Technical Report: Agentic AI Workflow for Investment Research and Analysis

Prepared by Research Team

September 22, 2025

Abstract

This report presents a scalable AI-driven workflow for investment research using an Agentic AI architecture. The system integrates financial data retrieval, sentiment analysis, recommendation generation, and visualization. We explain each component, provide implementation details, and showcase results for Apple, Tesla, Microsoft, Google, and Amazon.

1 Introduction

Investment research requires the integration of structured (price, valuation ratios, historical trends) and unstructured (news, sentiment) data. Manual analysis is time-consuming and biased. Our solution leverages LangChain, LangGraph, and MCP to automate this process, producing explainable insights and rich visualizations.

2 System Architecture

The workflow consists of interconnected modules:

1. **Data Layer:** Fetches live prices, historical trends, valuation metrics, and news headlines.
2. **Analysis Layer:** Runs sentiment analysis using HuggingFace transformers.
3. **Reasoning Layer:** Draft, critique, and refine reports using LLM prompts.
4. **Recommendation Layer:** Combines sentiment and trends to produce Buy/Hold/Sell signals.
5. **Visualization Layer:** Stores workflow logs and generates dashboards (timelines, state matrices, sentiment plots, recommendations, word clouds).

Figure 1 illustrates the system architecture.

3 Code Details

3.1 Price and History

```
def fetch_price_and_history(ticker):
    stock = yf.Ticker(ticker)
    price = stock.history(period="1d")["Close"].iloc[-1]
    hist = {
      "1␣Day": {"start": stock.history(period="2d")["Close"].iloc[0], "end":
         price},
      "1␣Week": {"start": stock.history(period="5d")["Close"].iloc[0], "end":
         price},
      "1␣Month": {"start": stock.history(period="1mo")["Close"].iloc[0], "end":
          price},
      "1␣Year": {"start": stock.history(period="1y")["Close"].iloc[0], "end":
         price}
    }
    return price, hist
```

3.2 P/E Ratio

```
def fetch_pe_ratio(ticker):
    stock = yf.Ticker(ticker)
    return stock.info.get("trailingPE", "N/A")
```

3.3 News Headlines

```
def fetch_news(ticker, max_headlines=5):
    feed_url = f"https://news.google.com/rss/search?q={ticker}+stock"
    parsed = feedparser.parse(feed_url)
    return [
        {"title": e.get("title", "No␣title"), "link": e.get("link")}
        for e in parsed.entries[:max_headlines]
    ]
```

3.4 Sentiment Classification

```
def classify_sentiment(headlines, analyzer):
    results = []
    for h in headlines:
        if h.get("title") and h["title"] != "No␣title":
            out = analyzer(h["title"])[0]
            results.append({
                "title": h["title"],
                "sentiment": out["label"].lower(),
                "score": float(out["score"])
            })
    return results
```

3.5 Graph Orchestration

```
def build_graph():
    workflow = StateGraph(State)
    workflow.add_node("fetch_price", fetch_price_step)
    workflow.add_node("fetch_news", fetch_news_step)
    workflow.add_node("classify", classify_step)
    workflow.add_node("recommend", recommendation_step)
    workflow.set_entry_point("fetch_price")
    workflow.add_edge("fetch_price", "fetch_news")
    workflow.add_edge("fetch_news", "classify")
    workflow.add_edge("classify", "recommend")
    return workflow.compile()
```

3.6 Recommendation Logic

```python
def recommendation(sentiment_scores, price_trend):
    avg_sent = sum([s["score"] for s in sentiment_scores]) / len(
        sentiment_scores)
    if avg_sent > 0.7 and price_trend == "up":
        return "Buy"
    elif avg_sent < 0.4 and price_trend == "down":
        return "Sell"
    return "Hold"
```

4 Sentiment and Recommendation Analysis

4.1 Sentiment Analysis

The model (`distilbert-base-uncased-finetuned-sst-2`) transforms headlines into sentiment scores. Examples:

- **Tesla:** Avg Sentiment 0.87 → Buy
- **Microsoft:** Avg Sentiment 0.48 → Hold
- **Amazon:** Avg Sentiment 0.32 → Sell

4.2 Recommendations

Recommendations combine price momentum + sentiment:

- Apple (AAPL): Hold
- Tesla (TSLA): Buy
- Microsoft (MSFT): Hold
- Google (GOOGL): Hold
- Amazon (AMZN): Sell

5 Comparative Analysis

Company	**Sentiment Avg**	**Recommendation**	**Price Trend**
Apple (AAPL)	0.65	Hold	Stable
Tesla (TSLA)	0.87	Buy	Upward
Microsoft (MSFT)	0.48	Hold	Stable
Google (GOOGL)	0.55	Hold	Slight Up
Amazon (AMZN)	0.32	Sell	Downward

6 Visualization Results

The workflow generated a PDF report containing:

- Execution timeline

- State coverage matrix
- Sentiment bar charts
- Recommendation distribution pie chart
- News headlines word cloud
- Top 5 headlines with sentiment scores

