

# **Intelligent Thesis Reviewer**

## **A Multi-Agent System for Automated Academic Evaluation**

Leveraging Parallel AI Agents and RAG for Comprehensive, Rubric-Based Document Review

# Agents for Good: Transforming Academic Evaluation

This project directly addresses critical challenges in education by automating the time-consuming and burdensome process of academic review. Our goal is to create a system that is not just efficient, but also equitable and empowering for both educators and students.



## Empower Educators

Free professors from repetitive tasks to focus on high-value mentorship and research.



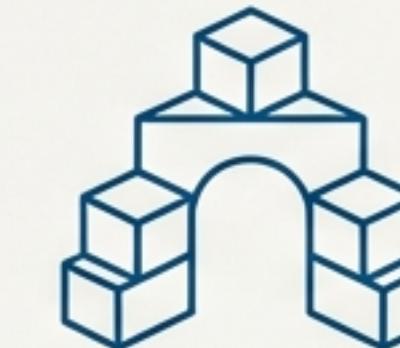
## Enhance Learning Outcomes

Provide students with faster, more detailed feedback cycles for iterative improvement.



## Support Educational Equity

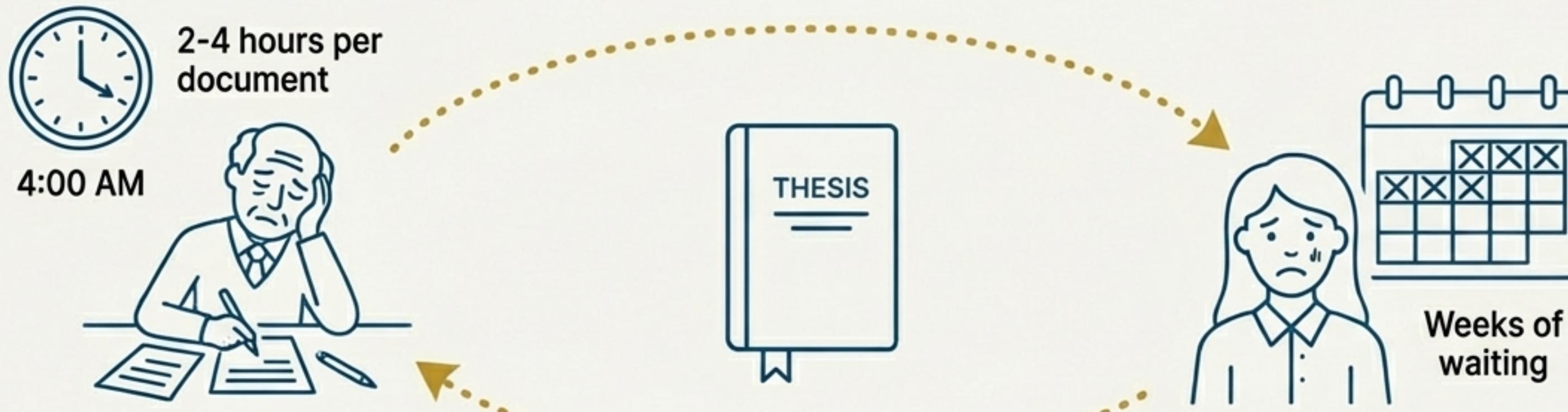
Ensure consistent, unbiased evaluation standards for every submission.



## Scale Educational Resources

Enable institutions to handle growing enrollment without compromising feedback quality.

