AI-Powered Earnings Call Analysis System

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# Project Overview

This project implements an advanced multi-agent AI system for analyzing earnings call transcripts and generating comprehensive investment reports. The system utilizes AutoGen's multi-agent framework to create a collaborative environment where different AI agents work together to produce accurate, detailed, and actionable investment insights. To enhance the depth and relevance of the analysis, agent tools are incorporated to call external financial data sources, allowing the system to enrich its insights with up-to-date market and company-specific information.

# Choice of framework

I considered using CrewAI for this project since it's a solid option for multi-agent orchestration, especially when tasks are linear and follow a clear role-based flow. However, for my use case, I needed something that supports more dynamic and collaborative interactions between agents, something where agents can not only perform tasks but also critique, build on, and refine each other’s work in real time. That’s where AutoGen’s GroupChat framework stood out. It’s much better suited for this kind of multi-agent collaboration, thanks to features like shared memory, contextual turn taking, and built-in support for tool use within a conversational setup. It just fits better for coordinating agents in a complex, back-and-forth financial analysis workflow.

# AutoGen System Architecture

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**The AutoGen framework has four specialized agents:**

1. **Client Agent**: Acts as the project manager and quality controller. This agent decides when to terminate the [groupchat](https://microsoft.github.io/autogen/stable/user-guide/core-user-guide/design-patterns/group-chat.html) and to produce output or instruct writer to revise further.
2. **Writer Agent**: Responsible for initial report drafting based on transcript analysis and revision based on feedback from Analyst and Editor Agents.
3. **Analyst Agent**: Performs fact-checking, financial ratio calculations and news sentiment analysis using external data (Alphavantage API) via two agent tools:
   1. historicalfinancialdata(ticker, year, quarter) # Returns the current quarter, previous quarter's and previous year's financial data (EPS, cash flow, income statement, balance sheet) using Alpha Vantage.
   2. analyzemarketsentiment(ticker, year, quarter) # Fetches news articles about a company from Alpha Vantage within the 30 days prior to the earnings report date. (**Date Range Rationale**: we assume operational realism where we only have access to news before the reported earnings call, to prevent future-leaking from post-call news that might cause sentiment analysis to be bias).
4. **Editor Agent**: Ensures report quality, clarity, and completeness of report.

**Agent Workflow:**

Sequence: Writer → Analyst → Writer → Editor → Writer → Client

1. After Writer's initial draft: Select Analyst
2. After Analyst's feedback: Select Writer for revision
3. After Writer's revision: Select Editor
4. After Editor's feedback: Select Writer for final revision
5. After Writer's final revision: Select Client
6. After Client Checks: Output Report **/** Reloop to Revise

# 4. File Structure for KEY Components

FYP /

├── app.py # Streamlit UI

├── autogenAI.py # Core AutoGen framework implementation (pipeline and prompts)

├── tools/

│ ├── research\_tools.py # Financial data and News retrieval tools (Alpha Vantage API)

├── Earnings2Insights/ # Transcript storage (dataset for all 64 companies)

└── saved\_reports/ # Generated report storag

# (for more details on implementation refer to README.md)

# 5. Notable Challenges & Solutions

### 1. Agent Randomness

**Challenge:** Output varied, with writer agent omitting important details. For example, formula for financial ratios.

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**Solution:**

1. Enhanced the system prompt for writer agent with **explicit reminders s**uch as instructing the Writer Agent to **always include formulas** when generating financial ratios.
2. **Increased the temperature** value to **0.95** to promote more **consistent and deterministic responses**.

### 2. Tool Integration

#### a. Historical Financial Data API

**Challenge:** Difficulty in retrieving accurate data for current quarter, previous quarter, and previous year to compute financial ratios.

**Solution:** Refined the tool functions (get\_previous\_quarter\_financials) to **correctly calculate the financial quarter end dates** based on the target company's fiscal calendar.

#### b. News Sentiment API

**Challenge: We should extract news around the reported date range for a more accurate news sentiment analysis and**reported date for quarter report is typically later than the quarter end date

**Solution:** Updated (analyze\_market\_sentiment\_alphavantage) to **derive reportedDate from the quarter report**

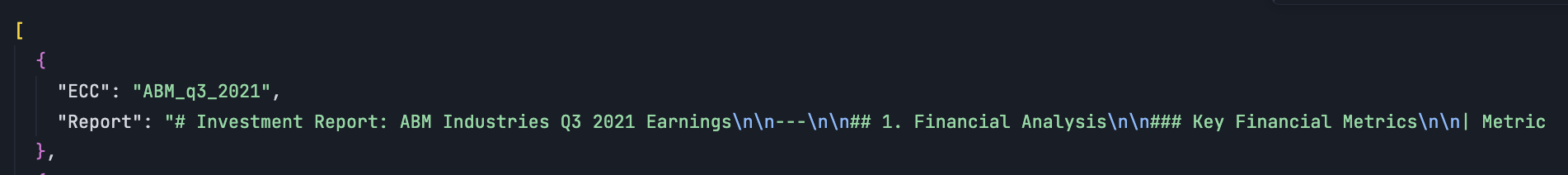
### 3. Agent Communication & Feedback Loop

**Challenge:** Writer Agent sometimes ignored feedback from Analyst Agent due to unclear prompts. For example, after the analyst agent hands off back to writer agent, the writer agent did not update the financials ratio table and left it blank which caused it to fail when the client check and creates unnecessary loops and wastes LLM tokens.

**Solution:** Added **explicit placeholders and structured instructions** in the Writer Agent’s system prompt to **trigger strict revision behavior** upon receiving feedback.

### 4. Output Formatting

**Challenge:** Final output needed to be a **single-line string** under the report key in JSON, but agents generated multi-line text.



**Solution:** Developed a convert\_report.py script to **replace newlines with \n**, preserving formatting in a single-line JSON-compliant string.

### 5. Missing Metadata in Transcripts

**Challenge:** Some earnings transcripts lacked **ticker, quarter, or year**, leading to incorrect tool function arguments.

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**Solution:** Extracted these metadata values directly from the **transcript file name** to ensure correct API calls. For example, CPF\_q4\_2019 => ticker: CPF, quarter: q4, year: 2019

### 6. Agent Scheduling Errors

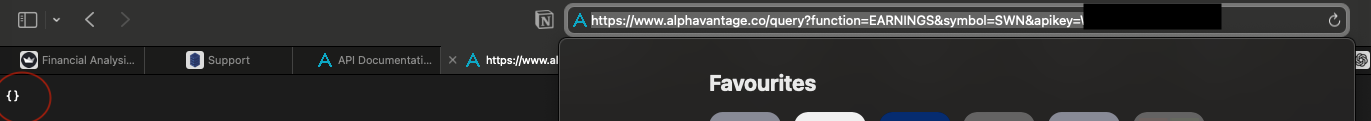
**Challenge:** Occasionally, agents executed **out of the defined sequence**, breaking workflow logic and triggering consecutive reply cap which terminates the current loop and restarts the whole analysis causing unnecessary token consumption. A screenshot of a computer

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**Solution:** [Pending – exploring manual sequencing]

### 7. Incomplete API Coverage

**Challenge:** Some companies (e.g., Southwestern Energy Company, SWN) had **no available data** in AlphaVantage.



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**Solution:** In such cases, we fallback to **earnings transcript content** to extract necessary financials manually.