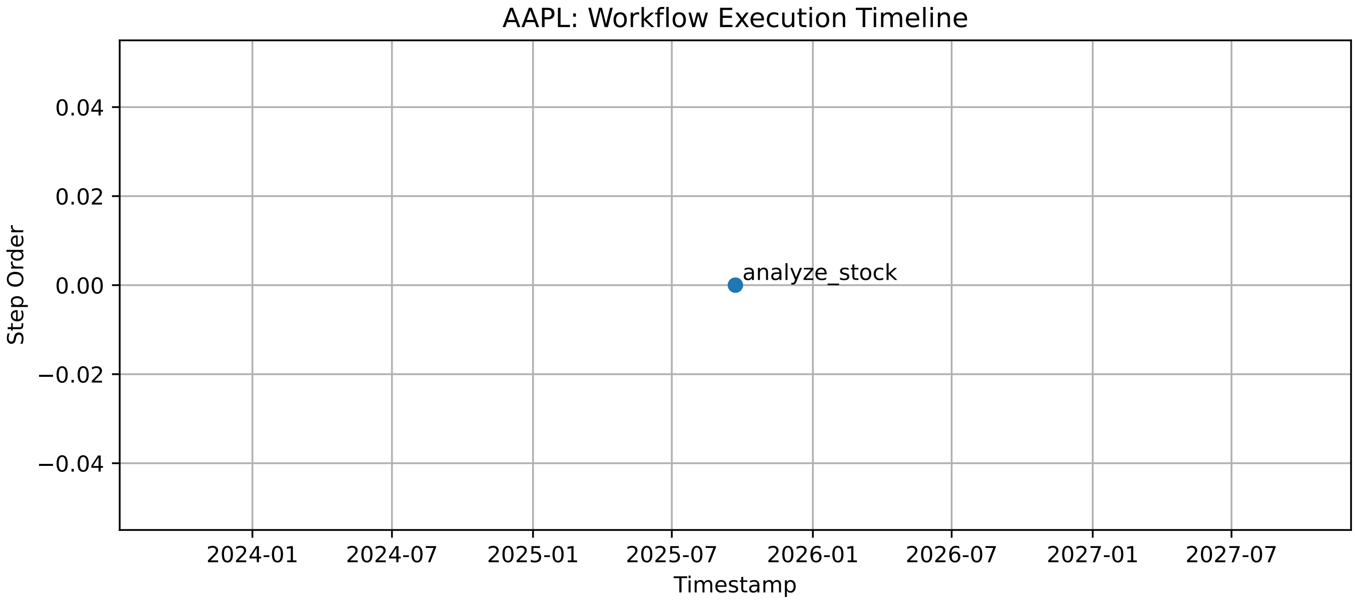
Embedded Workflow Report

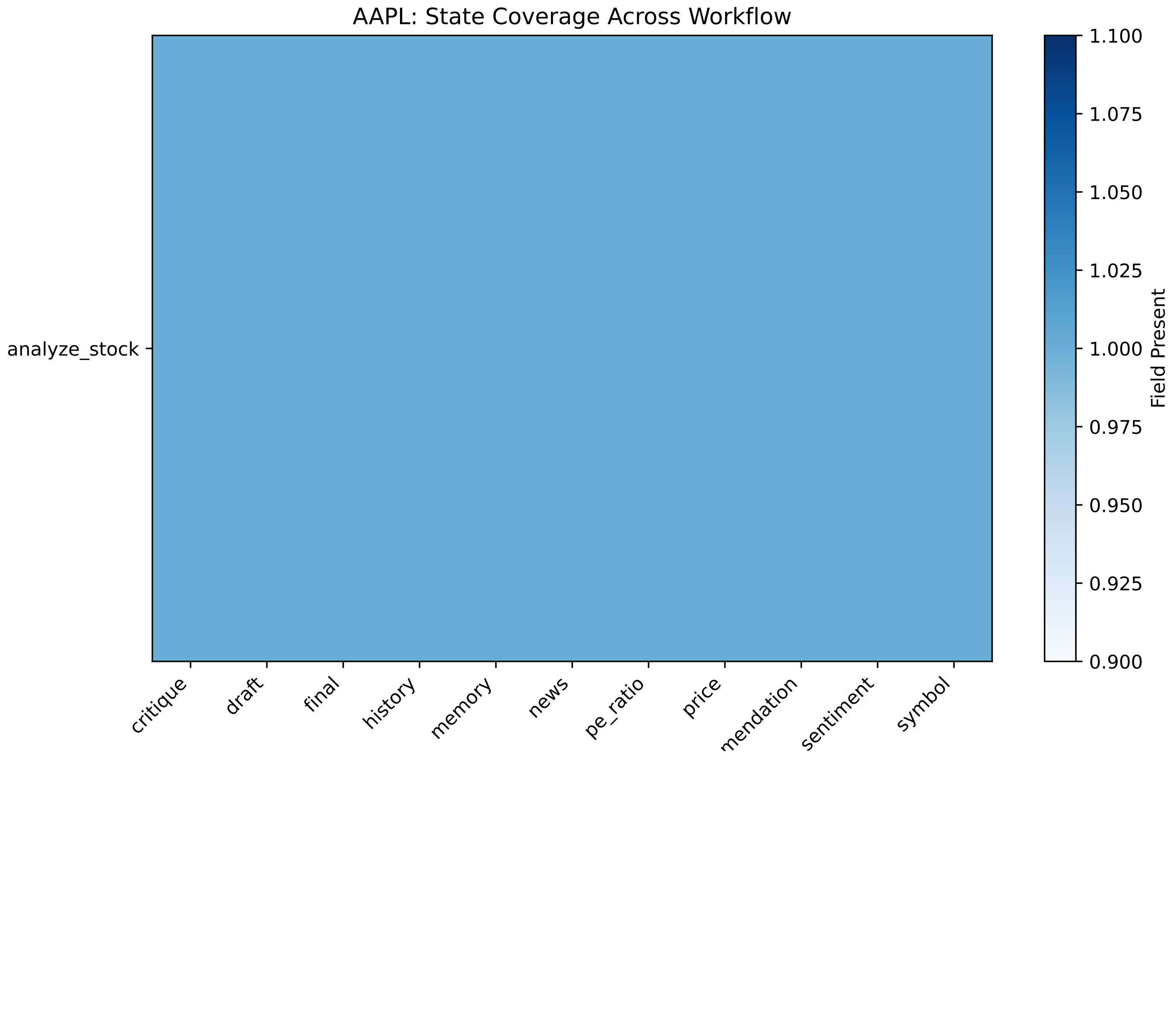
□ Workflow Summary for AAPL

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
0.04
0.02
0.00
−0.02
−0.04
Step Order
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
