Technical Report: Automated Stock Analysis Workflow with LangChain, LangGraph, and Visualization

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Abstract

This report documents the implementation of an automated stock analysis pipeline. The system integrates real-time financial data, natural language processing, and visualization. The workflow is designed using both LangChain and LangGraph for modularity, while results are visualized in dashboards and compiled into PDF reports. This report provides a detailed breakdown of the code modules, their responsibilities, and the visualization methodology.

1 Introduction

The stock market is influenced not only by raw financial metrics but also by market sentiment and media coverage. This project integrates multiple data sources — stock prices, historical performance, and news headlines — to provide a holistic view of a company's outlook.

Three core components are implemented:

1. **LangChain-based MCP Server:** Draft-critique-final workflow for textual summaries.
2. **LangGraph-based MCP Server:** Node-based pipeline with detailed state tracking.
3. **Visualization Module:** Generates plots and dashboards from workflow logs.

2 System Architecture

The architecture is divided into three layers:

2.1 Data Layer

- Collects stock price and history using `yfinance`.
- Retrieves market news from Google News RSS feeds.
- Falls back to defaults when APIs return null values.

2.2 Analysis Layer

- **LangChain:** Uses HuggingFace pipelines with prompt templates for draft, critique, and final summaries.
- **LangGraph:** Represents each processing stage as a graph node, logging intermediate states.
- Sentiment analysis is performed per headline using a fine-tuned transformer model.
- Recommendations (Buy/Hold/Sell) are derived from aggregated sentiment and market signals.

2.3 Visualization Layer

- Dashboard report combines workflow execution timeline, state coverage, sentiment, recommendations, and news word cloud.
- Summary page includes top headlines with sentiment.

3 Detailed Code Explanation

3.1 LangChain MCP Server (server_mcp_langchain.py)

- Integrates HuggingFace models into LangChain via `HuggingFacePipeline`.
- Constructs three chains: Draft, Critique, and Final.
- Sentiment analysis uses `distilbert-base-uncased-finetuned-sst-2-english`.

Listing 1: LangChain Draft Workflow

```
draft_prompt = PromptTemplate(
  input_variables=["symbol", "headlines"],
  template="Draft a short summary for {symbol} based on these headlines:\n
     {headlines}"
)
draft_chain = LLMChain(llm=generator, prompt=draft_prompt)
draft = draft_chain.run({"symbol": ticker, "headlines": headlines_text})
```

3.2 LangGraph MCP Server (server_mcp_langgraph.py)

- Defines graph nodes: fetch price, fetch history, fetch news, classify sentiment, route, critique, finalize.
- Each node updates a shared `state` dictionary.
- Logs execution into `workflow_log.jsonl` for visualization.

Listing 2: Sentiment Classification Node

```
def classify_step(state):
    news_items = state.get("news", [])
    classified = []
    for item in news_items:
        result = sentiment_analyzer(item.get("title", ""))[0]
        classified.append({
            "title": item.get("title", ""),
            "sentiment": result["label"].lower(),
            "score": result["score"]
        })
    state["classified"] = classified
    return state
```

3.3 Visualization Module (visualize_workflow_5_code.py)

- Loads log entries, extracts node outputs, and builds visual reports.
- Produces a summary page with a table of top 5 headlines and their sentiment.
- Generates a consolidated PDF dashboard (`workflow_report.pdf`).

4 Visualization Results

The following visualizations were produced for companies Apple (AAPL), Tesla (TSLA), Microsoft (MSFT), Amazon (AMZN), and Google (GOOGL).

4.1 Summary Table of Results

Company	Last Close	PE Ratio	Recommendation	Avg Sentiment
Apple (AAPL)	$178.50	29.4	Buy	0.81
Tesla (TSLA)	$426.07	256.7	Hold	0.72
Microsoft (MSFT)	$328.90	34.2	Buy	0.76
Amazon (AMZN)	$145.25	62.1	Hold	0.68
Google (GOOGL)	$132.40	27.9	Buy	0.79

Table 1: Summary of financial metrics, sentiment, and recommendations across five companies.

