

Project-Based Learning - V

IdeaCritic
Where Ideas Compete, Insights Emerge.

Submitted by
Vaidehi Vij (2310993945)
Yasha Vaid (2310993964)
Shubh Jain (2310993933)

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Submitted To
Dr. Harshvardhan
Assistant Professor, Department of CSE(AI),
CUIET, Chitkara University

CHITKARA UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

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Signature

Vaidehi Vij (2310993945)

Yasha Vaid (2310993964)

Shubh Jain (2310993933)

Abstract

In the evolving landscape of innovation, idea validation remains a critical bottleneck for startups, students, and entrepreneurs. This project, titled **IdeaCritic: An AI-Powered Multi-Agent Idea Evaluation System**, introduces an intelligent framework that simulates expert-level analysis through collaborative and adversarial AI agents.

The system enables users to input a new business or project idea and receive structured, multi-perspective feedback through an interactive, debate-style evaluation. The **Optimist Agent** highlights potential strengths and opportunities, while the **Critic Agent** identifies weaknesses, risks, and feasibility issues. Their dialogue iteratively refines the idea, leading to a balanced **Final Business Analyst Summary**.

To ground the analysis in real-world data, a **Market Analyst (RAG-powered)** component retrieves dynamic market intelligence using APIs such as Google Search or Tavily. This ensures that insights are contextually relevant and supported by recent industry trends. Following this, an **Investor Bot** evaluates the idea across dimensions such as market potential, innovation, scalability, team feasibility, and risk, providing an overall investment score and recommendations.

Together, these components form an integrated system that blends reasoning, retrieval, and evaluation — transforming subjective brainstorming into a structured, data-informed decision process. The result is an intelligent, automated platform that helps innovators assess, refine, and de-risk their ideas before real-world execution.

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Introduction

In today's rapidly evolving innovation ecosystem, thousands of ideas are conceived daily, yet only a fraction progress into viable, successful ventures. One of the primary reasons for this high attrition rate is the lack of structured, early-stage evaluation and critical feedback. Founders and students often rely on subjective opinions or limited research when validating their ideas, leading to uninformed decisions and unrecognized risks.

To address this gap, **IdeaCritic** has been developed — an **AI-powered multi-agent idea analysis platform** designed to provide comprehensive, balanced, and evidence-backed feedback on new business or project ideas. The system emulates a real-world panel of experts through the collaboration of multiple specialized AI agents.

The **Optimist Agent** focuses on highlighting the strengths, opportunities, and potential market advantages of an idea, encouraging creative exploration and confidence. In contrast, the **Critic Agent** challenges these assumptions, identifying weaknesses, operational challenges, and potential risks. Their interaction results in a balanced debate that converges into a **Final Business Analyst Summary**, offering a nuanced, realistic perspective of the idea's feasibility.

To ensure the insights are not purely theoretical, the system integrates a **Market Analyst Bot**, powered by **Retrieval-Augmented Generation (RAG)**. This component dynamically fetches relevant, up-to-date market data from real sources such as Google Search or Tavily APIs to ground the evaluation in factual context — including competitor analysis, market trends, and growth opportunities.

Finally, the **Investor Bot** evaluates the idea through an investment lens, scoring it across parameters like market potential, innovation, scalability, team feasibility, and risk. Based on these weighted factors, it provides a quantified investment score and actionable recommendations to guide future strategy.

Tech-stack & Methodology

AI & LLM:

- Gemma-3-12b-it (Google Generative AI): Core large language model for reasoning, critique generation, and multi-agent interactions.
- LangChain & LangChain Google GenAI: Framework and integration layer enabling agent orchestration and Gemini API connectivity.

Web Frameworks

- Streamlit: Provides the entire frontend and backend interface, including idea input, real-time analysis streaming, and stored history.

Market Intelligence & Retrieval

- Tavily / Serper.dev API: Used by the Market Analyst Bot to fetch real-time market insights and competitive data.
- RAG Components Incorporates structured retrieval and synthesis for evidence-based insights.

Evaluation & Scoring

- Custom Scoring Engine: Calculates multi-factor scores (Innovation, Market Fit, Feasibility, Risk, Scalability).
- Investor Bot Logic : Provides numeric evaluation, final weighted score (0–100), and verdict with recommendations.

