AI-BASED FORM 4 FILING INTERPRETATIONS FOR IMPROVED STOCK MARKET INFORMATION AVAILABILITY TO PUBLIC

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Problem

Insider activity insights is complex for beginners

- Beginners find it hard to interpret market movements caused by insider's actions.
- There is a lack of user-friendly tools that simplify this data.

Current stock platforms are not tailored to understand easily

- Many stock trading tools are too advanced and do not focus on educational support for beginners.
- These tools assume prior knowledge of market intricacies, leaving beginners struggling to learn.

Insider's actions are impactful but underutilized

- Insider's changes in equity reported in Form 4 filings can significantly influence stock prices, but novice traders don't capitalize on them.
- Properly understanding and interpreting these trades could give users an edge in the market.

Background

What are Form 4 filings?

- These filings report insider trading where major shareholders (owning more than 10%) or insiders sell or buy stock.
- All these transactions are publicly filed through the SEC, providing a wealth of data on company trends.

Form 4 filings as insider equity changes

- The actions of insiders, such as CEOs, are often seen as reliable indicators of future stock performance.
- Investors leverage this data to anticipate potential price movements in the market.

Why beginners struggle with this data?

- The raw data from SEC EDGAR filings is complex and unformatted.
- There's a lack of tools that break this information down into digestible, beginner-friendly formats.

Example Form 4 Filing (Apple)

SEC Form 4

FORM 4

☐ Check this box if no longer subject to Section 16. Form 4 or Form 5 obligations may continue. *See* Instruction 1(b).

UNITED STATES SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

STATEMENT OF CHANGES IN BENEFICIAL OWNERSHIP

Filed pursuant to Section 16(a) of the Securities Exchange Act of 1934
or Section 30(h) of the Investment Company Act of 1940

OMB APPROVAL	
OMB Number:	3235-0287
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1. Name and Address of Reporting Person*	2. Issuer Name **and** Ticker or Trading Symbol	5. Relationship of Reporting Person(s) to Issuer (Check all applicable)
Maestri Luca	Apple Inc. [AAPL]	Director · 10% Owner X Officer (give title below) · Other (specify below) **Senior Vice President, CFO**
(Last) (First) (Middle) ONE APPLE PARK WAY	3. Date of Earliest Transaction (Month/Day/Year) 09/26/2021	
(Street) CUPERTINO CA 95014	4. If Amendment, Date of Original Filed (Month/Day/Year)	6. Individual or Joint/Group Filing (Check Applicable Line) X Form filed by One Reporting Person ☐ Form filed by More than One Reporting Person
(City) (State) (Zip)		

Table I - Non-Derivative Securities Acquired, Disposed of, or Beneficially Owned

1. Title of Security (Instr. 3)	2. Transaction Date (Month/Day/Year)	2A. Deemed Execution Date, if any (Month/Day/Year)	3. Transaction Code (Instr. 8)		4. Securities Acquired (A) or Disposed Of (D) (Instr. 3, 4 and 5)			5. Amount of Securities Beneficially Owned Following Reported Transaction(s) (Instr. 3 and 4)	6. Ownership Form: Direct (D) or Indirect (I) (Instr. 4)	7. Nature of Indirect Beneficial Ownership (Instr. 4)
			Code	V	Amount	(A) or (D)	Price			

Table II - Derivative Securities Acquired, Disposed of, or Beneficially Owned
(e.g., puts, calls, warrants, options, convertible securities)

1. Title of Derivative Security (Instr. 3)	2. Conversion or Exercise Price of Derivative Security	3. Transaction Date (Month/Day/Year)	3A. Deemed Execution Date, if any (Month/Day/Year)	4. Transaction Code (Instr. 8)		5. Number of Derivative Securities Acquired (A) or Disposed of (D) (Instr. 3, 4 and 5)		6. Date Exercisable and Expiration Date (Month/Day/Year)		7. Title and Amount of Securities Underlying Derivative Security (Instr. 3 and 4)		8. Price of Derivative Security (Instr. 5)	9. Number of derivative Securities Beneficially Owned Following Reported Transaction(s) (Instr. 4)	10. Ownership Form: Direct (D) or Indirect (I) (Instr. 4)	11. Nature of Indirect Beneficial Ownership (Instr. 4)
				Code	V	(A)	(D)	Date Exercisable	Expiration Date	Title	Amount or Number of Shares				
Restricted Stock Unit	(1)	09/26/2021		A		68,065		(2)	(2)	Common Stock	68,065	$0	68,065	D	
Restricted Stock Unit	(1)	09/26/2021		A		68,065		(3)	(3)	Common Stock	68,065	$0	68,065	D	

Explanation of Responses:

1. Each restricted stock unit represents the right to receive, at settlement, one share of common stock.

Other Solutions

General stock platforms

- Most platforms focus on broad stock data without specializing in insider trading insights.
- Lack detailed insider trade information.