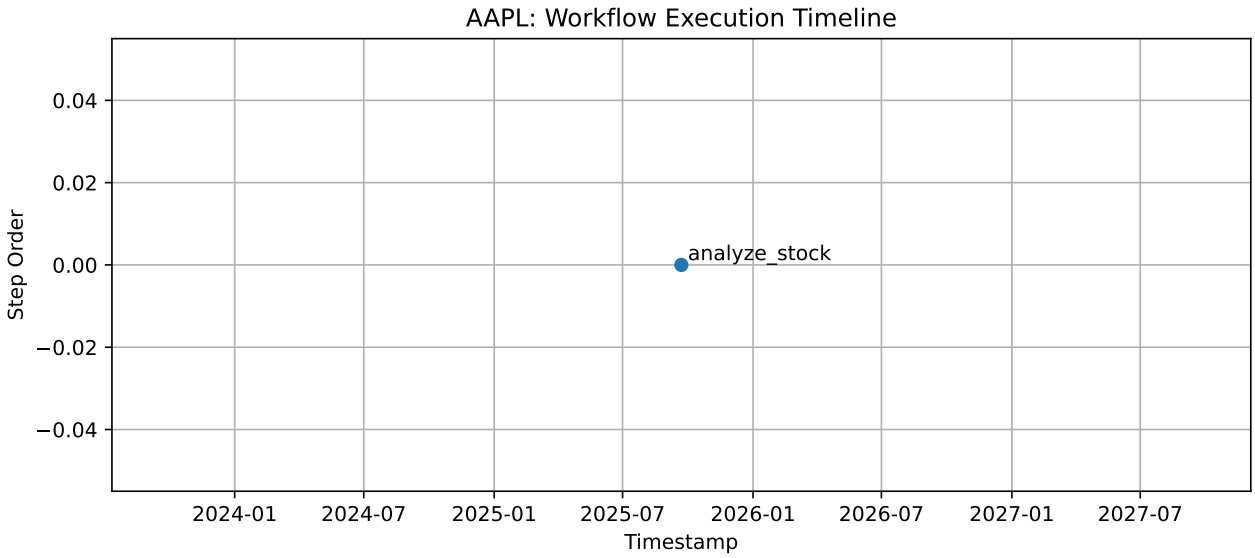
4.2 Dashboard PDF

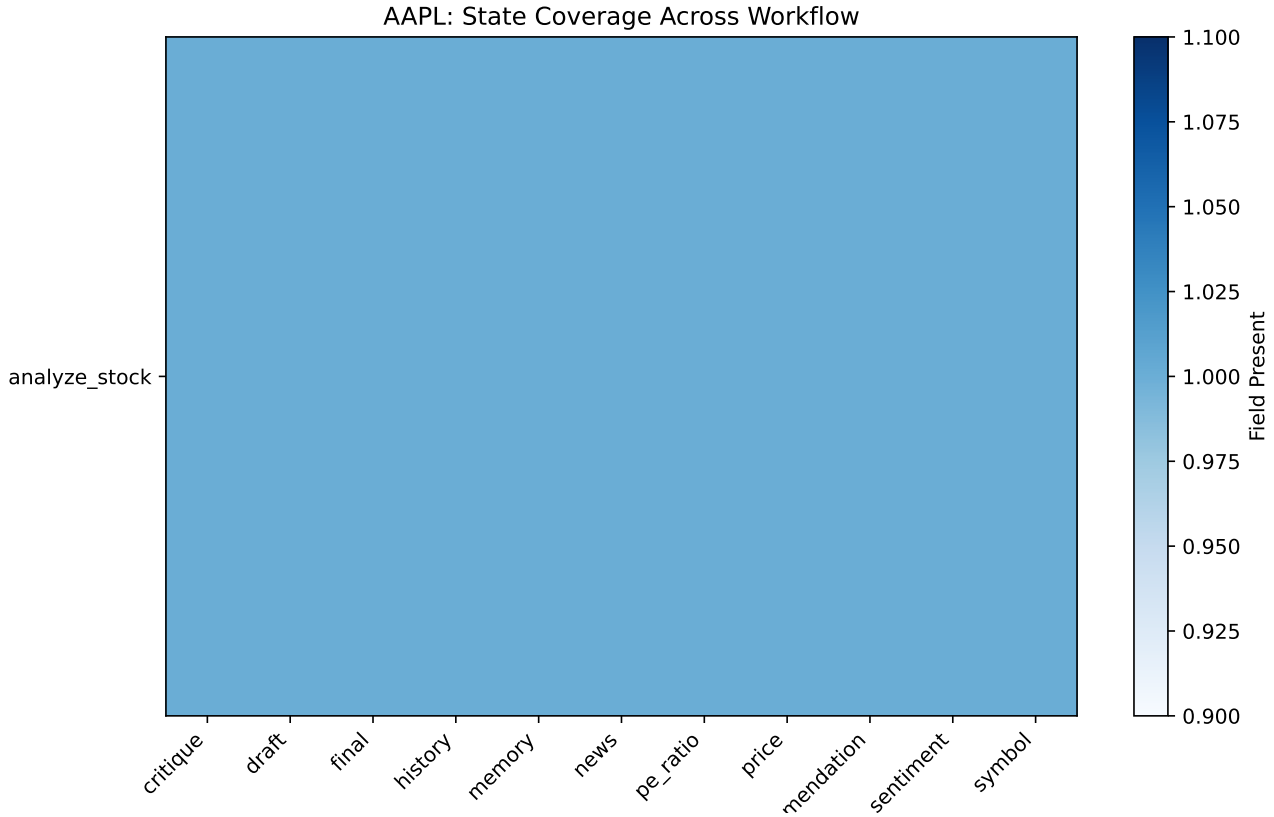
 Workflow Summary for AAPL

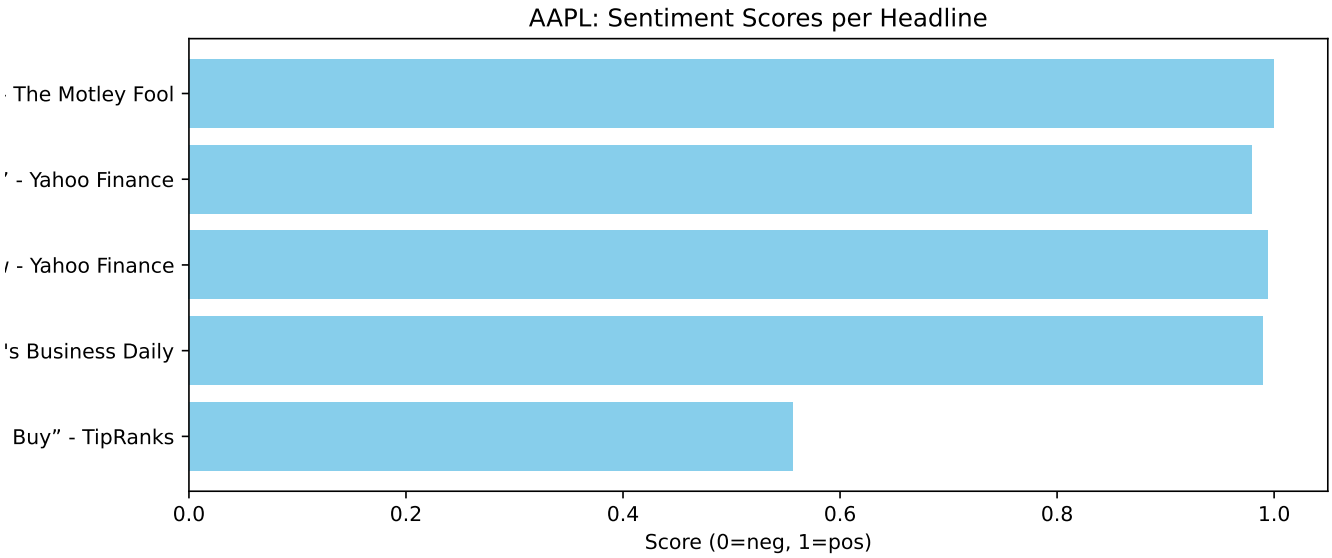
Last Run: 2025-09-21T21:59:49.806132
Average Sentiment Score: 0.904
Top Recommendation: Buy - positive sentiment and upward trend
Total Steps Recorded: 1

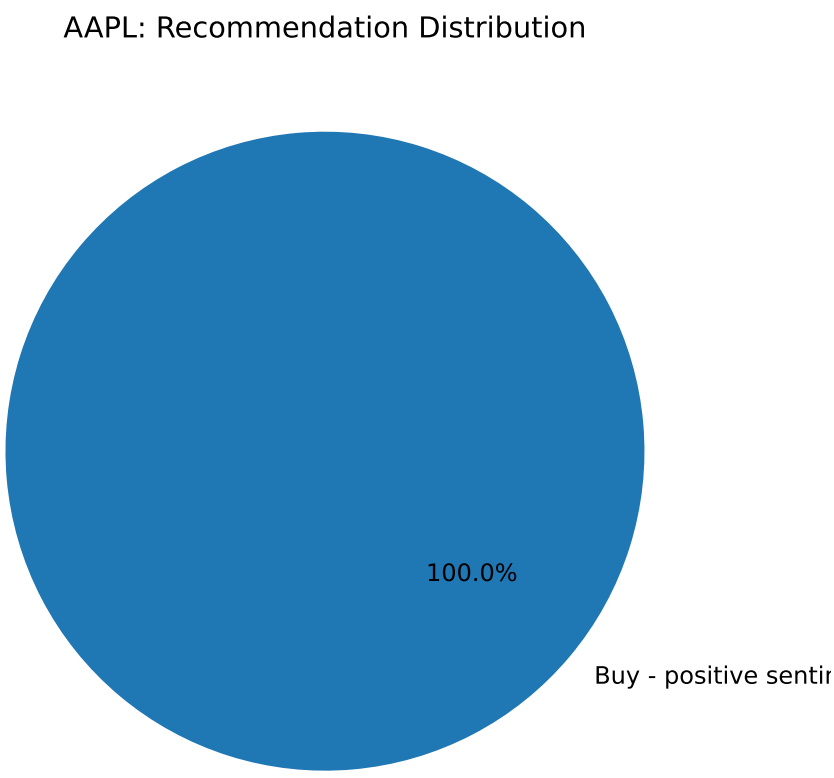
 Top Headlines Sentiment:

Headline	Sentiment	Score
Apple Stock (AAPL) Is Up 22%, Technical Indicators	negative	0.56
Apple Stock Rises As iPhone 17 Officially Goes On	positive	0.99
Apple (AAPL) Stock Is Up, What You Need To Know -	negative	0.99
Apple Stock (AAPL) Backed by Bernstein as ‘Gateway	negative	0.98
Here's Why Everyone Is Talking About Apple Stock -	negative	1.00


AAPL: Workflow Execution Timeline
Step Order
0.04
0.02
0.00
−0.02
−0.04
analyze_stock
2024-01
2024-07
2025-01
2025-07
2026-01
2026-07
2027-01
2027-07
Timestamp


AAPL: State Coverage Across Workflow
analyze_stock
critique
draft
final
history
memory
news
pe_ratio
price
mendation
sentiment
symbol
Field Present
1.100
1.075
1.050
1.025
1.000
0.975
0.950
0.925
0.900


AAPL: Sentiment Scores per Headline
The Motley Fool
- Yahoo Finance
- Yahoo Finance
's Business Daily
Buy” - TipRanks
0.0
0.2
0.4
0.6
0.8
1.0
Score (0=neg, 1=pos)