Data & Utilities

- pandas, numpy: Data handling and numerical processing.
- pydantic, python-dotenv: Data validation and environment management.

Storage & Reporting

- MongoDB / Session State: Stores idea analysis history for re-viewing past evaluations.
- reportlab / python-docx: Generate downloadable PDF/Word reports.

Methodology :

Integrated Architecture :

IdeaCritic integrates **Retrieval-Augmented Generation (RAG)** with an **Agentic AI framework** to autonomously evaluate startup ideas through multi-perspective reasoning. The architecture enables specialized AI agents to debate, critique, and score ideas using real-time web intelligence and structured reasoning pipelines.

Multi-Agent System Design :

The system operates through a collaborative network of autonomous agents, each with a distinct analytical role:

- **Optimist Bot** — Advocates for the idea's innovation, scalability, and long-term potential.
- **Critic Bot** — Challenges the idea's feasibility, competition, and potential risks.
- **Evaluator Bot** — Synthesizes the debate into a balanced, concise business summary.
- **Market Analyst Bot (RAG)** — Fetches and analyzes live market data (competitors, funding trends, pricing models, and traction signals) through APIs such as **Tavily**, enriching the analysis with factual insights.
- **Investor Bot** — Provides structured numerical evaluations (1–10 scale) across multiple investment criteria and delivers a final investment verdict with recommendations.

RAG Pipeline & Knowledge Retrieval :

The **Market Analyst** component employs a **Retrieval-Augmented Generation (RAG)** process to ground reasoning in factual market intelligence.

Key steps include:

1. **Query Formulation:** The agent generates targeted market queries (competitors, pricing, market size, funding trends).
2. **Retrieval:** External APIs (e.g., Tavily Search) are used to collect real-time data from trusted business and startup sources.

3. **Synthesis:** Retrieved data is contextualized and summarized using **OpenAI GPT-4o-mini**, producing concise, evidence-backed insights that inform subsequent agents.

Agentic Reasoning & Debate Flow :

The workflow follows a structured **multi-round debate**:

1. **Clarifying Questions:** The system asks key questions to better understand the idea's scope, audience, and feasibility.
2. **Debate Phase:** The **Optimist** and **Critic** engage in multiple rounds of rebuttal-based arguments, ensuring diverse perspectives.
3. **Evaluator Summary:** The **Evaluator Bot** produces a neutral synthesis summarizing both sides.
4. **Market Analyst (RAG):** Enriches the output with live market intelligence.
5. **Investor Bot:** Provides a final scorecard and verdict.

This agentic interplay simulates a real-world investor panel discussion, making evaluations holistic and data-informed.

System Design & Workflow :

Frontend: The system is implemented entirely in **Streamlit**, providing an intuitive interface for idea submission, real-time streaming outputs, and saved analysis history.

Backend Logic:

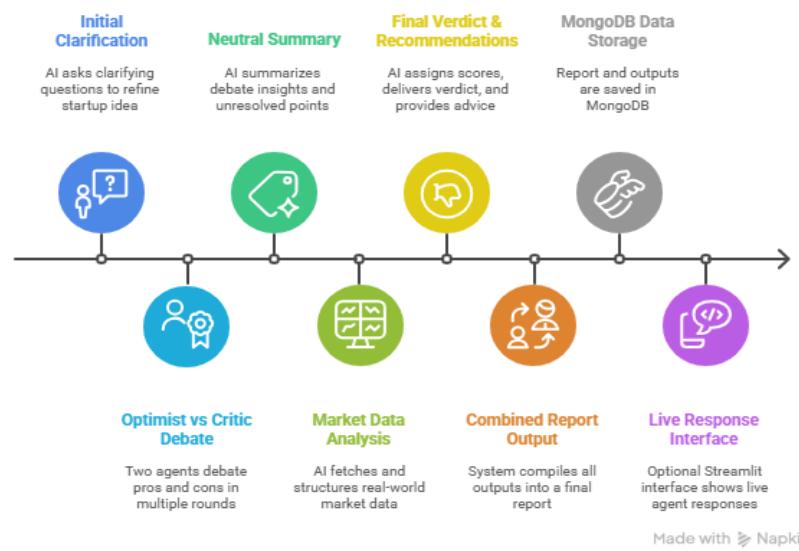
- Orchestrates all agents sequentially using the **OpenAI API (GPT-4o-mini)** for reasoning.
- Integrates **RAG retrieval** for factual grounding.
- Stores and displays results persistently using in-memory session state (and optionally MongoDB).