Financial analytics platforms

- Tools like Bloomberg and Yahoo Finance provide insider data but are hard to interpret.

No focus on interpretation

- Most tools don't offer aids that simplify insider trading trends

Why Is Ours better?

Focus on beginners

- Our tool is designed specifically for traders, providing a clear, easy-to-use interface.
- The tool simplifies insider trading data and offers educational support.

Educational insights (Context-Based)

- Users get personalized interpretations of insider's changes in equity.
- These tools break down complex stock movements into easy-to-understand insights.

Real-time updates

- The web scraper ensures that data from SEC Form 4 filings is as up-to-date as possible and easily accessible
- This timely information allows users to act quickly on insider trades.

Novelty

Narrative-driven trade approach

- We don't just provide data; we help users understand the context behind insider's change in equity.
- Users can grasp why certain trades were made, offering deeper insights into market trends.

Exclusive focus on Form 4 filings

- Unlike other tools, we specialize in insider trading data from Form 4 filings.
- This specific focus helps novice traders understand how insiders impact stock prices.

Method

Web scraping insider equity data

- Our web scraper pulls data from SEC EDGAR's Form 4 filings.
- It filters this data to identify high-profile trades from CEOs and major shareholders.

Interpretation

- Using Gemini API and our own model to analyze and interpret financial data.
- Simplified insights generated from insider trading activity.
- Tool assists in contextualizing current market trends based on insider actions.

Data visualization and filtering

- The tool includes graphs and filters for users to see specific trades and trends.
- Users can filter based on CEO trades, market cap, or filing dates.

METHOD: Systems Architecture Overview

Data Collection (Web Scraper)

- The system starts by collecting insider trading data from SEC EDGAR using a web scraper.
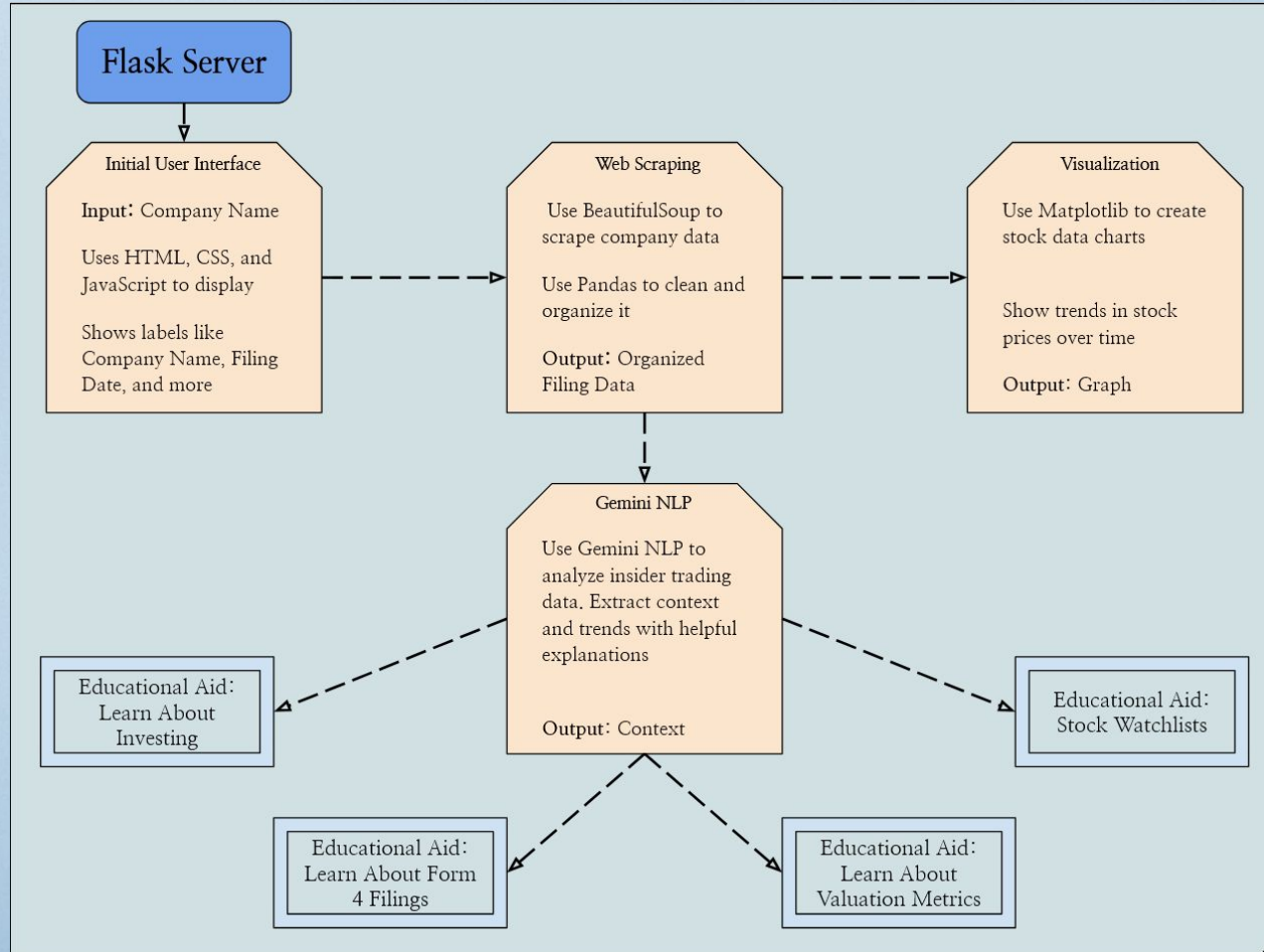- The scraper is programmed to extract and filter relevant Form 4 filings.

