```
# ==========================================================
#  Multi-Agent Financial Analysis System (Annotated Colab Demo)
# ==========================================================

# --- 1. Imports and Setup ------------------------------------
import yfinance as yf
import pandas as pd
import matplotlib.pyplot as plt
from datetime import datetime, timedelta, timezone
import nltk
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from textblob import TextBlob
import requests, json, re
from typing import Dict, Any

# Download tokenizer resources once per runtime
nltk.download('punkt')
nltk.download('punkt_tab')
nltk.download('stopwords')

# --- 2. Helper: Date function (UTC-safe) ---------------------
def utc_now_iso():
    """Return current UTC time in ISO format (no deprecation)."""
    return datetime.now(timezone.utc).isoformat()

# --- 3. Finance Agent ----------------------------------------
class FinancialsAgent:
    """Fetches key company metrics and plots price trends."""
    def act(self, ticker: str) -> Dict[str, Any]:
        info = yf.Ticker(ticker).info
        data = yf.download(ticker, period="1y", auto_adjust=True)
        plt.figure(figsize=(10,4))
        plt.plot(data.index, data['Close'])
        plt.title(f"{ticker} Close Price")
        plt.xlabel("Date")
        plt.ylabel("Close")
        plt.show()
        return {
            "type": "financials",
            "latest_price": float(data['Close'].iloc[-1]),
            "marketCap": info.get("marketCap"),
            "trailingPE": info.get("trailingPE"),
            "forwardPE": info.get("forwardPE"),
            "dividendYield": info.get("dividendYield"),
            "beta": info.get("beta")
        }

# --- 4. News Agent -------------------------------------------
class NewsAgent:
    """Fetches recent news headlines and performs sentiment."""
    def act(self, ticker: str) -> Dict[str, Any]:
        # Using a free RSS feed (no API key)
        url = f"https://news.google.com/rss/search?q={ticker}+stock"
        resp = requests.get(url)
        titles = re.findall(r"<title>(.*?)</title>", resp.text)
        processed = []
        for t in titles[2:7]:  # Skip feed header, limit to 5
            sent = TextBlob(t).sentiment.polarity
            cat = "earnings" if "earn" in t.lower() else "other"
            processed.append({"headline": t, "sentiment": round(sent,4), "category": cat})
        return {"type": "news", "data": processed}

# --- 5. Evaluator Agent --------------------------------------
class EvaluatorAgent:
    """Assesses sentiment balance and confidence."""
    def evaluate(self, news_data):
        sentiments = [a['sentiment'] for a in news_data]
        avg_sent = sum(sentiments)/len(sentiments) if sentiments else 0
        conclusion = "Cautiously Positive" if avg_sent > 0 else "Neutral/Negative"
        notes = ["News sentiment leans positive"] if avg_sent > 0 else ["News sentiment mixed or negative"]
