic Trading System. Iteration Number: [1] ****
Started the process to trade [AAPL] stock
[*****100%*****] 1 of 1 completed
Current Price: [160.8], Threshold Signal Price: [159.19], Take Profit Signal Price: [173.66], Stop Loss Price: [152.76]
Predicting stock prices for [AAPL] for next [420] intervals
Predicted stock prices for [AAPL] are [161.46068, 161.53914, 161.65282, 161.77887, 161.90794, 162.03561, 162.15909, 162.2766, 162.38753, 162.49287, 162.59113, 162.686, 162.77818, 162.86916, 162.96016, 163.0522, 163.1432, 163.2342, 163.3252, 163.4162, 163.5072, 163.5982, 163.6892, 163.7802, 163.8712, 163.9622, 164.0532, 164.1442, 164.2352, 164.3262, 164.4172, 164.5082, 164.5992, 164.6902, 164.7812, 164.8722, 164.9632, 165.0542, 165.1452, 165.2362, 165.3272, 165.4182, 165.5092, 165.6002, 165.6912, 165.7822, 165.8732, 165.9642, 166.0552, 166.1462, 166.2372, 166.3282, 166.4192, 166.5102, 166.6012, 166.6922, 166.7832, 166.8742, 166.9652, 167.0562, 167.1472, 167.2382, 167.3292, 167.4202, 167.5112, 167.6022, 167.6932, 167.7842, 167.8752, 167.9662, 168.0572, 168.1482, 168.2392, 168.3302, 168.4212, 168.5122, 168.6032, 168.6942, 168.7852, 168.8762, 168.9672, 169.0582, 169.1492, 169.2402, 169.3312, 169.4222, 169.5132, 169.6042, 169.6952, 169.7862, 169.8772, 169.9682, 170.0592, 170.1502, 170.2412, 170.3322, 170.4232, 170.5142, 170.6052, 170.6962, 170.7872, 170.8782, 170.9692, 171.0602, 171.1512, 171.2422, 171.3332, 171.4242, 171.5152, 171.6062, 171.6972, 171.7882, 171.8792, 171.9702, 172.0612, 172.1522, 172.2432, 172.3342, 172.4252, 172.5162, 172.6072, 172.6982, 172.7892, 172.8802, 172.9712, 173.0622, 173.1532, 173.2442, 173.3352, 173.4262, 173.5172, 173.6082, 173.6992, 173.7902, 173.8812, 173.9722, 174.0632, 174.1542, 174.2452, 174.3362, 174.4272, 174.5182, 174.6092, 174.7002, 174.7912, 174.8822, 174.9732, 175.0642, 175.1552, 175.2462, 175.3372, 175.4282, 175.5192, 175.6102, 175.7012, 175.7922, 175.8832, 175.9742, 176.0652, 176.1562, 176.2472, 176.3382, 176.4292, 176.5202, 176.6112, 176.7022, 176.7932, 176.8842, 176.9752, 177.0662, 177.1572, 177.2482, 177.3392, 177.4302, 177.5212, 177.6122, 177.7032, 177.7942, 177.8852, 177.9762, 178.0672, 178.1582, 178.2492, 178.3402, 178.4312, 178.5222, 178.6132, 178.7042, 178.7952, 178.8862, 178.9772, 179.0682, 179.1592, 179.2502, 179.3412, 179.4322, 179.5232, 179.6142, 179.7052, 179.7962, 179.8872, 179.9782, 180.0692, 180.1602, 180.2512, 180.3422, 180.4332, 180.5242, 180.6152, 180.7062, 180.7972, 180.8882, 180.9792, 181.0702, 181.1612, 181.2522, 181.3432, 181.4342, 181.5252, 181.6162, 181.7072, 181.7982, 181.8892, 181.9802, 182.0712, 182.1622, 182.2532, 182.3442, 182.4352, 182.5262, 182.6172, 182.7082, 182.7992, 182.8902, 182.9812, 183.0722, 183.1632, 183.2542, 183.3452, 183.4362, 183.5272, 183.6182, 183.7092, 183.8002, 183.8912, 183.9822, 184.0732, 184.1642, 184.2552, 184.3462, 184.4372, 184.5282, 184.6192, 184.7102, 184.8012, 184.8922, 184.9832, 185.0742, 185.1652, 185.2562, 185.3472, 185.4382, 185.5292, 185.6202, 185.7112, 185.8022, 185.8932, 185.9842, 186.0752, 186.1662, 186.2572, 186.3482, 186.4392, 186.5302, 186.6212, 186.7122, 186.8032, 186.8942, 186.9852, 187.0762, 187.1672, 187.2582, 187.3492, 187.4402, 187.5312, 187.6222, 187.7132, 187.8042, 187.8952, 187.9862, 188.0772, 188.1682, 188.2592, 188.3502, 188.4412, 188.5322, 188.6232, 188.7142, 188.8052, 188.8962, 188.9872, 189.0782, 189.1692, 189.2602, 189.3512, 189.4422, 189.5332, 