Interpretation/Integration

- The data is processed using python libraries to interpret stock movements.
- Simplifies the data, creating actionable insights for users.

User Interface (UI)

- A user-friendly interface displays graphs, stock trends, and insights.
- The interface is designed to be intuitive, especially for beginners, with AI analysis and stock descriptor options.
- Used Flask to create web scraper

METHOD - SYSTEMS ARCHITECTURE

Results

Functional web scraper

- Our scraper successfully extracts insider trading data from SEC EDGAR, focusing on Form 4 filings.
- The collected displays filing data, amount of stock, and price

Completed UI development

- The interface has been created with basic visualizations that incorporate descriptors of trade
- Merged web scraper with the user interface through a Flask server
- Contains educational aids to teach about investment

Stock Analysis

- Uses Gemini NLP to analyze insider trading data
- Explains context and trends with detailed and helpful explanations

WEB INTERFACE

StockBot

Search here for company name...   Submit

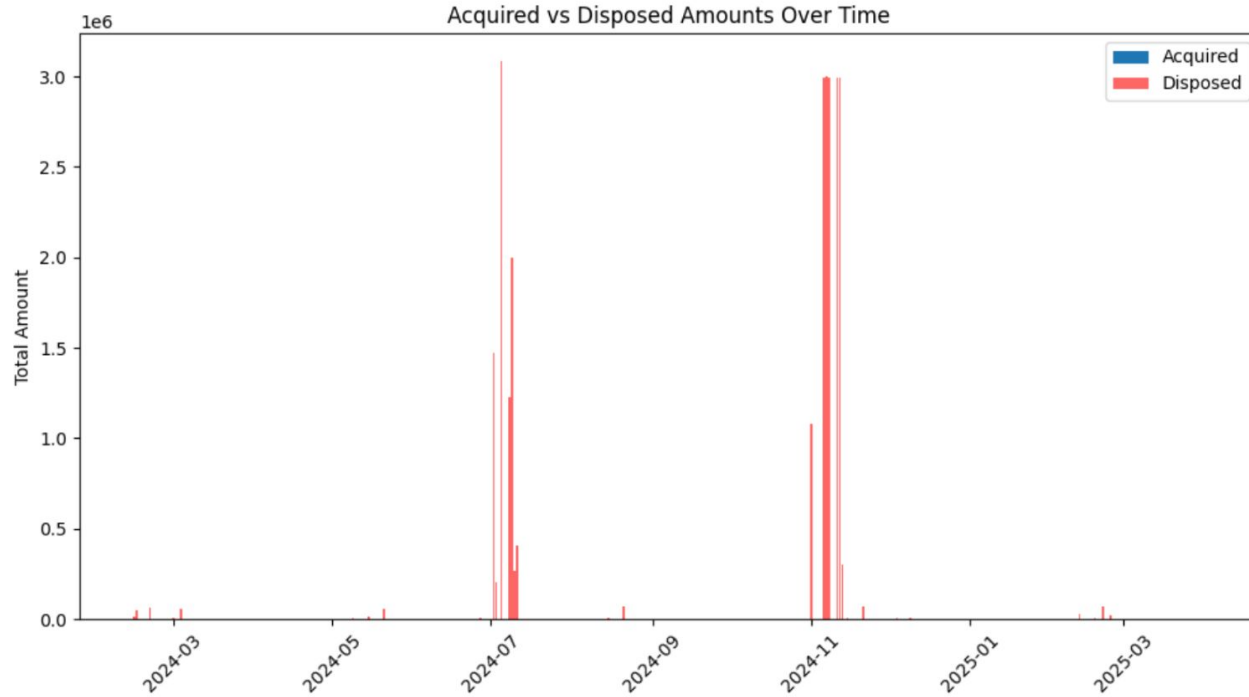Stock Visualization   AI Stock Analysis

*If the price is N/A, the stock was likely purchased through an alternative means, such as by trading another stock

Company Name	Form 4 Filing Date	Acquired (A) or Disposed (D)	Amount of Shares	Price Per Share
AMAZON COM INC	04/01/2025	D	2,500	$187.99
AMAZON COM INC	03/03/2025	D	2,500	$213.17
AMAZON COM INC	03/03/2025	D	239,843	N/A
AMAZON COM INC	03/04/2025	D	56,339	N/A

VISUALIZATION

AI STOCK ANALYSIS & EDUCATIONAL AIDS

AI Stock Analysis

Here are possible explanations for the trends in the provided Amazon Form 4 data:

1. Scheduled Vesting and Sales: The consistent pattern of "A" (Acquisition) transactions followed by "D" (Disposition) transactions, particularly on the same day (e.g., a lot of transactions occurring on 02/21/2024), suggests that these could be related to the vesting of stock options or restricted stock units (RSUs). Upon vesting, insiders may sell a portion of the shares to cover taxes or diversify their holdings.

2. Tax Planning: Insiders might be strategically selling shares towards the end of the year (especially noticeable in November and December 2024) for tax planning purposes, such as offsetting capital gains or taking advantage of certain deductions.

3. Company Performance and Outlook: Large disposition dates coincide with news announcements. For example, looking at July and August 2024, some data suggests a possible decrease in insider confidence at that time, potentially due to concerns about growth or profitability, causing them to sell off stock.