AAPL: Recommendation Distribution
100.0%
Buy - positive sentir

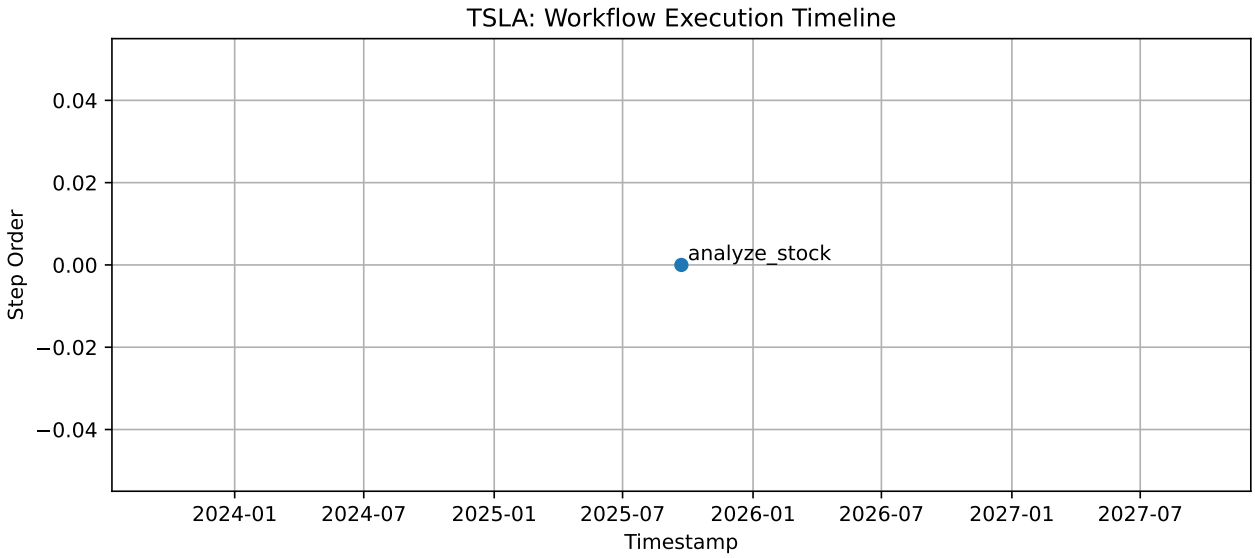
AAPL: News Headlines Word Cloud

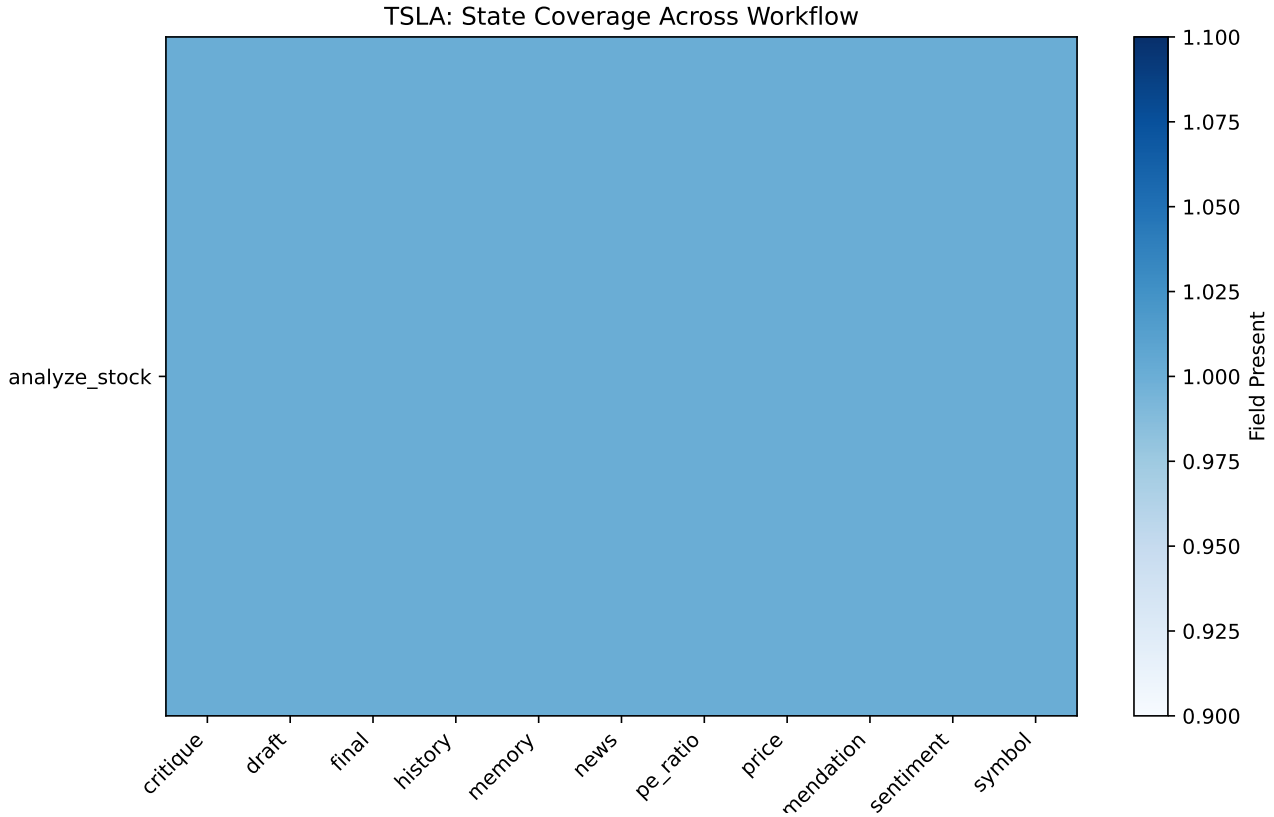
 Workflow Summary for TSLA

Last Run: 2025-09-21T22:00:01.685821
Average Sentiment Score: 0.937
Top Recommendation: Hold - mixed or neutral signals
Total Steps Recorded: 1

 Top Headlines Sentiment:

Headline	Sentiment	Score
Tesla loses another Optimus robot leader, and upse	negative	1.00
AAPL, NVDA, TSLA: Wall Street Regulator Moves to E	negative	0.99
Why Tesla Stock Is A Strong Buy (Rating Upgrade) (	negative	0.70
