CSCE 689: Programming LLMs - Course Project

Kunal SomendraSingh

UIN: 335007159

MarketPulseAI: One-Stop Application for Personalized Stock Portfolio Optimization

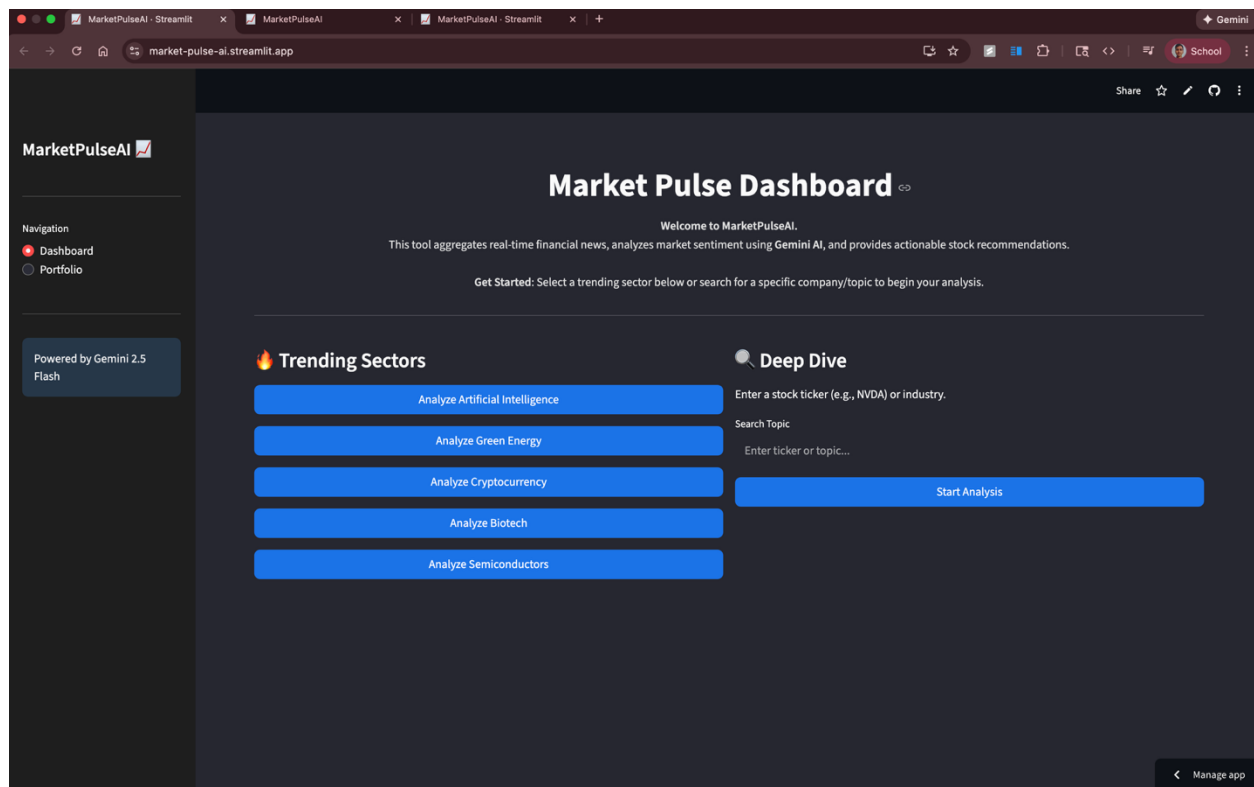## Link to website: [Market-Pulse-AI](#)

Fig 1: Market Pulse AI dashboard

1. My Vision and the Platform's Core Purpose

My primary goal of this project was to move beyond generic financial news summaries and deliver an accessible, explainable, and adaptive platform for retail investors.

I wanted to create a system that analyzes the "Market Pulse" of the market using AI and allows users to maintain their investment tracks and stay fully current with the latest sector-based news.

The result is a comprehensive application- **Market Pulse AI**, deployed on Streamlit, where the reasoning capability of LLMs is directly connected to a persistent portfolio tracking system powered by Supabase.