4. Executive Compensation Structure: The repeated acquisitions of shares with "N/A" for price suggest grants of restricted stock or options as part of executive compensation packages. The subsequent sales could be part of a pre-arranged trading plan (Rule 10b5-1 plans) to systematically liquidate some of these holdings.

5. Individual Financial Needs: While broader trends may be related to company-specific factors, individual insider sales can also be driven by personal financial needs, such as purchasing a home, funding education, or estate planning. These individual sales may not necessarily reflect a negative view of the company's prospects.

6. Diversification: Some insiders might simply be reducing their concentration in Amazon stock to diversify their investments and reduce their overall risk profile.

7. Market Conditions: Insiders may be taking advantage of what they perceive as favorable market conditions (or anticipating less favorable conditions) to sell shares and realize gains. The large sell-offs in November 2024 could be attributed to overall market volatility or concerns about a potential economic slowdown.

8. Increased Scrutiny: Given Amazon's size and public profile, insider trading activity is closely watched. Therefore, insiders are likely to be cautious and ensure that their transactions are properly disclosed and comply with all regulations to avoid any perception of impropriety.

9. Philanthropic activities: Insiders could be selling stock for charitable contributions or to establish or fund foundations. This is especially possible with a company such as Amazon, where some insiders have become extremely wealthy.

CONCLUSION AND FUTURE WORK

Problem

- Insider activity insights are complex and hard for beginners to interpret.
- Many stock platforms are too advanced, with a lack of educational tools to simplify insider trades.
- Beginners struggle to capitalize on the significant impact of insider trades reported in Form 4 filings.

Future Work

- Expand to include other SEC forms such as Form 5, which can provide additional insights into insider activities.
- Integrate these forms to offer a more comprehensive view of insider actions over time.

References

Dataset:
https://www.sec.gov/cgi-bin/browse-edgar?company=&CIK=&type=4&owner=include&count=40&action=getcurrent

API:
https://www.sec.gov/search-filings/edgar-application-programming-interfaces

References:
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https://github.com/areed1192/sigma_coding_youtube/blob/master/python/python-finance/sec-web-scraping/Web%20Scraping%20SEC%20-%20EDGAR%20Queries.

THANKS!