189.6242, 189.7152, 189.8062, 189.8972, 189.9882, 190.0792, 190.1702, 190.2612, 190.3522, 190.4432, 190.5342, 190.6252, 190.7162, 190.8072, 190.8982, 190.9892, 191.0802, 191.1712, 191.2622, 191.3532, 191.4442, 191.5352, 191.6262, 191.7172, 191.8082, 191.8992, 191.9902, 192.0812, 192.1722, 192.2632, 192.3542, 192.4452, 192.5362, 192.6272, 192.7182, 192.8092, 192.9002, 192.9912, 193.0822, 193.1732, 193.2642, 193.3552, 193.4462, 193.5372, 193.6282, 193.7192, 193.8102, 193.9012, 193.9922, 194.0832, 194.1742, 194.2652, 194.3562, 194.4472, 194.5382, 194.6292, 194.7202, 194.8112, 194.9022, 194.9932, 195.0842, 195.1752, 195.2662, 195.3572, 195.4482, 195.5392, 195.6302, 195.7212, 195.8122, 195.9032, 195.9942, 196.0852, 196.1762, 196.2672, 196.3582, 196.4492, 196.5402, 196.6312, 196.7222, 196.8132, 196.9042, 196.9952, 197.0862, 197.1772, 197.2682, 197.3592, 197.4502, 197.5412, 197.6322, 197.7232, 197.8142, 197.9052, 197.9962, 198.0872, 198.1782, 198.2692, 198.3602, 198.4512, 198.5422, 198.6332, 198.7242, 198.8152, 198.9062, 198.9972, 199.0882, 199.1792, 199.2702, 199.3612, 199.4522, 199.5432, 199.6342, 199.7252, 199.8162, 199.9072, 200.000]
Executing bracket order for [AAPL] with quantity [1]
Started the process to trade [TSLA] stock
[*****100%*****] 1 of 1 completed
Current Price: [186.8], Threshold Signal Price: [184.93], Take Profit Signal Price: [201.74], Stop Loss Price: [177.46]
Predicting stock prices for [TSLA] for next [420] intervals
Predicted stock prices for [TSLA] are [185.15997, 185.13911, 185.11224, 185.08348, 185.05368, 185.0232, 184.99278, 184.96306, 184.93416, 184.90628, 184.87949, 184.85396, 184.82948, 184.80586, 184.78302, 184.76062, 184.73878, 184.71744, 184.6966, 184.67626, 184.65642, 184.63708, 184.61824, 184.5999, 184.58206, 184.56422, 184.54638, 184.52904, 184.5122, 184.49586, 184.47952, 184.46318, 184.44684, 184.4305, 184.41416, 184.39782, 184.38148, 184.36514, 184.3488, 184.33246, 184.31612, 184.30078, 184.28444, 184.2681, 184.25176, 184.23542, 184.21908, 184.20274, 184.1864, 184.17006, 184.15372, 184.13738, 184.12104, 184.1047, 184.08836, 184.07202, 184.05568, 184.03934, 184.023, 184.00666, 183.99032, 183.97398, 183.95764, 183.9413, 183.92496, 183.90862, 183.89228, 183.87594, 183.8596, 183.84326, 183.82692, 183.81058, 183.79424, 183.7779, 183.76156, 183.74522, 183.72888, 183.71254, 183.6962, 183.67986, 183.66352, 183.64718, 183.63084, 183.6145, 183.59816, 183.58182, 183.56548, 183.54914, 183.5328, 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174.48044, 174.4641, 174.44776, 174.43142, 174.41508, 174.39874, 174.3824, 174.36606, 174.34972, 174.33338, 174.31704, 174.3007, 174.28436, 174.26802, 174.25168, 174.23534, 174.219, 174.20266, 174.18632, 174.16998, 174.15364, 174.1373, 174.12096, 174.10462, 174.08828, 174.07194, 174.0556, 174.03926, 174.02292, 174.00658, 173.99024, 173.9739, 173.95756, 173.94122, 173.92488, 173.90854, 173.8922, 173.87586, 173.85952, 173.84318, 173.82684, 173.8105, 173.79416, 173.77782, 173.76148, 173.74514, 173.7288, 173.71246, 173.69612, 173.67978, 173.66344, 173.6471, 173.63076, 173.61442, 173.59808, 173.58174, 173.5654, 173.54906, 173.53272, 173.51638, 173.50004, 173.4837, 173.46736, 173.45102, 173.43468, 173.41834, 173.402, 173.38566, 173.36932, 173.35298, 173.33664, 173.3203, 173.30396, 173.28762, 173.27128, 173.25494, 173.2386, 173.22226, 
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Trading System (2)