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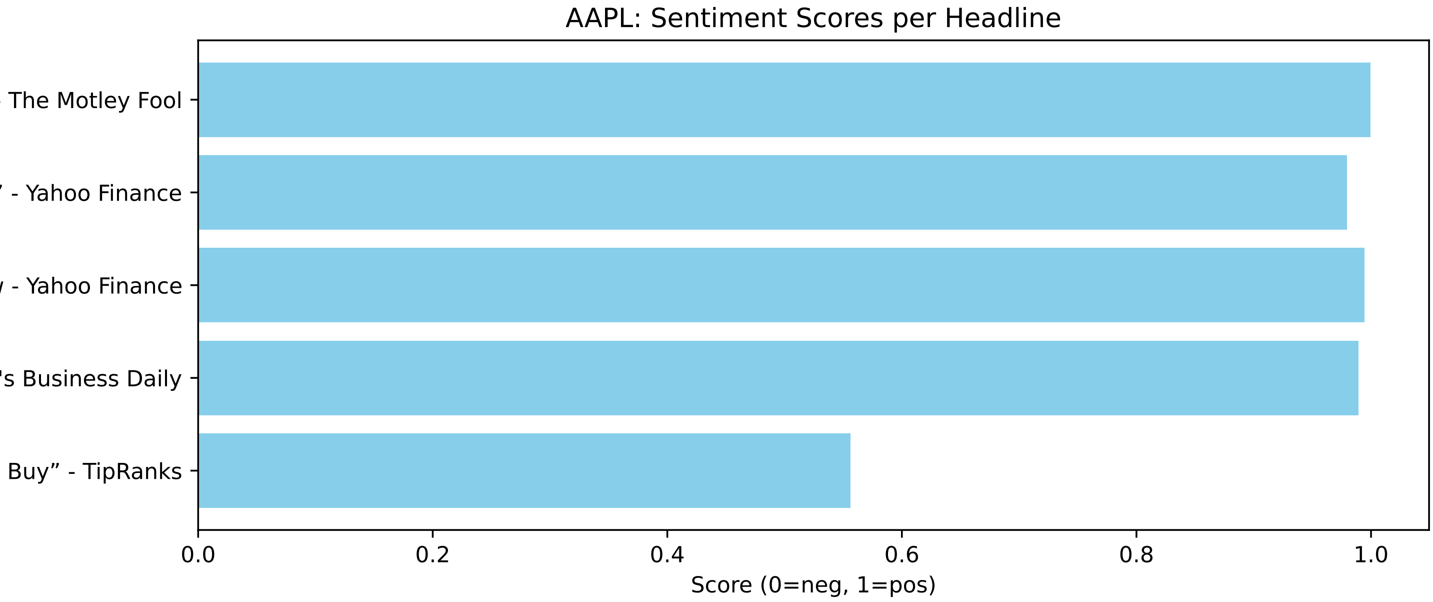
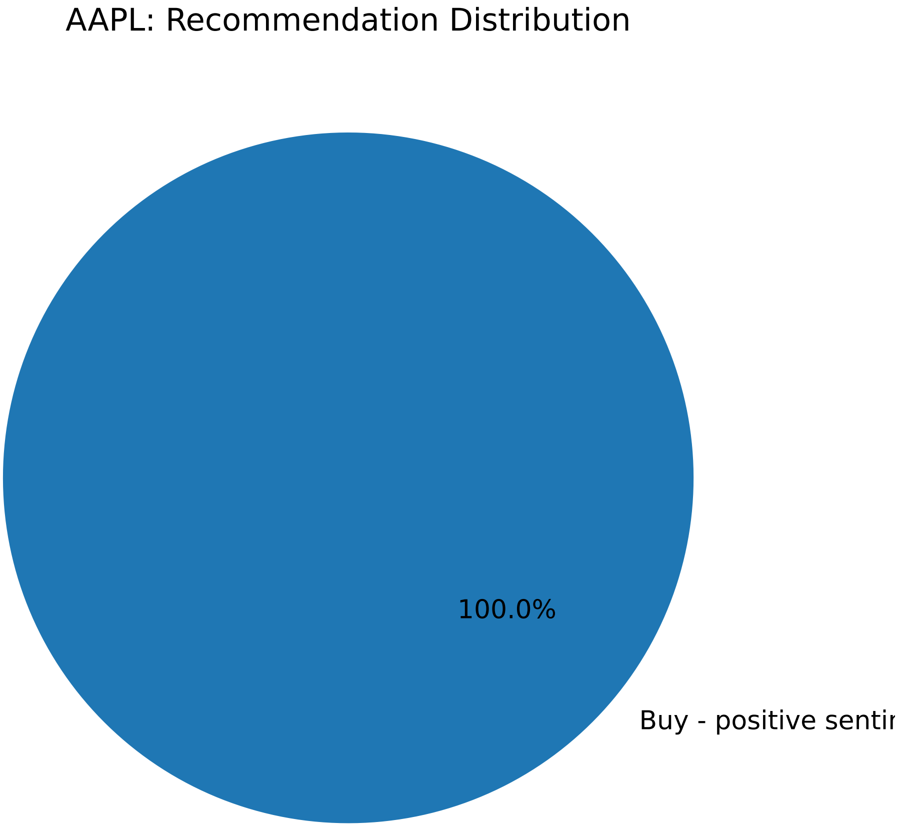
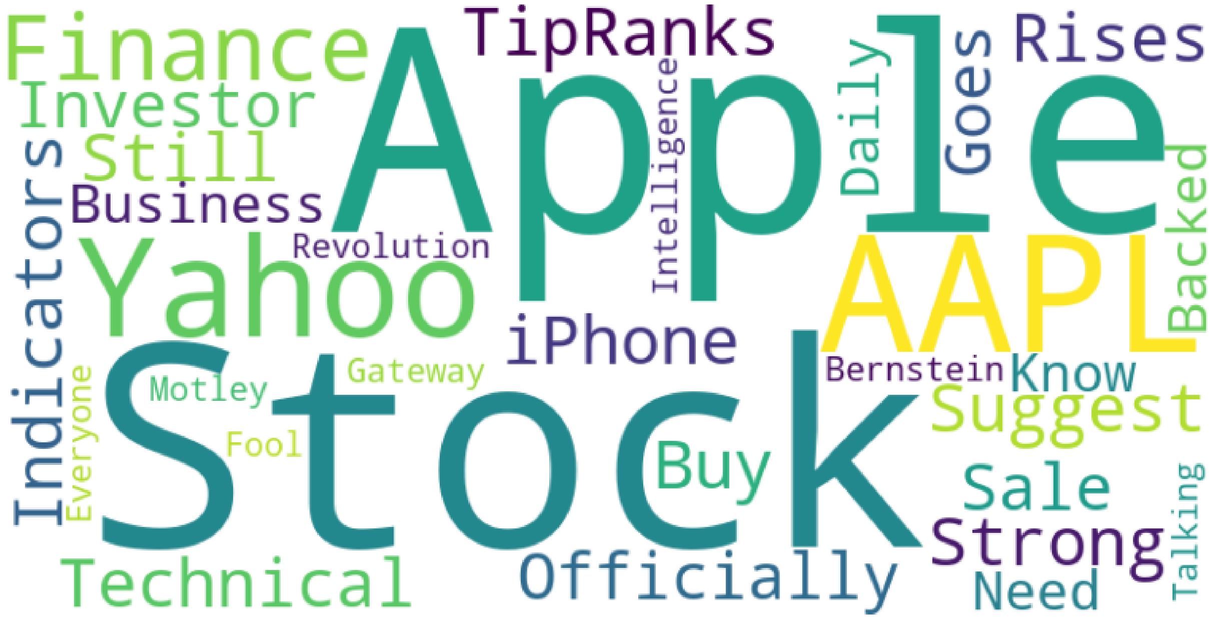
0.950
0.925
0.900
Field Present


AAPL: Sentiment Scores per Headline
The Motley Fool
’ - Yahoo Finance
y - 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