        return {"score": 100 if avg_sent>0 else 60, "conclusion": conclusion, "notes": notes}

# --- 6. Investment Research Agent (Coordinator) --------------
class InvestmentResearchAgent:
    """Combines Finance + News + Evaluation + Memory."""
```

```python
    def __init__(self):
        self.fin_agent = FinancialsAgent()
        self.news_agent = NewsAgent()
        self.eval_agent = EvaluatorAgent()
        self.memory = {}  # simple dict memory

    def run_full(self, ticker: str) -> Dict[str, Any]:
        print(f"\n{'='*60}\nRunning full analysis for {ticker} ...")
        results = {}

        # Step 1: Financials
        fin = self.fin_agent.act(ticker)
        results['financials'] = fin

        # Step 2: News + Sentiment
        news = self.news_agent.act(ticker)
        results['news'] = news['data']

        # Step 3: Evaluation
        eval_res = self.eval_agent.evaluate(news['data'])
        results['evaluation'] = eval_res

        # Step 4: Summary Draft
        draft = f"""
Investment Research Draft for {ticker}
Generated: {utc_now_iso()}

Latest price: {fin['latest_price']:.2f}

Key Financials:
- marketCap: {fin['marketCap']}
- trailingPE: {fin['trailingPE']}
- forwardPE: {fin['forwardPE']}
- dividendYield: {fin['dividendYield']}
- beta: {fin['beta']}

Recent News Highlights:
""" + "\n".join(
            [f"- [{a['category']}] {a['headline']} (sentiment={a['sentiment']})"
             for a in news['data']]
        ) + f"""

Preliminary conclusion: {eval_res['conclusion']}

[Evaluator Notes]
- {eval_res['notes'][0]}

Confidence Score: {eval_res['score']}/100
"""
        print("\n--- FINAL REPORT ---")
        print(draft)
        results['draft'] = draft

        # Step 5: Memory storage
        self.memory[ticker] = {
            "timestamp": utc_now_iso(),
            "summary": eval_res['conclusion']
        }
        print(f"\nMemory entries for {ticker}: {len(self.memory)}")
        return results

# --- 7. Run analysis for multiple tickers ---------------------
tickers = ["AAPL","TSLA","GOOG","NVDA","INTC","MSFT"]
ira = InvestmentResearchAgent()
all_results = {}
for t in tickers:
    all_results[t] = ira.run_full(t)

# --- 8. (Optional) Summary Table ------------------------------
summary = pd.DataFrame({
    t: {
        "latest_price": all_results[t]['financials']['latest_price'],
        "sentiment_score": all_results[t]['evaluation']['score'],
        "outlook": all_results[t]['evaluation']['conclusion']
    }
    for t in tickers
}).T
```
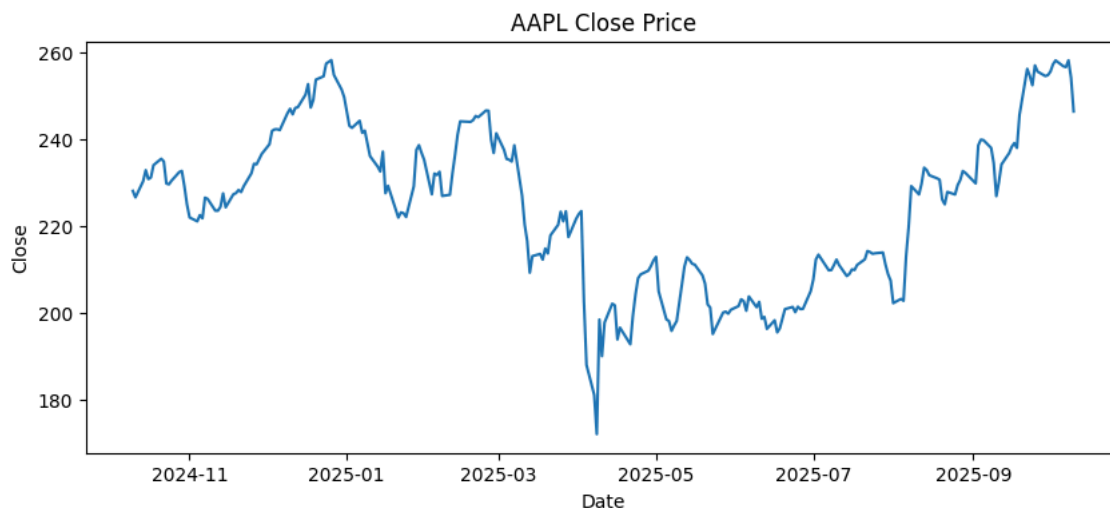
```
print("\n=== Summary of All Analyses ===")
display(summary)
```

```
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package punkt_tab to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt_tab.zip.
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.


============================================================
Running full analysis for AAPL ...
[********************100%***********************]  1 of 1 completed
```

