■ University of San Diego – AAI-520-IN3

Final Project Report: Multi-Agent Investment Research System

Team: Richa Arun Kumar Jha · Raminder Singh · Samiksha Kodgire

Instructor: Dr. Premkumar Chithaluru

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Abstract

This project presents a multi-agent financial research system integrating quantitative and qualitative analyses. Agents autonomously collect, process, and summarize live financial data for six major technology stocks—AAPL, GOOG, TSLA, AMZN, NVDA, and MSFT. The architecture combines traditional finance analytics (SMA, RSI, Volatility) with NLP-based sentiment and LLM-driven summarization, offering an automated investment research workflow.

1. Project Overview

The developed system demonstrates a modular, autonomous, and data-driven research pipeline that integrates AI-based agents to analyze real-time financial markets. It leverages large language models and financial APIs to deliver intelligent insights that emulate professional investment research processes.

2. System Architecture and Workflow Patterns

The architecture consists of three major interconnected workflows: 1. **Data & Technical Analysis** – Fetches market data, computes SMA20, SMA50, RSI, and visualizes price trends. 2. **Risk & Sentiment Evaluation** – Quantifies volatility, drawdown, and performs sentiment analysis using DistilBERT. 3. **Decision & Summarization** – Routes news, correlates sentiment with price trends, recommends portfolio allocations, and summarizes findings using Microsoft's Phi-3 Mini model.

3. Agent Functions and Interactions

Agent	Functionality	Implementation
DataAgent	Fetches and preprocesses OHLC market data	yfinance API
TechnicalAgent	Computes SMA, RSI, and trend signals	pandas, numpy
RiskAgent	Evaluates volatility, drawdown, and risk score	Custom risk function
NewsAgent	Retrieves latest financial headlines	requests, NewsAPI
SentimentAgent	Performs sentiment classification	DistilBERT via transformers
RoutingAgent	Categorizes headlines by topic	Keyword-based NLP routing
PortfolioAgent	Suggests allocation ratios	Rule-based portfolio mapping
EvaluationAgent	Compares sentiment vs price trend	Directional correlation logic
LLMOptimizerAgent	Generates professional summaries	Phi-3 Mini LLM

4. Key Findings and Insights

• AAPL, NVDA, and MSFT exhibit consistent bullish technical signals. • TSLA and NVDA show higher volatility and risk-adjusted returns. • Positive sentiment closely aligns with upward price trends for AAPL and NVDA. • Recommended diversified allocation: 70% Equity, 20% Bonds, 10% Cash, suitable for moderate risk profiles.

5. Technical Implementation

The notebook integrates Python's data science ecosystem with deep learning models for sentiment and summarization. Key libraries include `pandas`, `numpy`, `matplotlib`, and `transformers`. The system runs in Google Colab utilizing CUDA acceleration for Phi-3 Mini inference. The workflow ensures end-to-end automation, reproducibility, and interpretable visual outputs.

6. Conclusion

This multi-agent investment research system successfully integrates quantitative finance metrics with natural language processing and generative AI models. It provides a modular and scalable foundation

for real-world financial analytics and research automation. Future enhancements could include macroeconomic integration, ESG sentiment tracking, and multilingual reporting.

7. References

Yahoo Finance, NewsAPI.org, Hugging Face Transformers (DistilBERT, Phi-3 Mini), PyTorch, NLTK, Matplotlib, and University of San Diego AAI-520-IN3 course materials.

Appendix A: Repository and Deliverables

GitHub Repository: https://github.com/ramindersinghusd/aai-520-in3-project/blob/main/final_project/ Deliverables: FinalProject_v13_clean.ipynb, FinalProject_v13_clean.html, FinalProject_v13_clean.html.pdf Environment: Google Colab (T4 GPU).