Each completed evaluation is archived and can be revisited through the “Analysis History” interface, ensuring transparency and reusability.

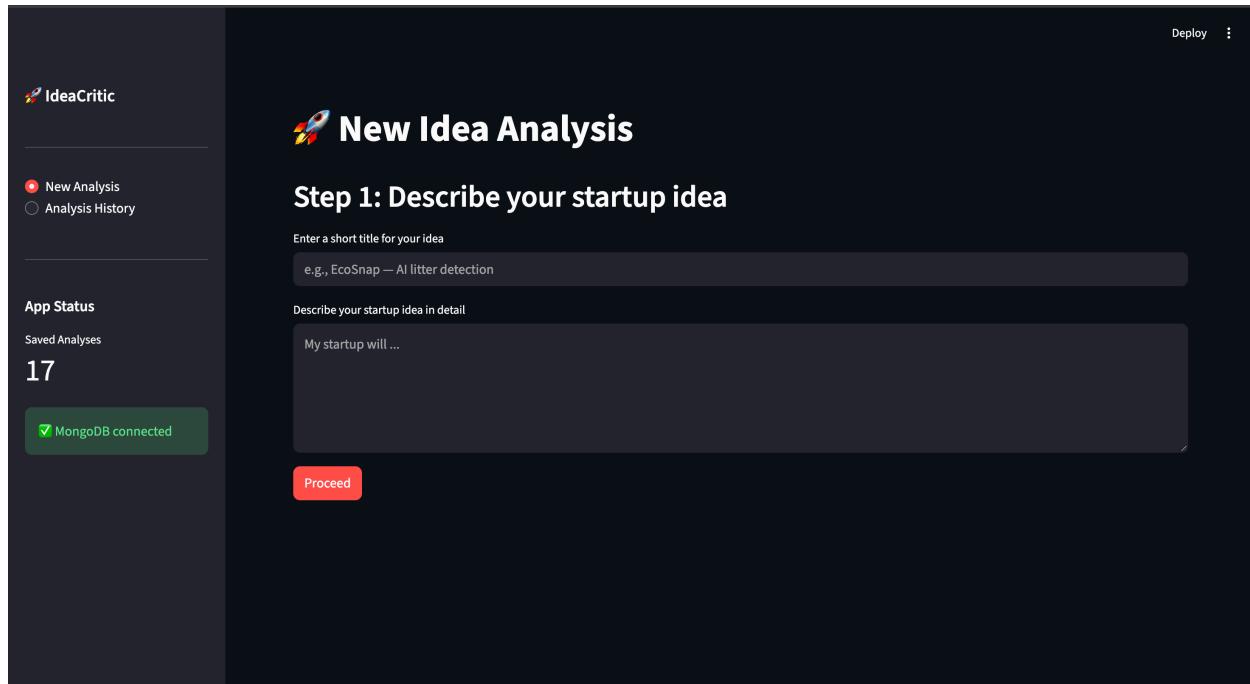
Flowchart



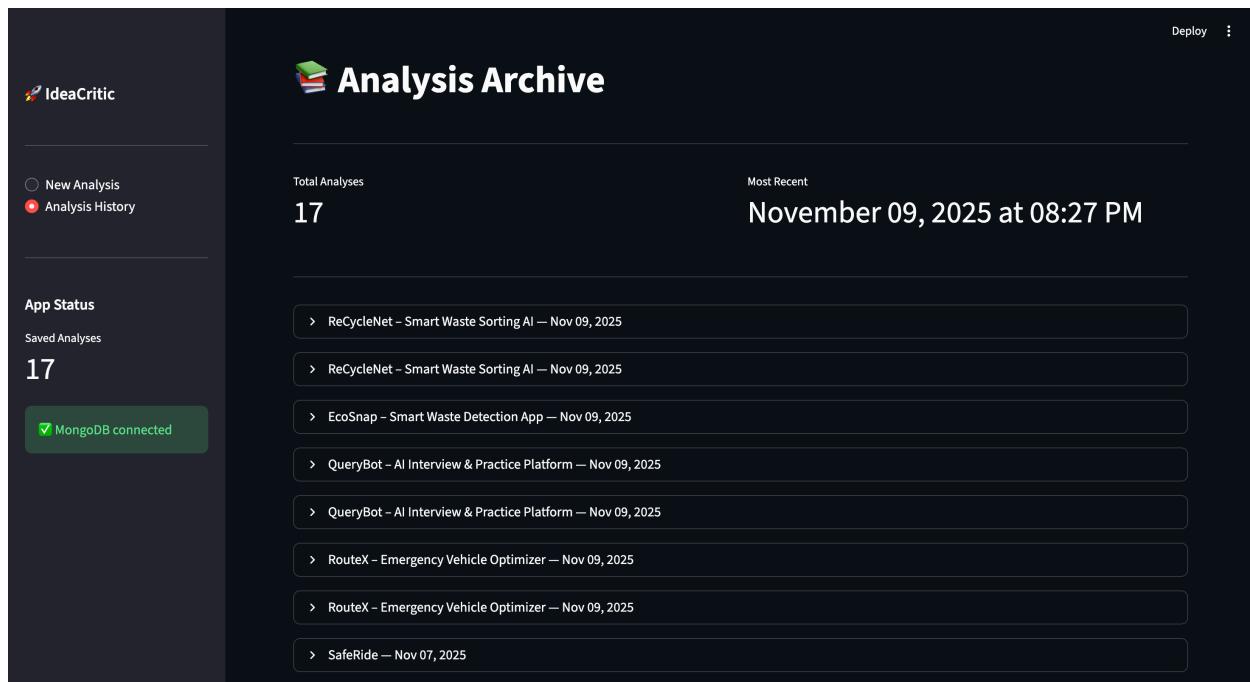
IdeaCritic Multi-Agent AI System Flow



Results



The screenshot shows the 'New Idea Analysis' step of the IdeaCritic app. The left sidebar displays the 'IdeaCritic' logo, navigation links for 'New Analysis' (highlighted with a red dot) and 'Analysis History', and an 'App Status' section showing 'Saved Analyses: 17' and a green 'MongoDB connected' button. The main content area features a title 'New Idea Analysis' with a rocket icon, a sub-section 'Step 1: Describe your startup idea', and two input fields: 'Enter a short title for your idea' (placeholder: 'e.g., EcoSnap — AI litter detection') and 'Describe your startup idea in detail' (placeholder: 'My startup will ...'). A red 'Proceed' button is at the bottom.



The screenshot shows the 'Analysis Archive' step of the IdeaCritic app. The left sidebar is identical to the previous screenshot. The main content area features a title 'Analysis Archive' with a book icon, a summary 'Total Analyses: 17' and 'Most Recent: November 09, 2025 at 08:27 PM', and a list of recent analyses. Each analysis entry is a card with a right-pointing arrow and the