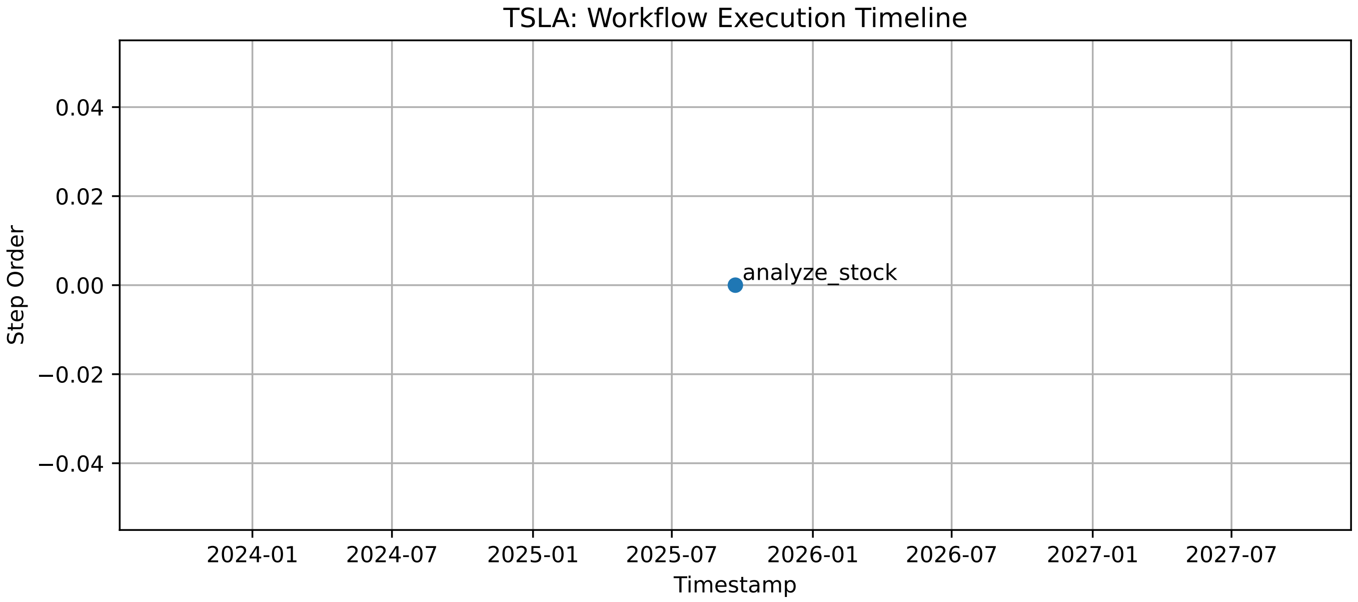


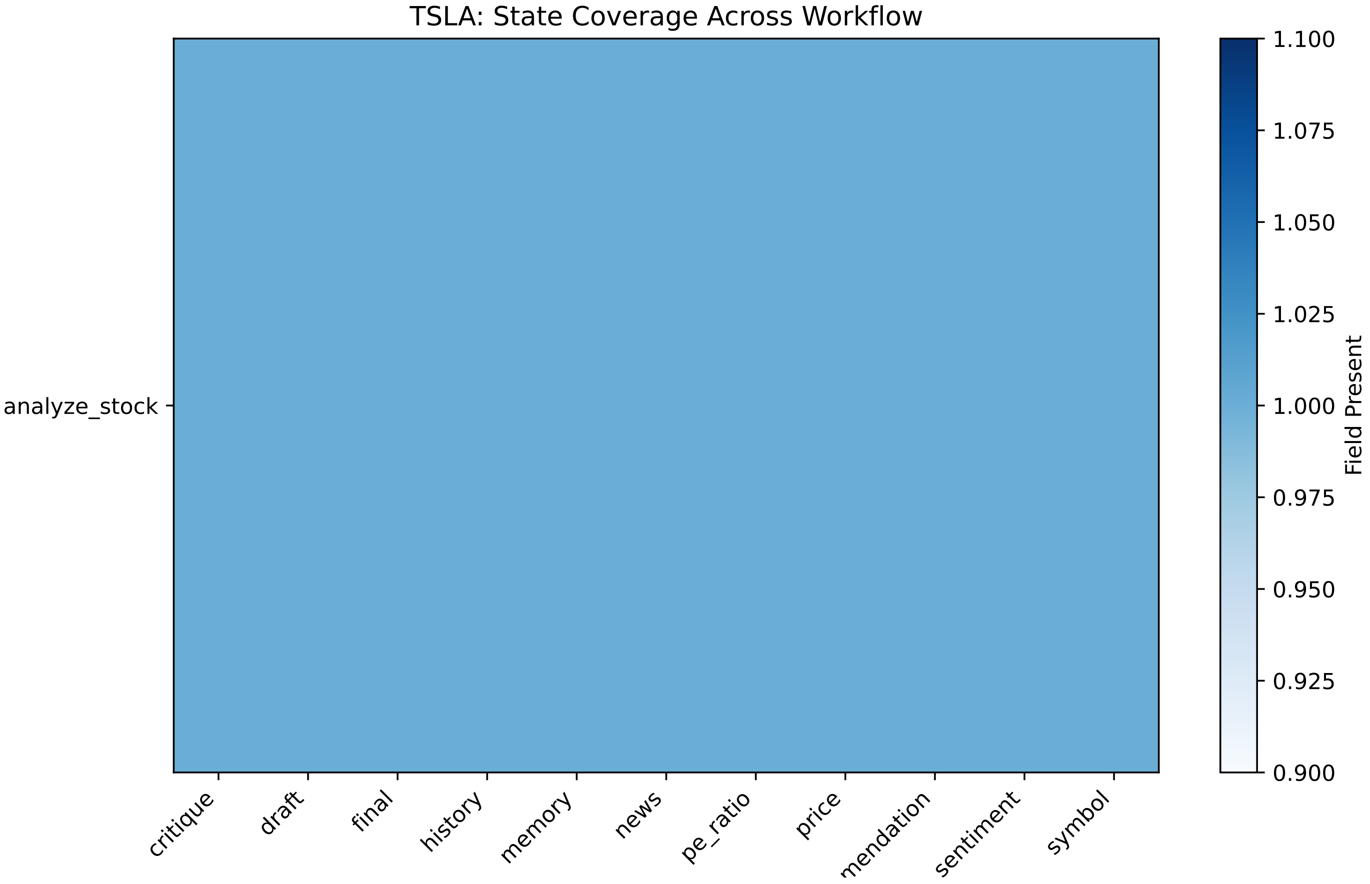
□ Workflow Summary for TSLA

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
critique
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final
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pe_ratio