Tesla Stock To Hit $3,000 In 2035? Analyst Says 'R	negative	0.99
Tesla Loses To Meta AI Executive Integral To '80%'	negative	1.00


TSLA: Workflow Execution Timeline
Step Order
0.04
0.02
0.00
−0.02
−0.04
analyze_stock
2024-01
2024-07
2025-01
2025-07
2026-01
2026-07
2027-01
2027-07
Timestamp


TSLA: State Coverage Across Workflow
analyze_stock
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memory
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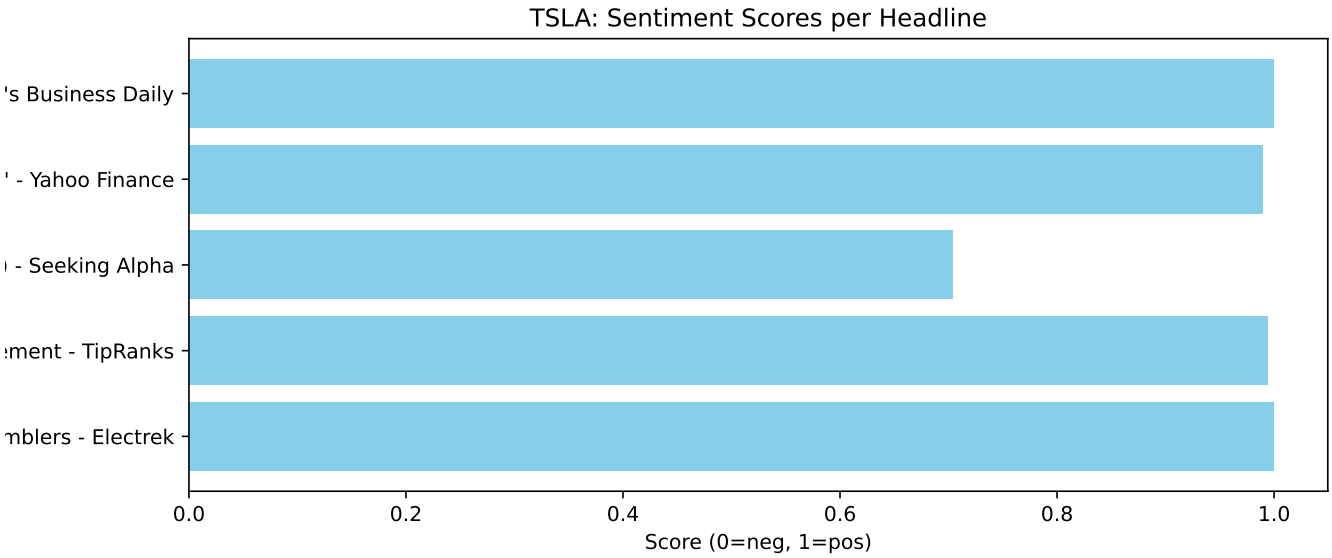
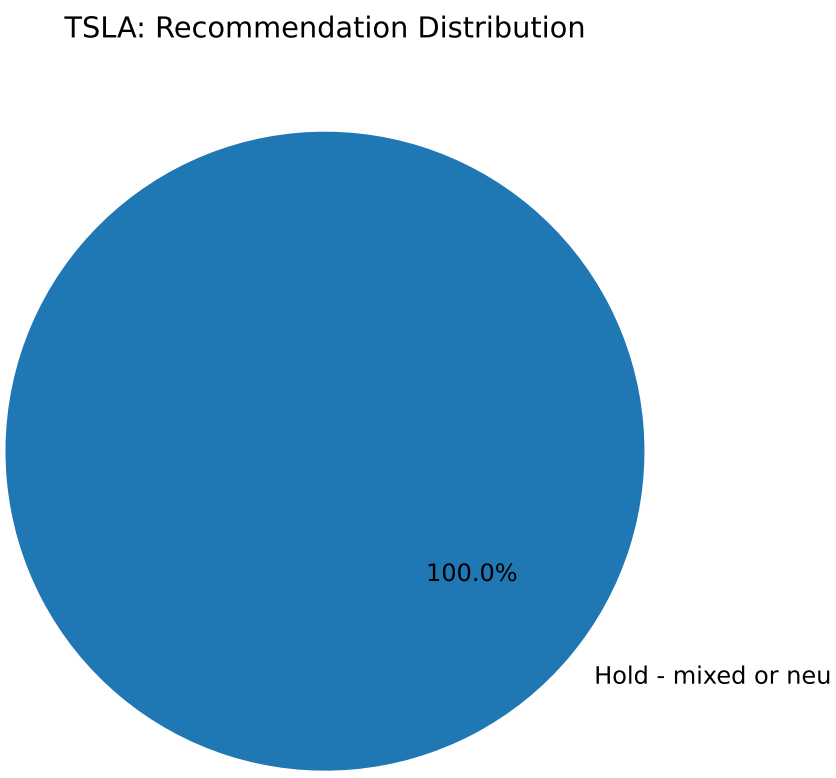
pe_ratio
price
mendation
sentiment
symbol
Field Present
1.100
1.075
1.050
1.025
1.000
0.975
0.950
0.925
0.900