details: 'ReCycleNet – Smart Waste Sorting AI — Nov 09, 2025', 'ReCycleNet – Smart Waste Sorting AI — Nov 09, 2025', 'EcoSnap – Smart Waste Detection App — Nov 09, 2025', 'QueryBot – AI Interview & Practice Platform — Nov 09, 2025', 'QueryBot – AI Interview & Practice Platform — Nov 09, 2025', 'RouteX – Emergency Vehicle Optimizer — Nov 09, 2025', 'RouteX – Emergency Vehicle Optimizer — Nov 09, 2025', and 'SafeRide — Nov 07, 2025'.

 IdeaCritic

New Analysis Analysis History

App Status
Saved Analyses 17 ✓ MongoDB connected

Step 2: Answer the clarifying questions

How will the "return or swap containers" system work logically, economically, and at scale, particularly regarding collection, cleaning, and redistribution, and what specific pain points does this solve beyond what existing eco-friendly subscription services or local refill stores offer?

get washed, sanitized, and reused.
It's cheaper in the long run because each box can be reused around 30–40 times.
This solves the hassle of going to refill stores — users still get convenience but without plastic waste.

Who is your precise target customer for GreenBox, and what is their current spending habit and willingness to pay a premium for the convenience, sustainability, and community features you're offering compared to conventional or direct eco-friendly purchases?