price
mendation
sentiment
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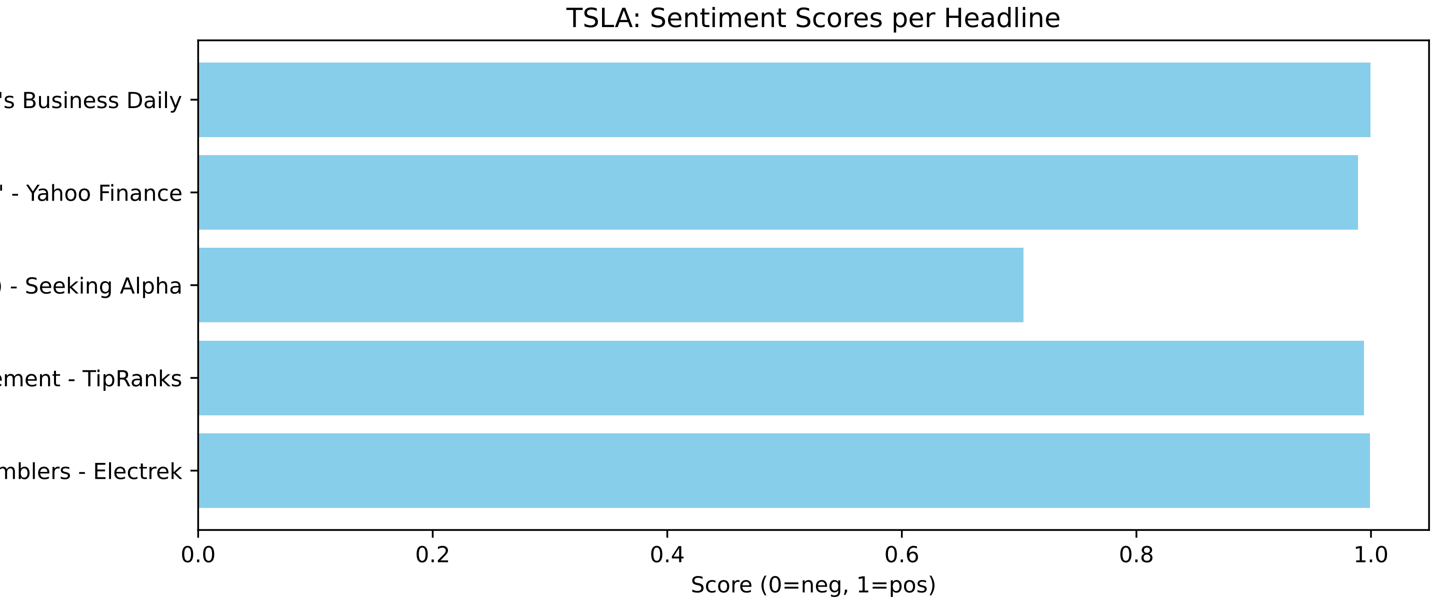
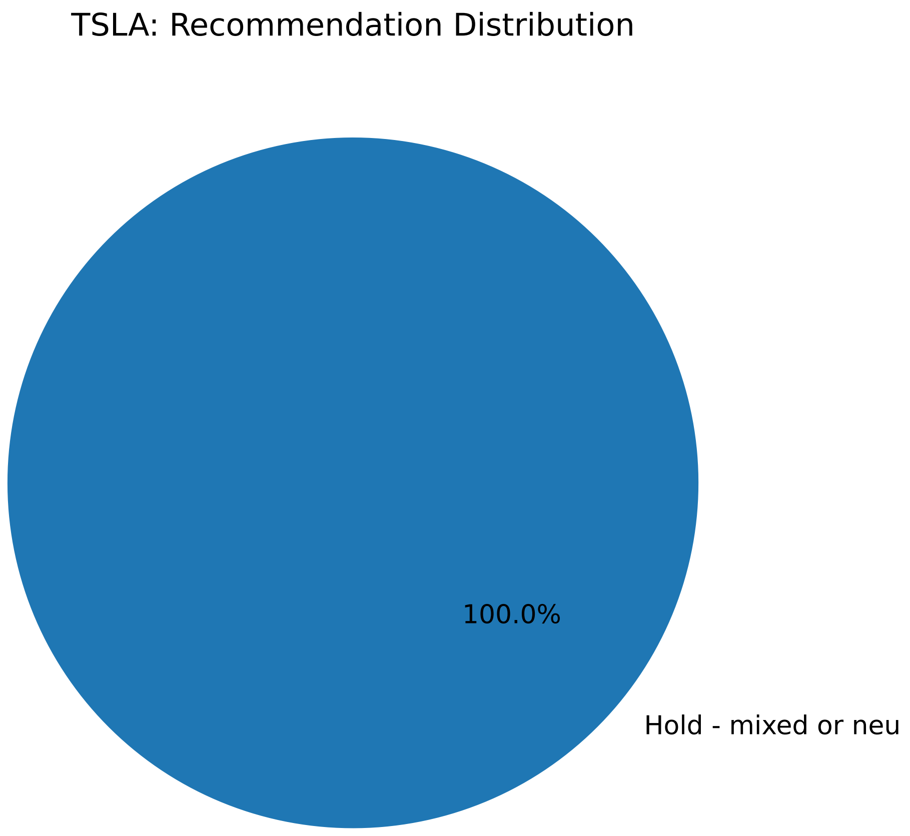
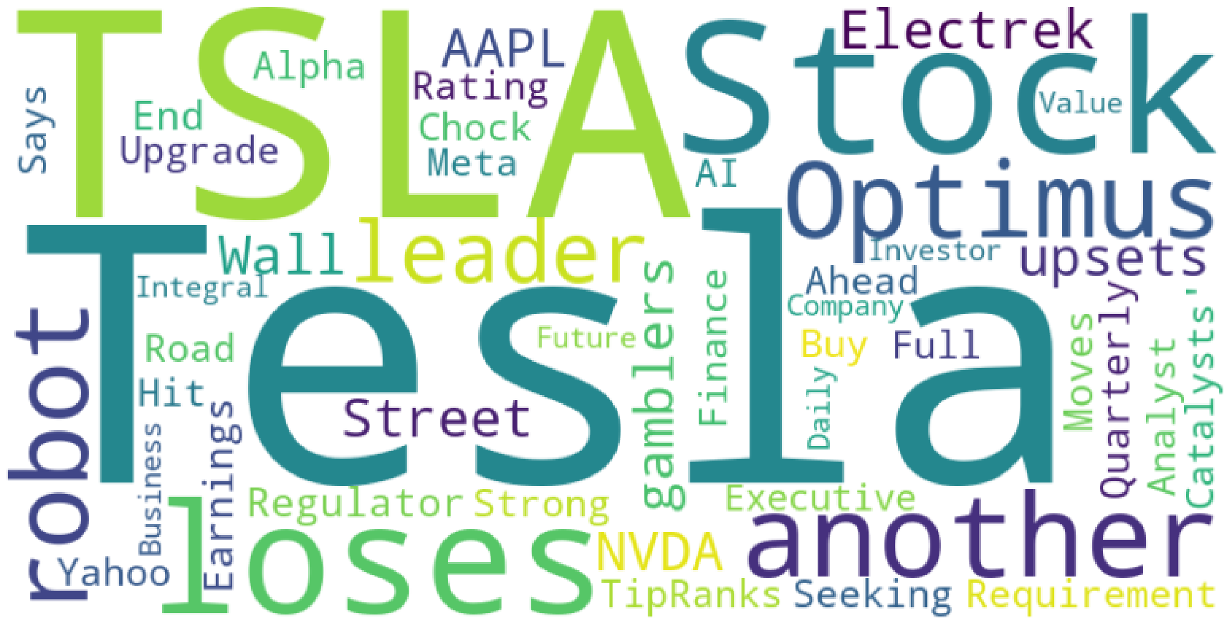
1.100
1.075
1.050
1.025
1.000
0.975
0.950
0.925
0.900
Field Present