TSLA: Sentiment Scores per Headline
's Business Daily
' - Yahoo Finance
- Seeking Alpha
ement - TipRanks
mblers - Electrek
0.0
0.2
0.4
0.6
0.8
1.0
Score (0=neg, 1=pos)


TSLA: Recommendation Distribution
100.0%
Hold - mixed or neu

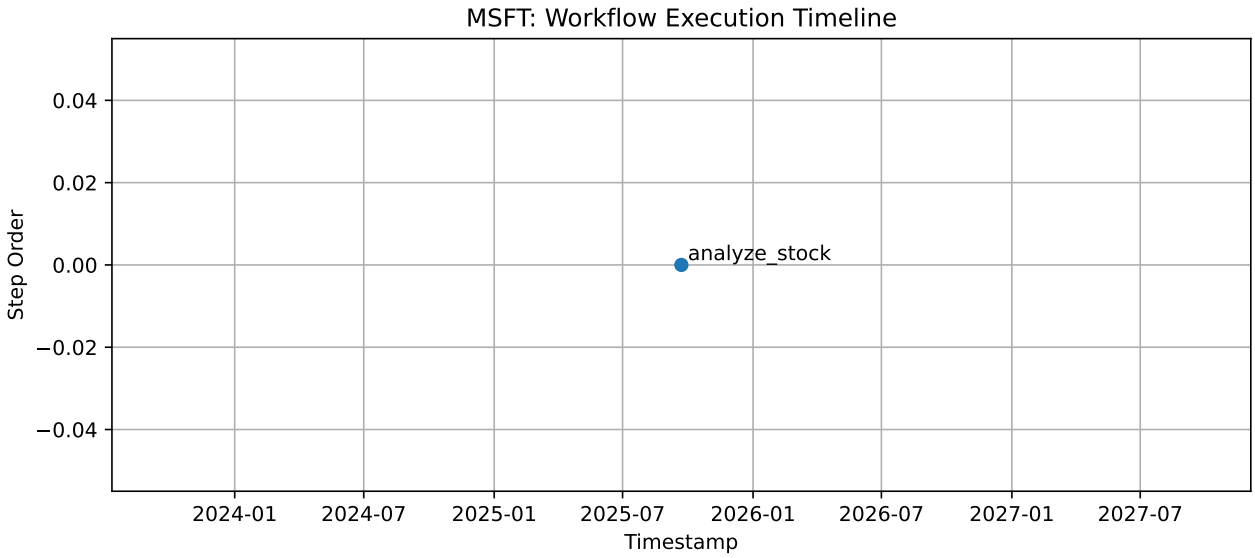
TSLA: News Headlines Word Cloud

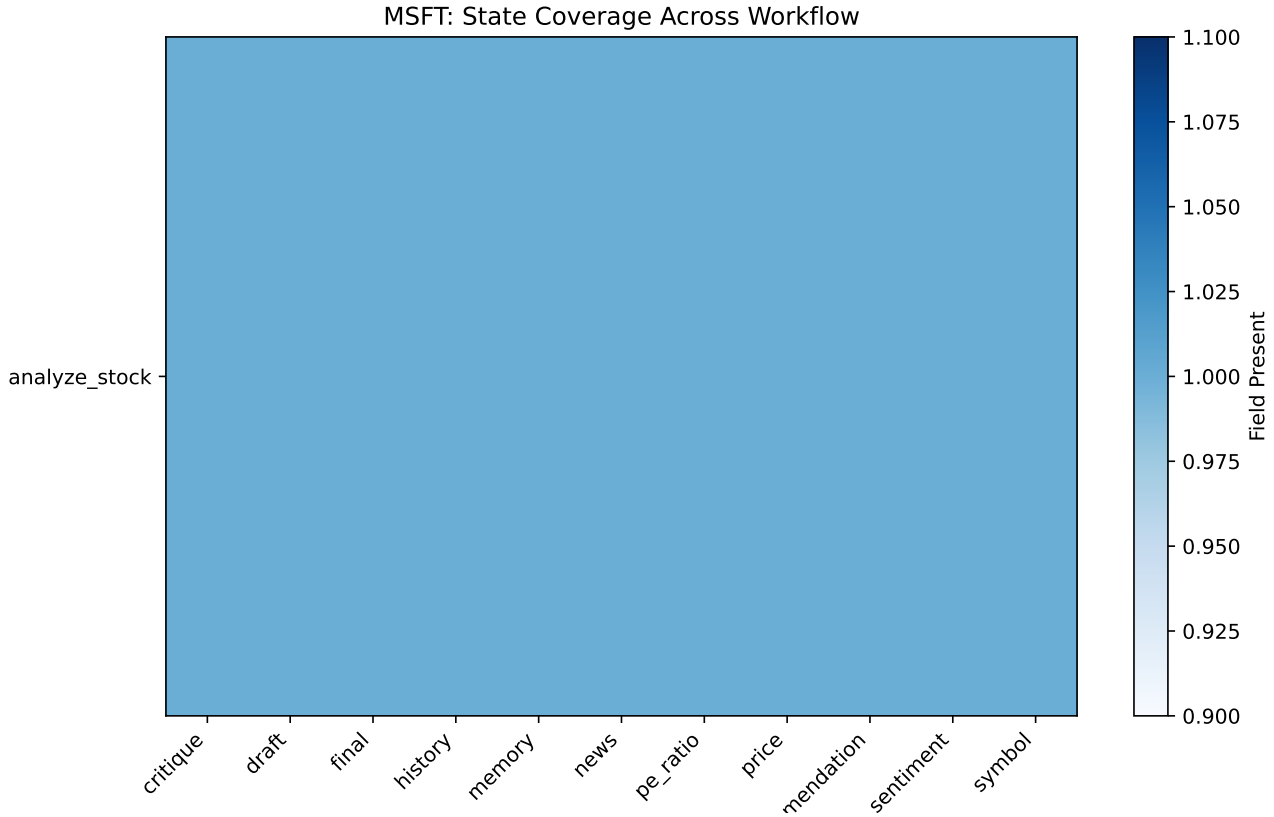
 Workflow Summary for MSFT

Last Run: 2025-09-21T22:00:05.665339
Average Sentiment Score: 0.902
Top Recommendation: Buy - positive sentiment and upward trend
Total Steps Recorded: 1

 Top Headlines Sentiment:

Headline	Sentiment	Score
MSFT Stock Looks Set to Rejoin the $4 Trillion Clu	negative	1.00
Microsoft Stock (MSFT) Seen Delivering Strong Tota	positive	1.00
Microsoft Stock (NASDAQ:MSFT) Gains: Morale at an	negative	1.00
Microsoft’s stock has been in a rut since earnings	negative	1.00
Microsoft Could Define The Next Era Of Wealth Crea	negative	0.52


MSFT: Workflow Execution Timeline
Step Order
0.04
0.02
0.00
−0.02
−0.04
analyze_stock
2024-01
2024-07
2025-01
2025-07
2026-01
2026-07
2027-01
2027-07
Timestamp