2. Implementation Architecture

I designed the system using a three-tiered, resource-efficient architecture:

- Frontend (Dashboard): Built with **Streamlit** and custom CSS for a professional, premium user interface, ensuring easy local and public deployment.
- Analysis Engine: The core intelligence runs on the Google Gemini API (**gemini-2.5-flash**), responsible for structured data extraction and reasoning.
- Data and Persistence Layer: I chose Supabase DB to ensure the user's portfolio data is persistent. Market data acquisition utilizes duckduckgo-search for news and yfinance for real-time stock prices.

3. End-to-End User Flow and Feature Exploration

The application guides the user through a structured investment analysis workflow, providing multiple points of detailed, context-aware information.
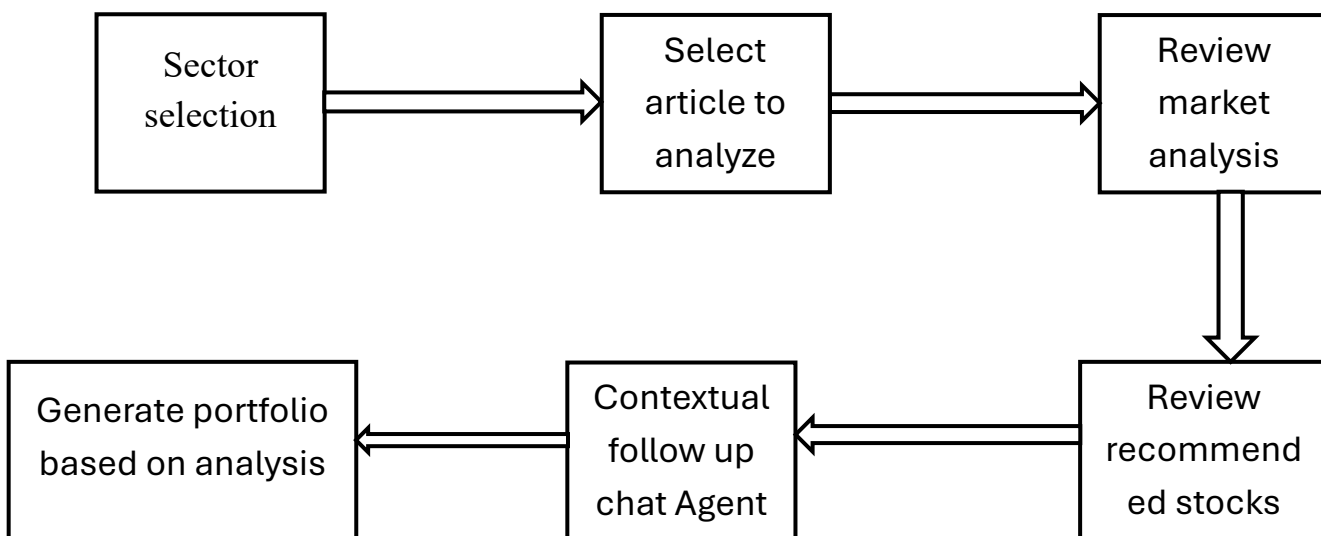
Flowchart of user interaction with the AI-powered platform.

Step 1: Sector Selection and News Ingestion

The user begins by choosing an area of focus:

- Industry Choice: The application provides a set of predefined industries to explore, or the user can input any new industry they want to research.
- Data Freshness: Upon selection, the app immediately fetches the top 10 latest articles within a 3-day window to cover the most current news in that sector.
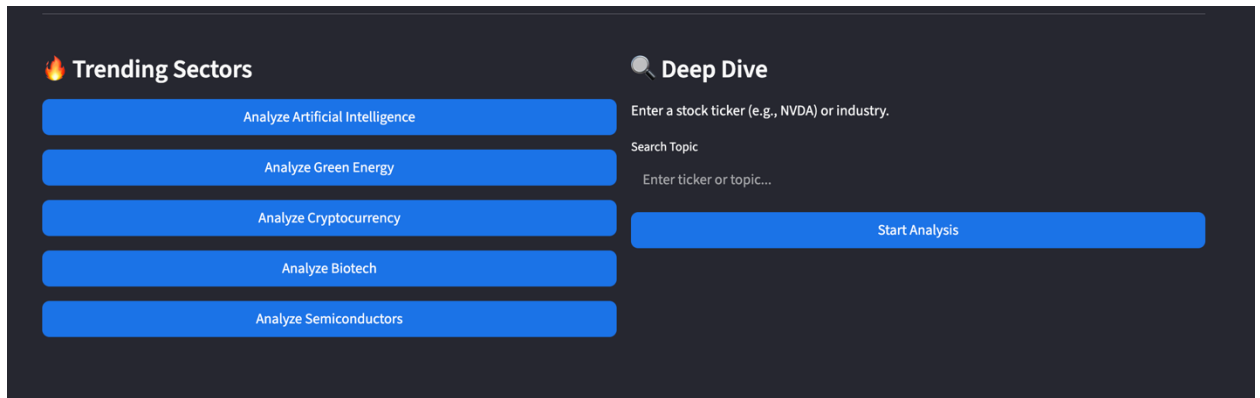