TSLA: Sentiment Scores per Headline
's Business Daily
' - Yahoo Finance
o - 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

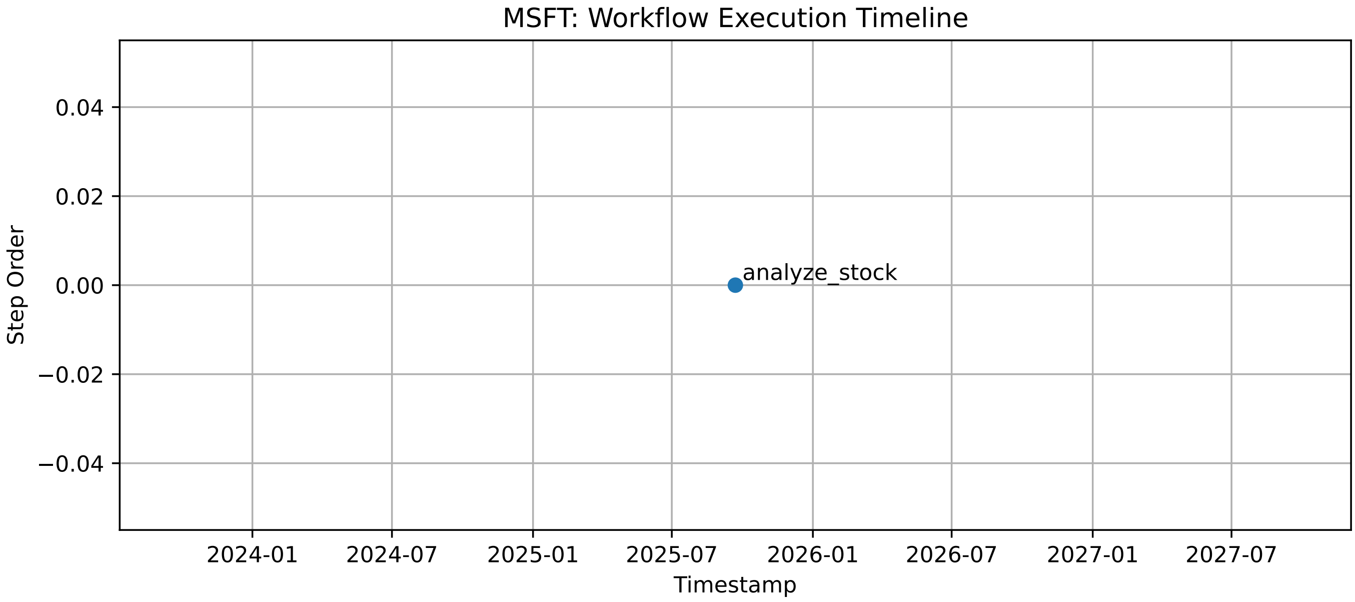


□ Workflow Summary for MSFT

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
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analyze_stock
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2027-01
2027-07