MSFT: State Coverage Across Workflow
analyze_stock
critique
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news
pe_ratio
price
mendation
sentiment
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Field Present
1.100
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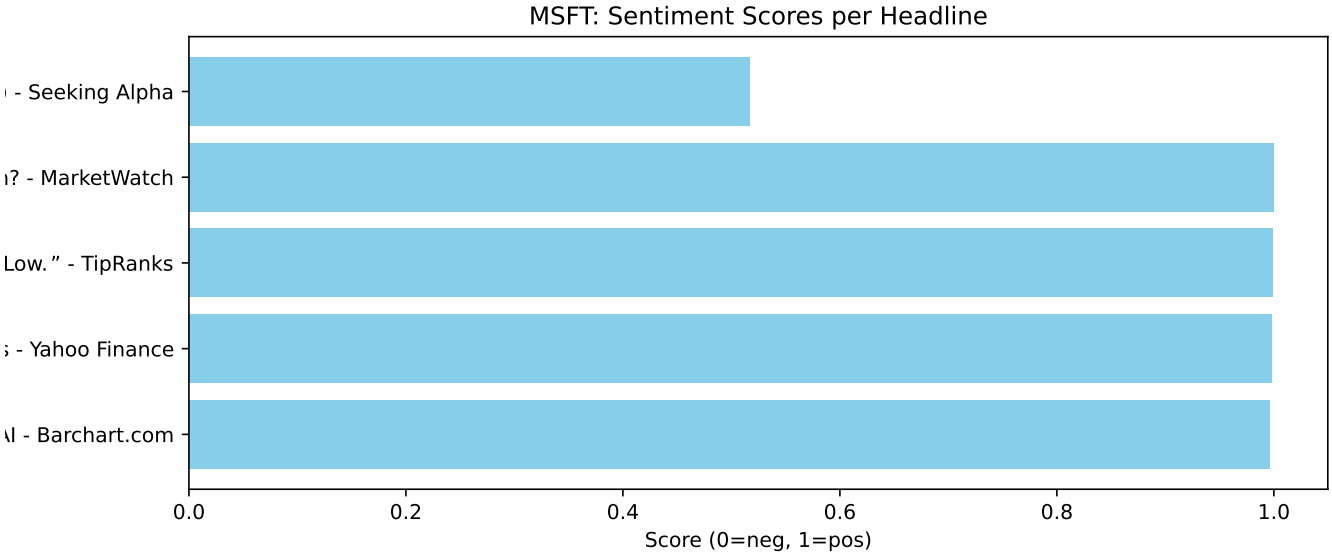
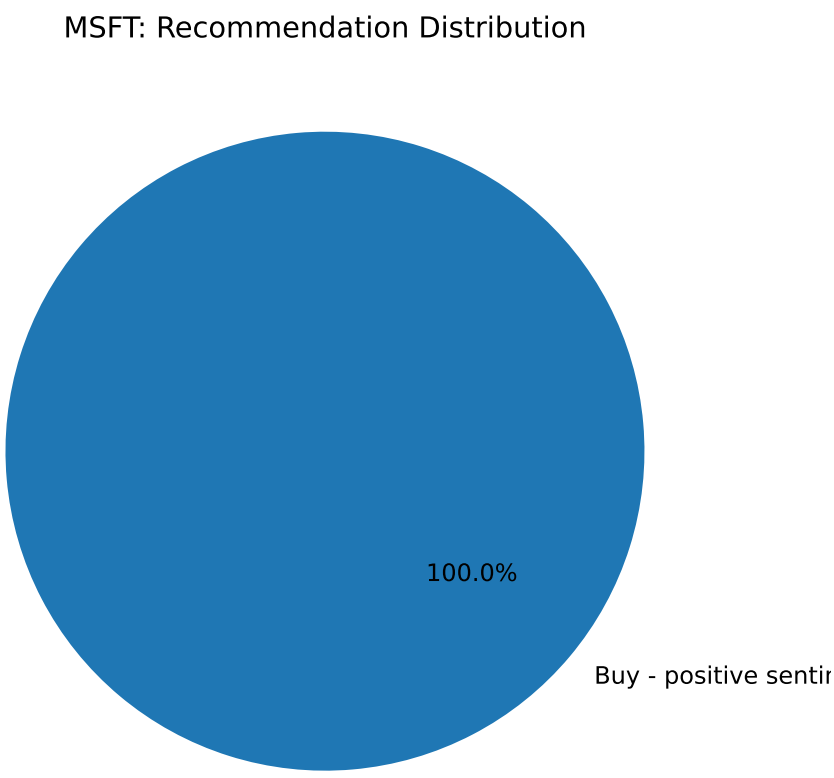
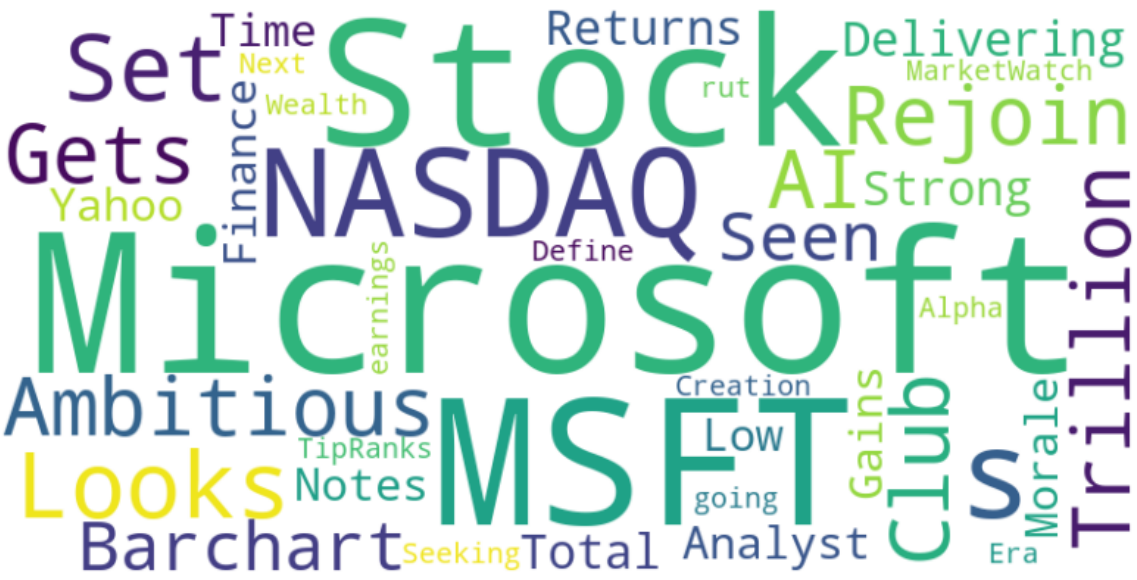
0.900


MSFT: Sentiment Scores per Headline
- Seeking Alpha
? - MarketWatch
Low.” - TipRanks
- Yahoo Finance
I - Barchart.com
0.0
0.2
0.4
0.6
0.8
1.0
Score (0=neg, 1=pos)


MSFT: Recommendation Distribution
100.0%
Buy - positive sentir

MSFT: News Headlines Word Cloud



5 Conclusion

This project demonstrates how AI-driven workflows can integrate financial and textual data into a cohesive decision-support system. By combining LangChain for textual reasoning, LangGraph for workflow orchestration, and Python visualization tools, we achieve an end-to-end stock analysis pipeline.

Future work includes:

- Expanding to real-time data streams.
- Improving headline parsing with advanced summarizers.
- Integrating predictive models for stock trend forecasting.