Fig 2: Entry point of dashboard to select industry to analyze

Step 2: Selective Analysis and LLM Processing

I give the user control over the analysis inputs:

- Article Triage: The user is presented with the latest articles and has the choice to select which articles to analyze using the LLM. This ensures the LLM's analysis is focused exactly on the events the user considers most relevant.
- Detailed Analysis Output: The LLM processes the selected reports and provides a detailed analysis in bullet points.

Fig 3: Fresh article fetch and article selection section

Step 3: Sentiment and Stock Recommendation

This step delivers the core decision-support intelligence:

- Sentiment Metric: I implemented a clear and actionable sentiment analysis metric: Positive, Neutral, or Avoid. This insight immediately helps the user reconsider their portfolio exposure for the selected industry.
- Stock Suggestions: The application provides a suggestion for 5 stocks that the user can explore. These suggestions are categorized with explicit actions: buying, selling, or watching for future. Each recommendation is justified by event-based reasoning.
- Along with stock suggestion, the LLM provides short info on the stock's short term vs long term growth plan and buy/sell option.

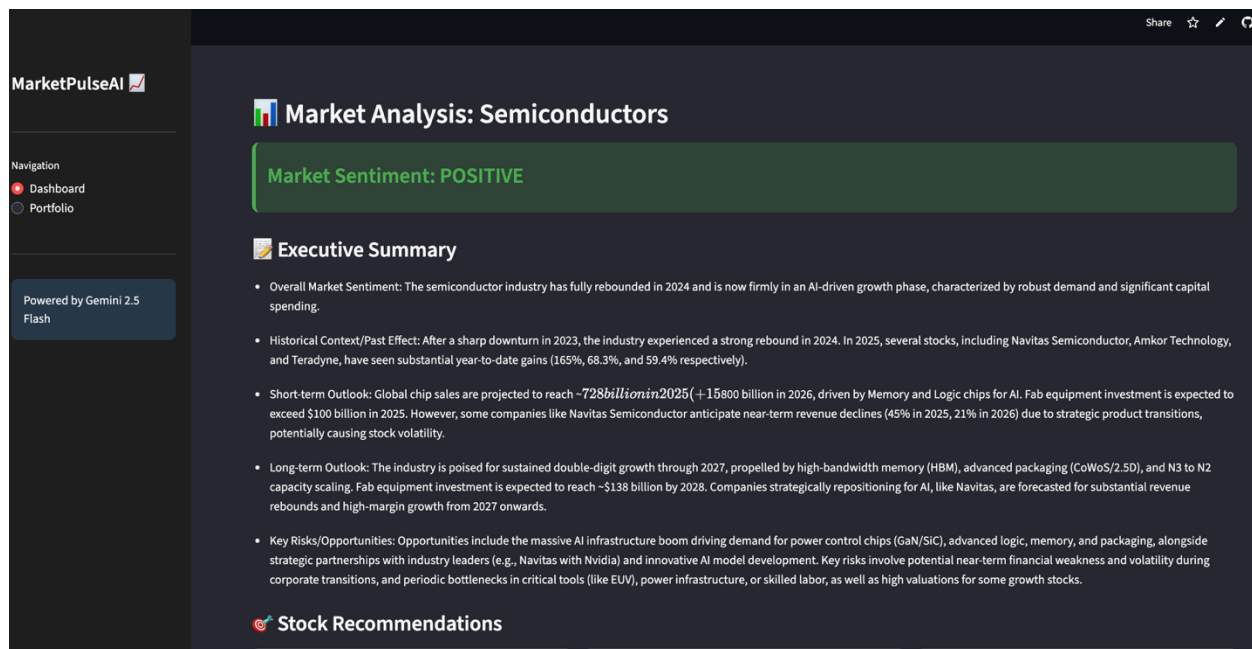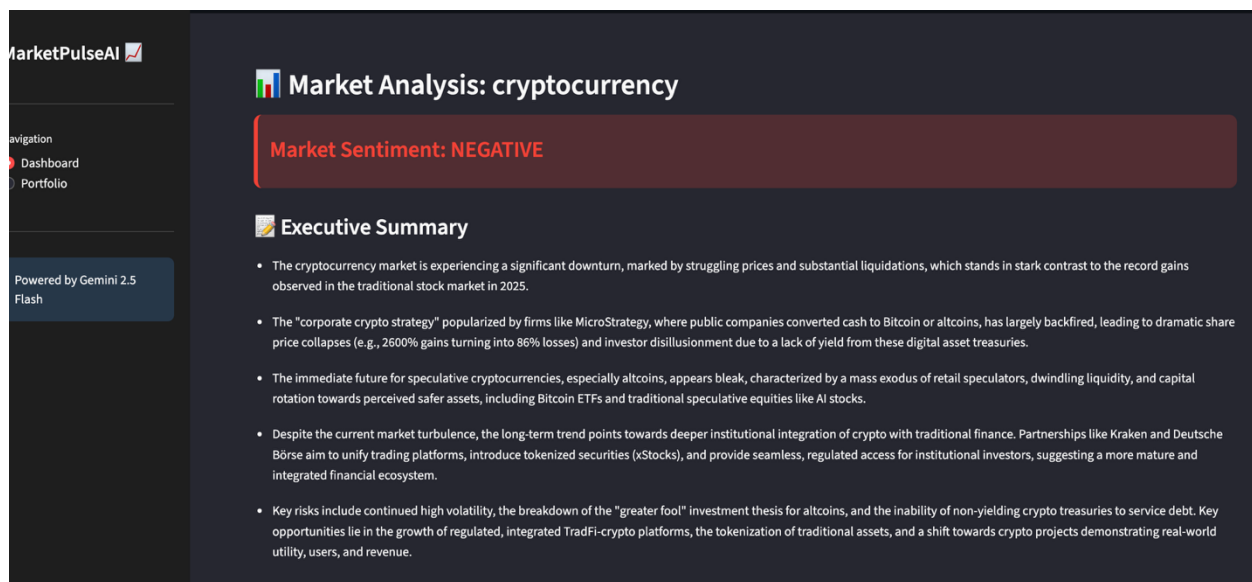Fig 4: Positive market sentiment for Semiconductor industry

Fig 5: Negative market sentiment for cryptocurrency industry

Step 4: Contextual Discussion (The Chat Analyst)

One main point of concern for users is the follow up question based on the analysis. Users would like to build more confidence on result by asking follow-up questions. To resolve follow-up questions, I integrated the Chat Analyst:

- Context-Based Queries: The user has an option to discuss context-based queries with a Chat Analyst.
- Grounded Reasoning: This chat feature is highly context-aware, able to help the user with more analysis directly related to the articles and sentiment reports currently on screen.
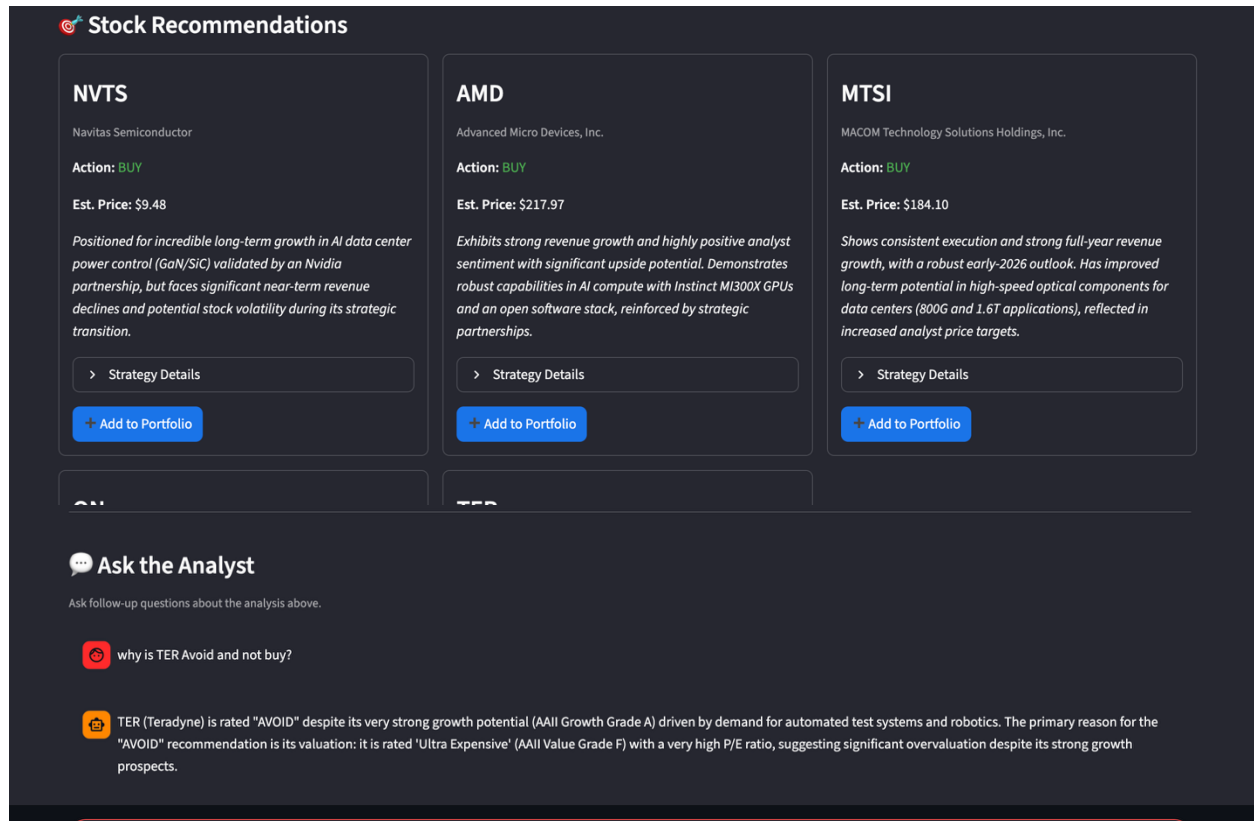
Fig 6: Stock recommendation to users based on sight with real time stock price updates

Step 5: Persistent Portfolio Management

This feature ensures long-term utility and tracking:

- Portfolio Addition: The detailed analysis info and suggested stocks are then added to the portfolio. Users can review their added stocks and its corresponding buy/sell value.
- A sub section under Strategy Details provide users with a short note on long term vs short term stock opinion to either buy or sell.

- Real-Time Data: The app fetches the stock price in real time when the portfolio is viewed, providing the current value alongside the user's entry price.
- Persistence: The entire portfolio is stored using Supabase DB, ensuring that users can easily track their industry of interest, stay up-to-date with the latest news, and resolve their queries across sessions.
- The portfolio segment of the dashboard has the functionality for users to download the stock recommendations as a CSV file for further deeper analysis.