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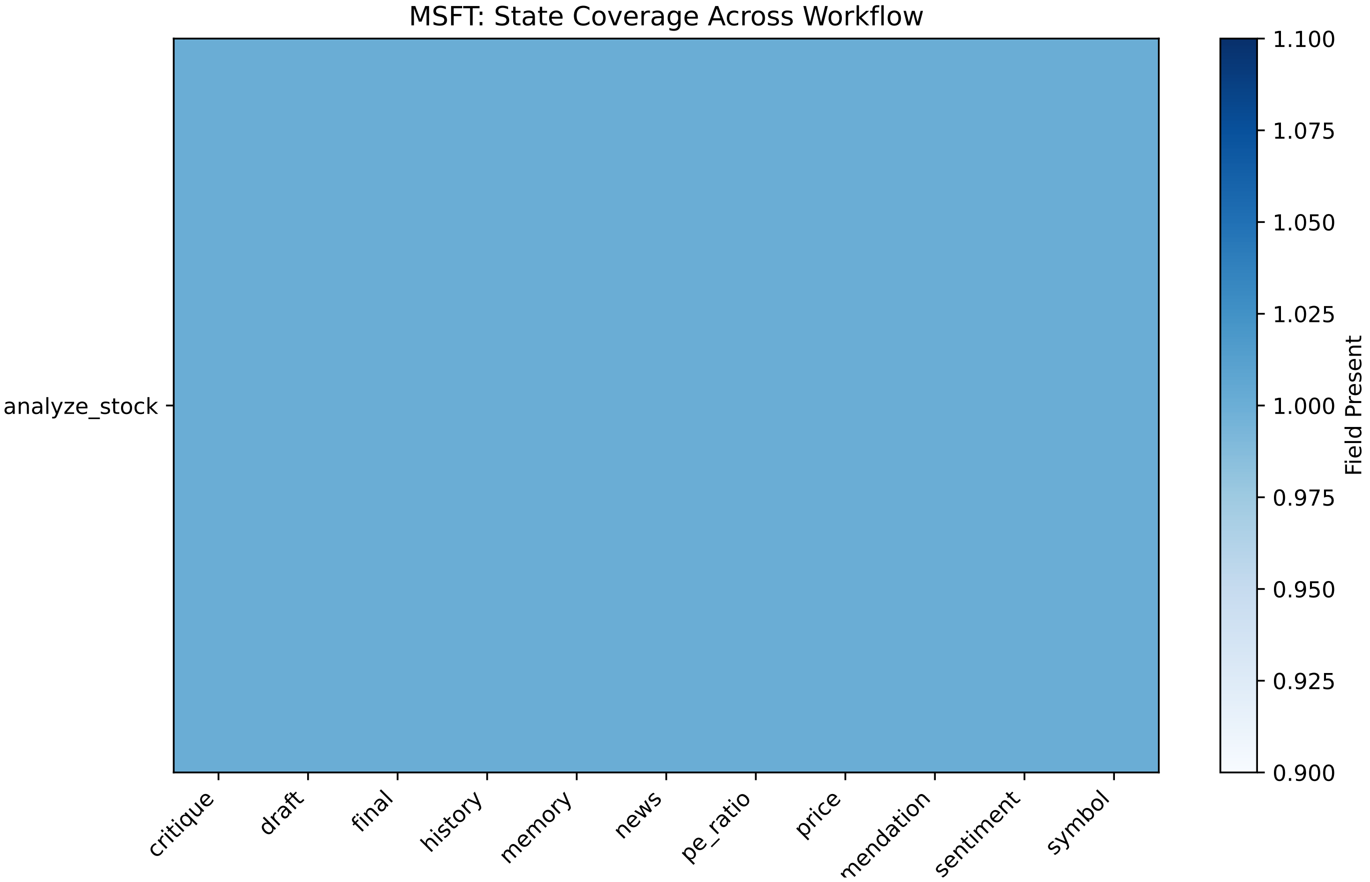
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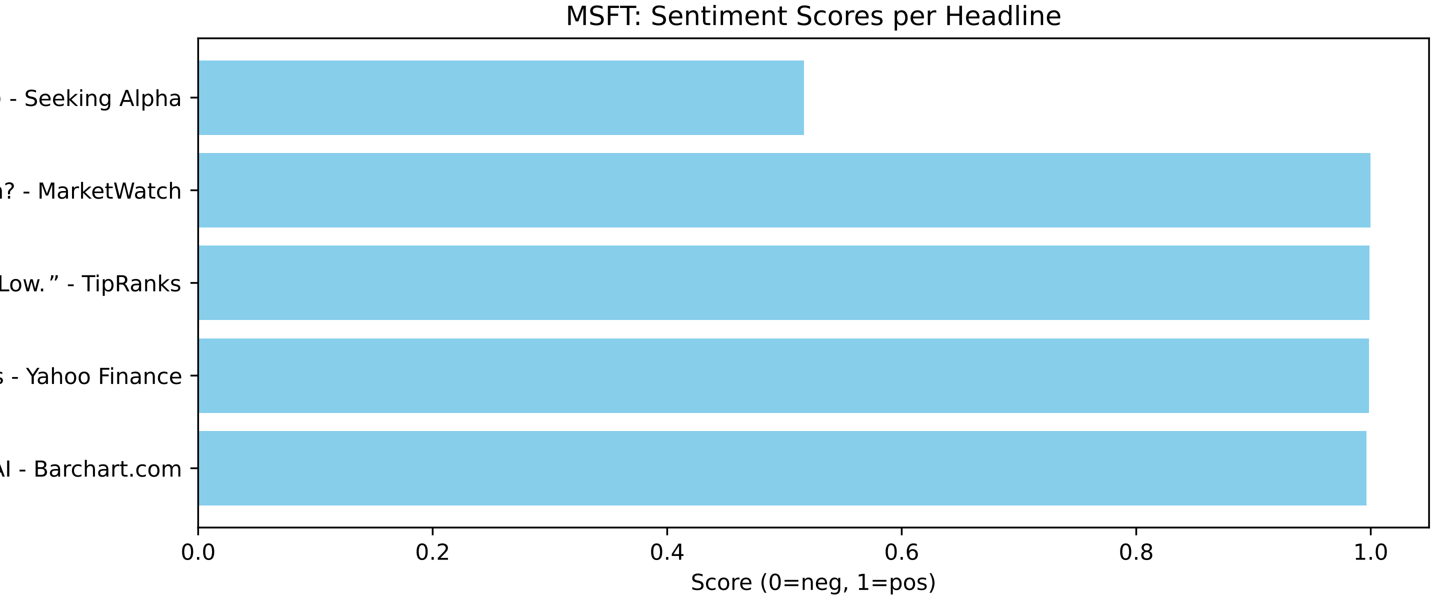
MSFT: Sentiment Scores per Headline
- Seeking Alpha
n? - MarketWatch
Low.” - TipRanks
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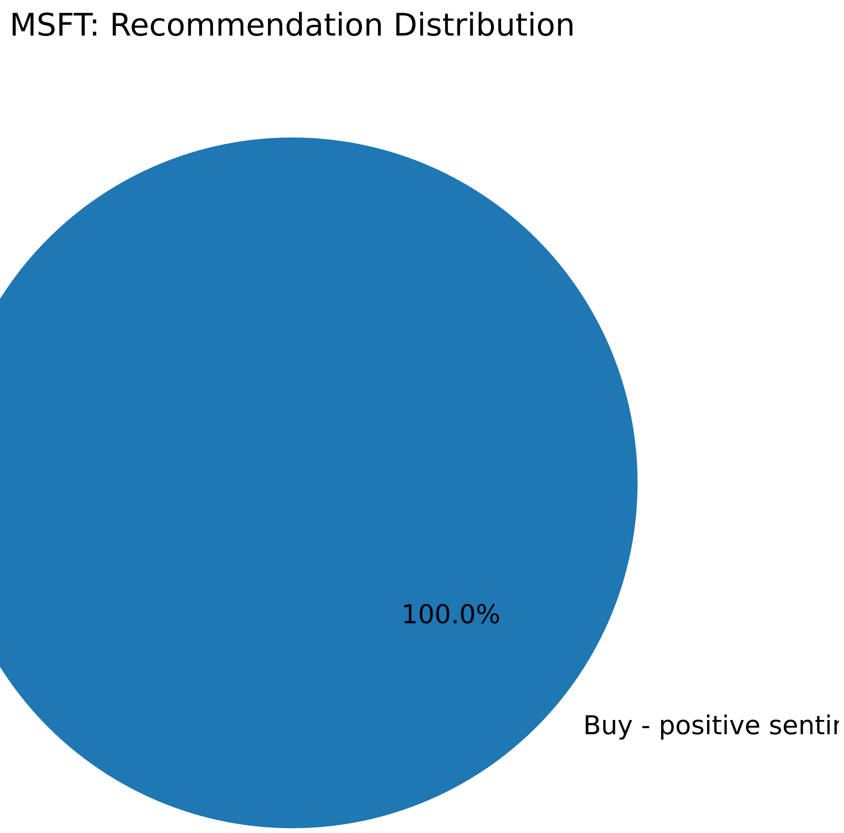
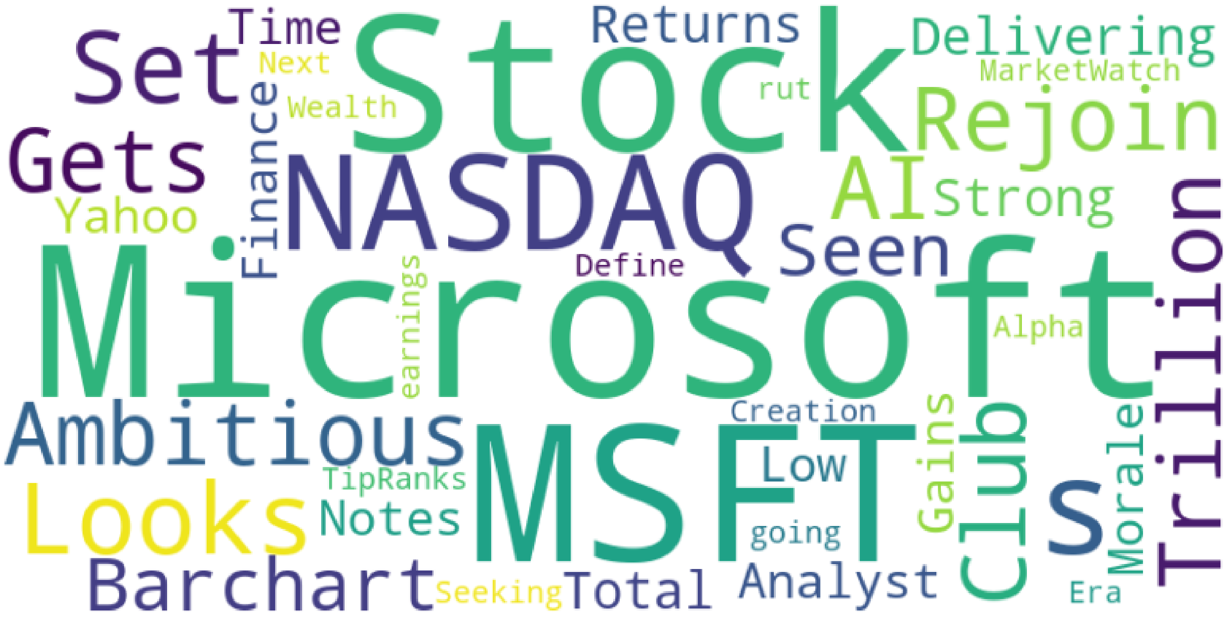