AAPL Close Price


```
/tmp/ipython-input-83351720.py:41: FutureWarning: Calling float on a single element Series is deprecated and will raise a TypeError
  "latest_price": float(data['Close'].iloc[-1]),

--- FINAL REPORT ---

Investment Research Draft for AAPL
Generated: 2025-10-10T19:04:50.467319+00:00

Latest price: 246.28

Key Financials:
- marketCap: 3654891077632
- trailingPE: 37.42857
- forwardPE: 29.636581
- dividendYield: 0.41
- beta: 1.094

Recent News Highlights:
- [other] Apple Inc. (AAPL) Stock Price, News, Quote &amp; History - Yahoo Finance (sentiment=0.0)
- [other] Should You Buy Apple Stock Before Oct. 30? - The Motley Fool (sentiment=0.6)
- [other] Apple (NASDAQ: AAPL) Stock Price Prediction and Forecast 2025-2030 (Oct 2025) - 24/7 Wall St. (sentiment=0.0)
- [other] Analyst Says Apple (AAPL) Is Going to Make a New All-Time High - Yahoo Finance (sentiment=0.1482)
- [other] Apple Inc. Stock (AAPL) Opinions on iPhone 16 Preorders and Analyst Downgrades - Quiver Quantitative (sentiment=0.0)

Preliminary conclusion: Cautiously Positive

[Evaluator Notes]
- News sentiment leans positive

Confidence Score: 100/100


Memory entries for AAPL: 1

============================================================
Running full analysis for TSLA ...
[********************100%***********************]  1 of 1 completed
```
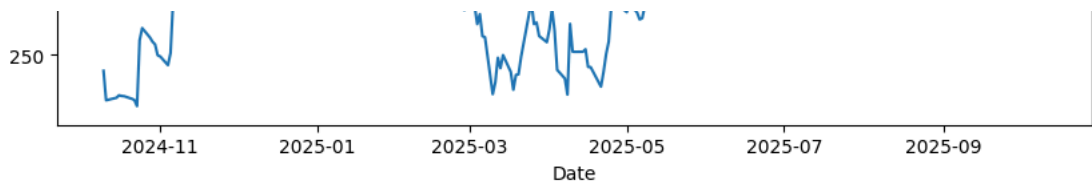
TSLA Close Price

```
/tmp/ipython-input-83351720.py:41: FutureWarning: Calling float on a single element Series is deprecated and will raise a TypeError
  "latest_price": float(data['Close'].iloc[-1]),

--- FINAL REPORT ---

Investment Research Draft for TSLA
Generated: 2025-10-10T19:04:51.960934+00:00

Latest price: 418.15

Key Financials:
- marketCap: 1390411907072
- trailingPE: 245.97058
- forwardPE: 129.05864
- dividendYield: None
- beta: 2.086

Recent News Highlights:
- [other] Tesla analysts are expecting the stock to go Plaid Mode soon - Teslarati (sentiment=0.0)
- [other] Tesla Stock Is on Edge as Reviews Land, Edmunds Says the New Model Y 'Is the Big Surprise' - TipRanks (sentiment=0.0682)
- [other] Narratives Can Fly, But Numbers Don't Lie: My Tesla Reckoning (NASDAQ:TSLA) - Seeking Alpha (sentiment=0.8)
- [other] Tesla Stock (TSLA) Slides as Traffic Light Dodging Cars Face New Safety Probe - TipRanks (sentiment=0.2682)
- [other] Why I'm Dumping Tesla Stock (NASDAQ:TSLA) - Seeking Alpha (sentiment=0.0)

Preliminary conclusion: Cautiously Positive

[Evaluator Notes]
- News sentiment leans positive

Confidence Score: 100/100


Memory entries for TSLA: 2

============================================================
Running full analysis for GOOG ...
[********************100%***********************]  1 of 1 completed
```
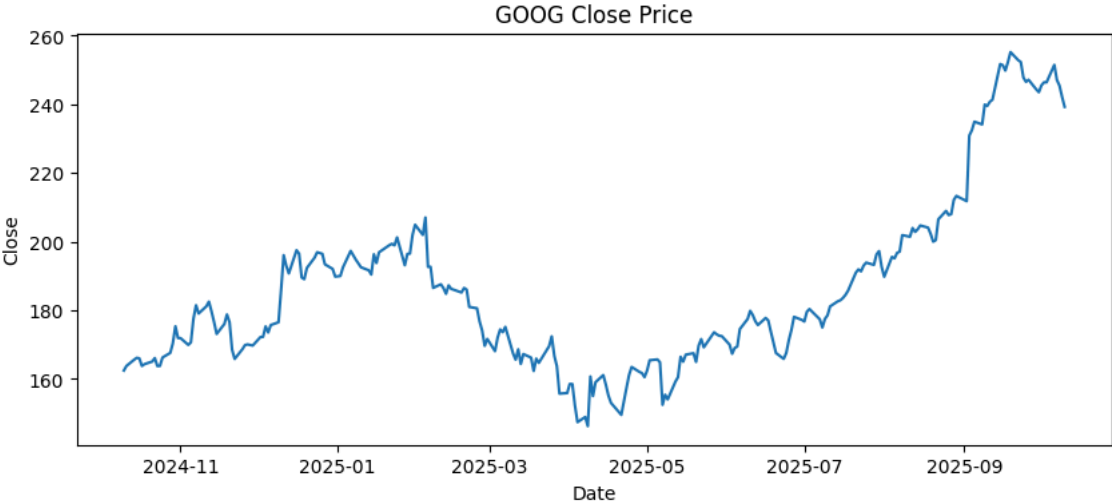
GOOG Close Price


```
/tmp/ipython-input-83351720.py:41: FutureWarning: Calling float on a single element Series is deprecated and will raise a TypeError
  "latest_price": float(data['Close'].iloc[-1]),

--- FINAL REPORT ---

Investment Research Draft for GOOG
Generated: 2025-10-10T19:04:53.332812+00:00

Latest price: 239.28

Key Financials:
- marketCap: 2889375547392
- trailingPE: 25.53682
- forwardPE: 26.735195
- dividendYield: 0.35
- beta: 1.0
```