Fig 7: Portfolio table and results after analysis

id	created_at	Ticker	Name	Sector	Recommendation	Price	Short Term Plan
9	2025-12-06T21:54:28.121607+00:00	BTC	Bitcoin	Cryptocurrency	BUY	39.55	Consider buying on significant dips, acknowledging continued volatility amidst w
8	2025-12-06T21:54:26.872726+00:00	COIN	Coinbase Global, Inc.	Cryptocurrency	WATCH	269.73	Watch for overall crypto market sentiment improvement and increased institution
7	2025-12-06T21:54:25.522131+00:00	DOGE	Dogecoin (Representative Altcoin)	Cryptocurrency	AVOID	0.0	Liquidate any speculative altcoin holdings; avoid new entries into meme coins or
6	2025-12-06T21:52:26.473397+00:00	MSFT	Microsoft Corp	micron technology	BUY	483.16	Consider adding to existing positions or initiating new ones, capitalizing on its cu
5	2025-12-06T21:52:23.55277+00:00	NVDA	NVIDIA Corp	micron technology	BUY	182.41	Initiate or add to a position, especially if further market weakness in AI stocks occ
4	2025-12-06T21:52:20.668828+00:00	AMD	Advanced Micro Devices	micron technology	BUY	217.97	Accumulate shares on any market pullbacks or sector-specific dips, targeting pot
3	2025-12-06T15:50:59.432126+00:00	ORCL	Oracle Corp.	Database/Cloud	BUY	112.3	Buy for cloud growth.
2	2025-12-06T15:50:59.432121+00:00	MSFT	Microsoft Corp.	Artificial Intelligence	BUY	415.0	Accumulate on dips.
1	2025-12-06T15:50:59.432102+00:00	TSLA	Tesla Inc.	Automotive	WATCH	245.5	Monitor for breakout above $250.

Fig 8: Portfolio exported to CSV file.

4. Addressing Technical Challenges

The main challenges I faced were maintaining accuracy and relevance in financial narratives interpreted by the LLM and managing API reliability/quotas.

Challenge	Solution Implemented
Hallucination Risk	Added strict System Instructions ("Guardrails") to the LLM prompt, forcing it to stick to the context of the ingested news and justify recommendations with evidence.
API Stability	Implemented tenacity-style retry logic with exponential backoff on all Gemini API calls to gracefully handle occasional timeouts and prevent failures from stopping the analysis.
Inconsistent Sentiment	I planned to average multiple events per sector and enforce reasoning citation checks to mitigate conflicting news tones.
Context Base Chat Analyst	The chat analyst function is grounded in the articles provided and analyzed and does not provide unnecessary details out of context.
Data Accuracy	Main challenge was to scrape recent data to get quality articles and retrieving accurate stock price for the recommended stocks.

5. Qualitative Analysis of results.

This project is qualitatively successful and highly useful in five key areas, primarily by overcoming the limitations of generic AI finance tools and providing **explainable, actionable intelligence** for the user.

- Explainable and Trustworthy Reasoning: The system provides event-backed proposals that require the LLM to justify suggestions with clear citations and context from the analyzed news. This eliminates black-box recommendations, building user trust.
- Adaptive and Personalized Analysis: Users can select their specific sector (predefined or custom) and filter the articles used for analysis, ensuring the output is highly relevant and adaptive to their unique portfolio and interests, unlike static market overviews. Moreover, the articles fetched are recent within 3 day window from major US news articles and the articles are available for cross checking sources.
- Actionable Decision Support: By translating complex narratives into a simple, actionable metric (Positive, Neutral, or Risky) and providing specific stock actions (buying, selling, or watching), the system serves as a direct, high-utility input for investment decisions.
- Seamless Workflow Consolidation: The application integrates real-time news analysis, LLM reasoning, a Contextual Chat Analyst, and a persistent portfolio tracker (Supabase DB) into a single platform. This consolidates the user's research and tracking workflow, providing a high degree of qualitative utility.
- Enhanced User Clarity via Dialogue: The Contextual Chat Assistant allows users to resolve ambiguities and ask follow-up questions directly grounded in the analysis, elevating the system from a report generator to an interactive, decision-support layer.

We see that the platform is successful in assisting users to generate industry-specific insights for their choice of industry. Moreover, we see that based on results and output, the platform delivered its AI-powered insight to act as a financial intelligence tool that users can utilize as a research partner for in depth exploration of stock and portfolio optimization.

6. Conclusion and Future Utility

The seamless flow I designed, from targeted news ingestion to persistent portfolio tracking, ensures the user is continually updated with the latest market narratives and equipped with LLM-generated, explainable investment rationale.

The ability to deliver explainable, adaptive financial insights directly linked to a long-term investment tracking platform is the strongest utility of MarketPulseAI.

My future roadmap is focused on enhancing this intelligence further, primarily through RAG-based systems to strengthen evidence citation and Agentic Automation to evolve the platform into an always-on financial monitoring assistant. Along with this, I would like to add personalization to the application to allows user authentication to enable a robust personal portfolio tracking system.