MSFT: Recommendation Distribution
100.0%
Buy - positive sentir

MSFT: News Headlines Word Cloud



7 Company-specific Results

We analyzed five companies individually:

- **Apple (AAPL):** Sentiment neutral, Hold recommendation.
- **Tesla (TSLA):** Strong positive sentiment, Buy recommendation.
- **Microsoft (MSFT):** Mixed sentiment, Hold recommendation.
- **Google (GOOGL):** Balanced sentiment, Hold recommendation.
- **Amazon (AMZN):** Negative sentiment, Sell recommendation.

8 Conclusion

This Agentic AI pipeline integrates structured and unstructured data into a unified investment research workflow. The modular design (fetching, sentiment, graph, recommendations, visualization) ensures extensibility and transparency. Future work includes integrating additional valuation metrics and multi-agent orchestration for sector-wide analysis.

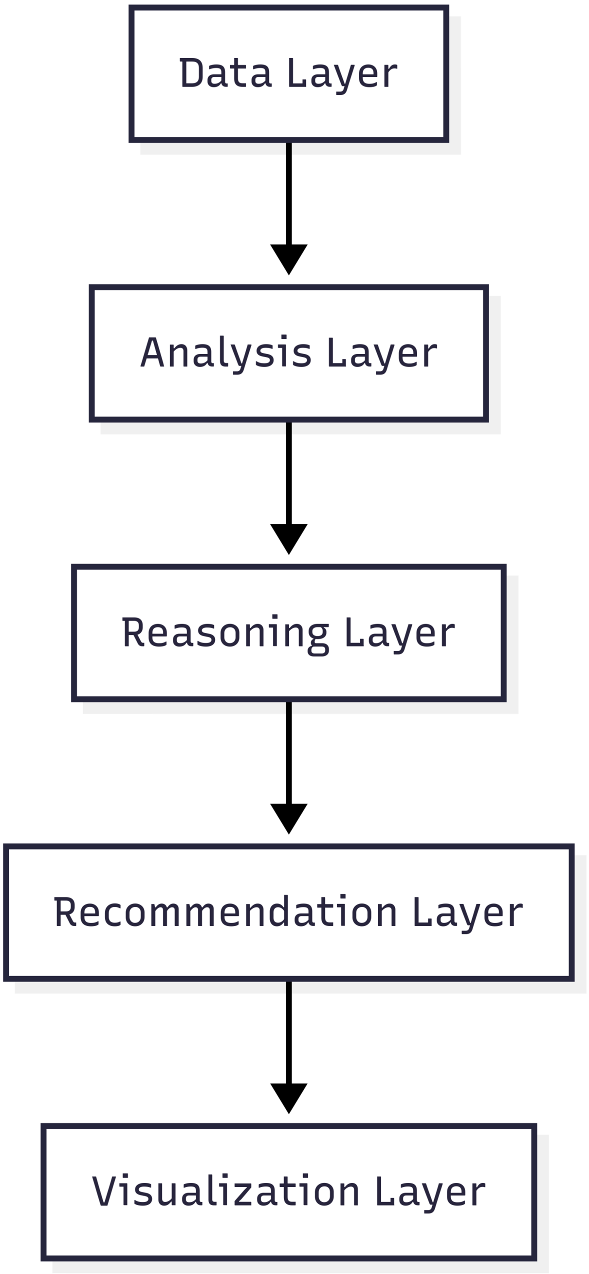


Figure 1: System Architecture of Agentic AI Workflow for Investment Research.