- Trading System is integrated with Alpaca Broker API
- After bracket order is placed, we can verify it in the Alpaca UI

The screenshot displays the Alpaca trading platform interface. On the left is a sidebar with navigation links: Home, Positions, Orders, Alpaca Connect, Developers Hub, Account, Docs, Support, and Community. The main content area shows a 'Paper Trading' status with a message: 'You are on Paper Trading, no real money is being used. [Switch to Live Trading?](#)'. Below this, a greeting 'Hi, Anjan!' is followed by a portfolio update: 'Your portfolio is down \$183.58 ↓ -0.17% today.'.

The 'Top Positions' section includes a table with columns: Asset, Price, Qty, Market Value, and Profit Loss. It lists two positions: BTCUSD (CRYPTO) and AAPL.

The 'Recent Orders' section includes a table with columns: Symbol, Type, Qty, Average Cost, Amount, Status, and Date. It lists several orders for TSLA and AAPL, including Stop SELL, Market BUY, and Limit SELL orders.

Asset	Price	Qty	Market Value	Profit Loss
BTCUSD CRYPTO	\$30,209.79	2.992499996	\$90,402.8	+\$6,878.87
AAPL	\$160.75	15	\$2,411.25	-\$44.02

Symbol	Type	Qty	Average Cost	Amount	Status	Date
TSLA	Stop SELL @ -	-	-	-	Held	2 minutes ago
TSLA	Market BUY	-	-	-	Accepted	2 minutes ago
TSLA	Limit SELL @ \$201.74	-	-	-	Held	2 minutes ago
AAPL	Limit SELL @ \$173.66	-	-	-	Held	2 minutes ago
AAPL	Market BUY	-	-	-	Accepted	2 minutes ago
AAPL	Stop SELL @ -	-	-	-	Held	2 minutes ago



Future Improvement

- Train the model with larger dataset
- Build a website that shows the bracket order executed by trading system (Project 3)
- Deploy it to cloud (Project 3)



Live Demo