Recent News Highlights:
- [other] Google Launches Gemini Enterprise As Tech Giants Race To Offer AI Agents - Investor's Business Daily (sentiment=0.0)
- [other] Alphabet's stock could soar if Google's Gemini AI gets a TikTok-style makeover - MarketWatch (sentiment=0.0)
- [other] Google's stock is up 70%: Can the rally last? - Yahoo Finance (sentiment=0.0)
- [other] Alphabet: Undervalued Mag-7 Stock Hiding In Plain Sight (NASDAQ:GOOG) - Seeking Alpha (sentiment=-0.2143)
- [other] Is Alphabet Stock Still a Buy Below $250? - The Motley Fool (sentiment=0.6)

Preliminary conclusion: Cautiously Positive
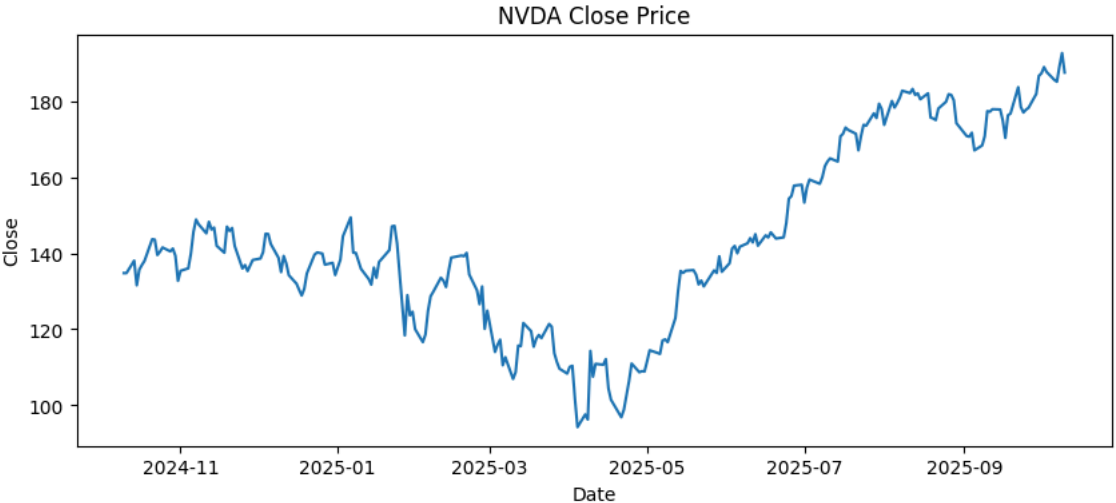
[Evaluator Notes]
- News sentiment leans positive

Confidence Score: 100/100

Memory entries for GOOG: 3

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Running full analysis for NVDA ...
[********************100%**********************] 1 of 1 completed

NVDA Close Price

/tmp/ipython-input-83351720.py:41: FutureWarning: Calling float on a single element Series is deprecated and will raise a TypeError
  "latest_price": float(data['Close'].iloc[-1]),

--- FINAL REPORT ---

Investment Research Draft for NVDA
Generated: 2025-10-10T19.04.54.472307+00.00

Latest price: 187.45

Key Financials:
- marketCap: 4564405714944
- trailingPE: 53.563717
- forwardPE: 45.50316
- dividendYield: 0.02
- beta: 2.123

Recent News Highlights:
- [other] AMD & Nvidia (NVDA) Stocks Fall on Senate AI Export Bill - TipRanks (sentiment=0.0)
- [other] Nvidia Stock Spikes To Record High On UAE Trade Approval - Investor's Business Daily (sentiment=0.08)
- [other] Why Nvidia (NVDA) Stock Is Trading Lower Today - Yahoo Finance (sentiment=0.0)
- [other] Prediction: This Unstoppable Stock Will Join Nvidia, Microsoft, Apple, and Alphabet in the $3 Trillion Club Before 2028 -
- [other] NVDA: Nvidia Stock Breaks New Record After Cantor Hikes Price Target to $300 - Yahoo Finance (sentiment=0.1364)

Preliminary conclusion: Cautiously Positive

[Evaluator Notes]
- News sentiment leans positive

Confidence Score: 100/100