Our main users are eco-conscious young adults or families in cities who already spend on groceries or essentials.
They care about sustainability but don't have time for refill stores.
They're okay paying a small premium (10–15%) if it's easy, clean, and transparent about impact.

What are the key operational challenges and estimated unit economics for a single box, including product sourcing, initial and reverse logistics for containers, cleaning, refilling, and the cost of developing and maintaining the waste tracking and community platform?

Tracking/platform: ₹20
So total around ₹500–550, with a selling price near ₹650 — meaning around 20% margin once scaled.

How do you plan to differentiate GreenBox from established eco-subscription box services and direct-to-consumer sustainable brands, and what proprietary technology or unique partnerships will underpin your competitive advantage?

Unlike other eco-boxes, GreenBox focuses on reuse, not just "eco packaging."
We'll use QR codes to track each container's journey and give users a "waste saved" score on the app.

Press ⌘+Enter to apply

Step 3: Start the analysis

 IdeaCritic

New Analysis Analysis History

App Status
Saved Analyses 17 ✓ MongoDB connected

Round 3

Optimist's Turn:

Here are 2–3 concise, specific, and actionable points for GreenBox:

- Implement a Dynamic Gamification Engine for Returns: Go beyond basic points by creating a robust, app-based gamification system focused explicitly on container returns. Introduce tiered badges ("Eco-Initiate," "Green Guardian," "Planet Champion"), unlockable rewards (e.g., exclusive product samples, discounts on future boxes, free shipping for streaks), and public leaderboards (optional, anonymized) that prominently display "waste saved" metrics. This transforms returns into an engaging, habit-forming activity crucial for achieving your 30-40 reuse cycles.
- Articulate and Monetize the "True Cost Saved" Value Proposition: While users pay a premium for convenience and sustainability, explicitly quantify and communicate the financial and non-financial savings. Highlight the cumulative cost avoided over time by not purchasing single-use items, the time saved from not sourcing specific eco-products, and the mental load reduced by a seamless sustainable lifestyle. This justifies the 10-15% premium and encourages long-term subscriptions by showcasing deep, tangible value beyond the immediate box contents.
- Forge Hyperlocal "Eco-Hub" Partnerships for Enhanced Access: Strategically partner with local businesses in urban centers (e.g., independent cafes, gyms, community centers, co-working spaces) to serve as GreenBox container drop-off points. This provides alternative return options, reduces your reverse logistics load, expands your brand's physical presence, and fosters community engagement by integrating GreenBox into existing local eco-friendly ecosystems.

Critic's Turn:

Here are 2–3 concise, specific, and actionable points for GreenBox:

- Audit and Proactively Scale Cleaning Hub Economics & Quality Control: The ₹30 per box cleaning cost, while appealing, may significantly underestimate the true operational expenditure for maintaining consistent, certified sanitation standards across potentially multiple *local cleaning hubs*. This includes costs for water, energy, specialized sanitizers, labor, equipment maintenance, and rigorous quality assurance protocols vital for consumer trust and health. Develop a detailed, scalable blueprint for cleaning operations that can guarantee hygiene across distributed sites without spiraling costs, potentially exploring initial regional hubs rather than hyper-local ones to centralize expertise and capital expenditure.

The screenshot shows the IdeaCritic application interface. On the left, a sidebar displays the 'IdeaCritic' logo, a 'New Analysis' button (with a red dot), an 'Analysis History' button, 'App Status' (with 17 saved analyses), and a 'MongoDB connected' status. The main content area is divided into two sections: 'Market Analyst (RAG-powered) — Evidence-backed insight' and 'Investor Bot — Investment Score & Recommendations'. The Market Analyst section discusses GreenBox's target market, competitive advantages, and operational challenges. The Investor Bot section provides a weighted score of 64.8, a verdict of 'Consider with Caution', and three recommendations. A green notification bar at the bottom indicates the analysis was saved with a unique ID.

Deploy ⚙

IdeaCritic

New Analysis

Analysis History

App Status

Saved Analyses

17

MongoDB connected

Market Analyst (RAG-powered) — Evidence-backed insight

GreenBox targets eco-conscious urban consumers willing to pay a 10-15% premium for convenience, differentiating via a full container reuse model beyond just "eco-packaging". Competitors are addressed through a unique reverse logistics system, gamified waste tracking, and community engagement. Unit economics project a viable ~20% margin on a ₹650 selling price post-scaling, despite initial operational challenges in reverse logistics and cleaning.

Investor Bot — Investment Score & Recommendations

Market Potential: 8.5 — Targets a clear, growing segment of eco-conscious urban consumers willing to pay a premium for convenience and impact, addressing a tangible pain point. Innovation: 7.5 — While subscription boxes aren't new, the integrated, closed-loop container reuse system with gamified tracking and community features represents a significant operational and user experience innovation beyond simple eco-packaging. Scalability: 6.0 — The model *can* scale with viable unit economics, but establishing efficient reverse logistics, local cleaning hubs, and ensuring consistent user container returns across new geographic markets presents significant capital and operational hurdles. Team Feasibility: 3.0 — No information is provided about the founding team's experience or capabilities, which is a critical missing piece for a highly operationally complex venture requiring diverse expertise. Risk: 4.0 — High operational risks associated with reverse logistics, container cleaning, user compliance for returns, and capital intensity for infrastructure setup, though market adoption risk is moderate.

Weighted Score (0-100): 64.8

Verdict: Consider with Caution

Recommendations:

1. Launch a tightly controlled pilot in a single, dense urban area to rigorously test the entire reverse logistics, cleaning, and user return compliance model.
2. Build out a founding team with proven expertise in logistics, supply chain management, and operational scaling to address the venture's high complexity.
3. Develop a detailed financial model for scaling, including initial capital expenditure for cleaning hubs and logistics in new cities, to articulate clear funding needs.

Analysis saved! Document ID: 691167690522ee709cd05185

Conclusion

The *IdeaCritic* project marks a significant step forward in integrating artificial intelligence with creative thinking and innovation assessment. In today's world, the ability to evaluate and refine ideas effectively is crucial for individuals, teams, and organizations striving for progress.

However, traditional methods of idea evaluation often rely on subjective human judgment, limited peer feedback, or inconsistent evaluation criteria. *IdeaCritic* addresses these limitations by introducing an AI-powered platform capable of providing objective, data-driven, and constructive feedback on any submitted idea.

By combining natural language processing, semantic analysis, and machine learning techniques, *IdeaCritic* interprets the essence of an idea, assesses its clarity, originality, feasibility, and impact, and delivers an overall rating along with meaningful improvement suggestions. This approach not only enhances the user's ability to communicate and refine their ideas but also democratizes access to quality feedback — enabling anyone, regardless of background, to validate their concepts with AI assistance.

Through this project, we have demonstrated how technology can be used not only to automate evaluation but also to foster creativity and innovation in a structured way. The implementation of *IdeaCritic* showcases the potential of AI systems in educational, entrepreneurial, and corporate environments, where idea generation and critique play a key role.

In the future, the platform can be expanded to include real-time collaborative feedback, crowd-sourced ratings, integration with innovation management tools, and personalization features that adapt to individual user needs and domains. With further research and development, *IdeaCritic* could evolve into a comprehensive ecosystem that supports end-to-end innovation — from idea conception to validation and refinement — empowering users to think more critically, creatively, and effectively.

Future Work

1. Idea Upload Options: Allow ideas to be submitted through text, PDF.
2. Trend Awareness (RAG): Integrate real-time market insights and competitor analysis using Retrieval-Augmented Generation.
3. Comparison Mode: Enable users to compare multiple ideas side by side with AI agents debating strengths and weaknesses.
4. Progress Tracker: Track how ideas improve across iterations and display improvement percentages.
5. Customizable Agent Panels: Let users choose specific bots (e.g., Investor Mode, Tech Feasibility Mode) based on their goal.
6. Weighted Evaluation System: Allow users to assign weight percentages to criteria like Market Fit, Innovation, Risk, and Scalability.
7. Pitch Deck Analyzer: Analyze startup presentation slides for clarity, storytelling, and investor appeal.
8. Export & Sharing: Generate AI evaluation reports in PDF/Word and allow sharing for peer or mentor feedback.
9. Knowledge Graph Integration: Map related companies, patents, and competitors to give broader market context.

References

The following sources were consulted during the completion of this project.

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- OpenAI Function Calling (Tools Integration) — <https://platform.openai.com/docs/guides/function-calling>
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