# The Academic Review Bottleneck



## For Professors

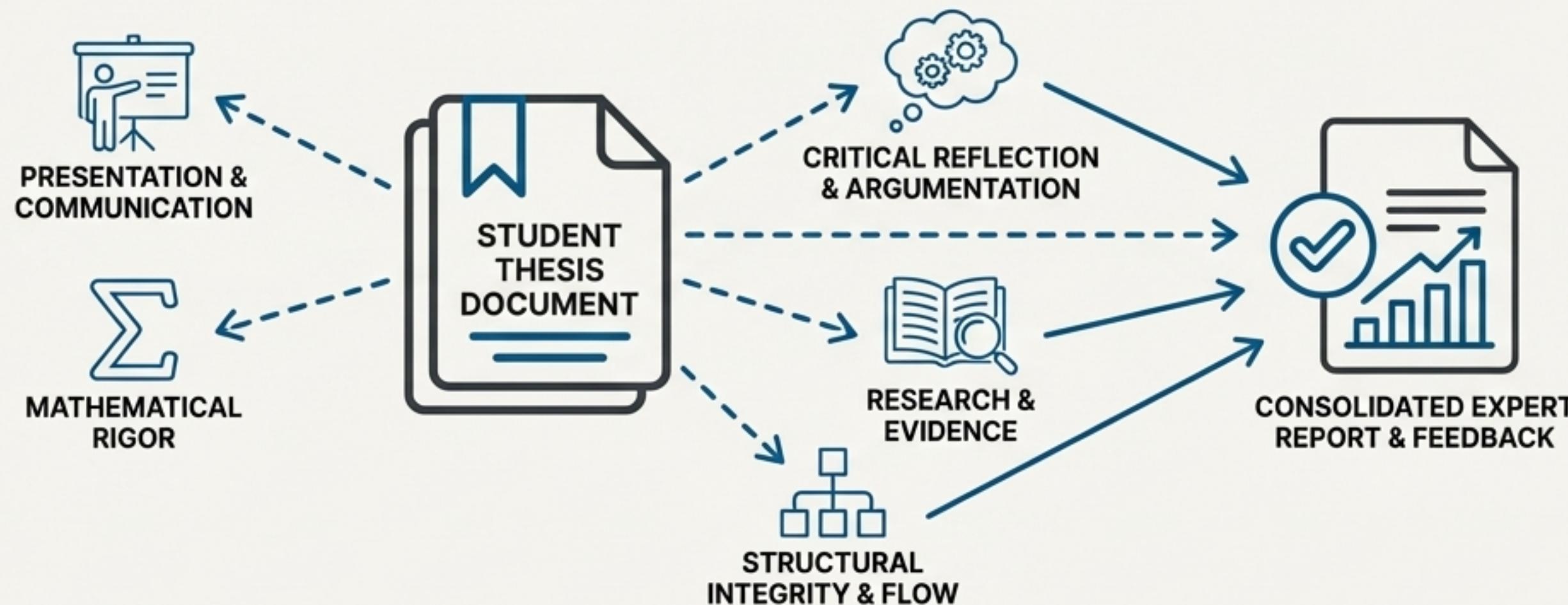
- **The Burden:** Reviewing student theses against a robust rubric is incredibly time-consuming, often taking 2-4 hours per document.
- **The Repetition:** The work is demanding and repetitive, diverting valuable time from curriculum development and personalized student interaction.

## For Students

- **The Wait:** Feedback cycles can take weeks, stalling progress and creating anxiety.
- **The Uncertainty:** Delayed, inconsistent feedback makes it difficult to understand expectations and improve effectively before deadlines.

# An AI-Powered Expert Review Panel for Every Student

We have built an advanced agentic AI system that automates the comprehensive review of student thesis documents. It functions as a dedicated team of specialized AI agents working in parallel to evaluate student work against rigorous rubric criteria.



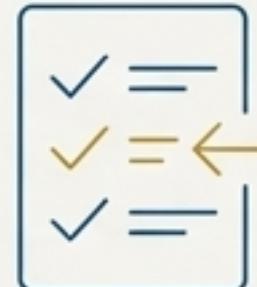
## Key Features

- Processes complete student documents.
- Evaluates against five distinct rubric criteria concurrently.
- Grounds all feedback in the official rubric using RAG.
- Delivers a detailed, actionable report rivaling human expert review.

# Transforming the Review Process: From Hours to Minutes

**90-95%**

Reduction in review time. A task that traditionally takes a professor 2-4 hours is completed in **10-15 minutes**.



## 10x Throughput

Process ten student submissions in the time it takes a professor to manually review one, thanks to batch processing capabilities.

## 15 Actionable Items

Generates three specific, targeted recommendations per criterion for a total of 15 clear improvement steps for the student.

## 24/7 Availability

The system operates continuously, eliminating scheduling bottlenecks and enabling faster feedback delivery.

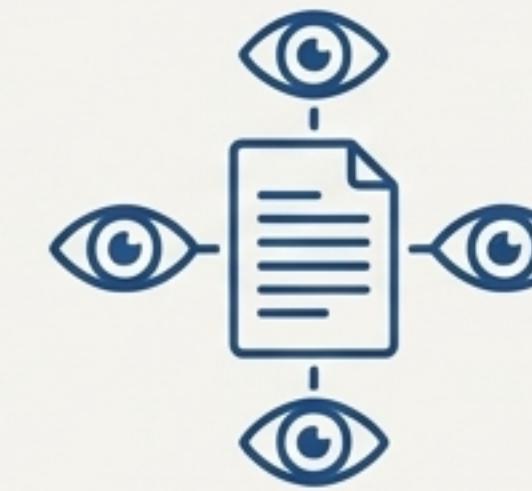
# Elevating Feedback Quality and Consistency

The system delivers feedback that is not just faster, but also more consistent, comprehensive, and systematically aligned with institutional standards.



## 100% Rubric Adherence

Every evaluation is grounded in the official rubric via Retrieval-Augmented Generation (RAG), eliminating subjective interpretation and ensuring fairness.



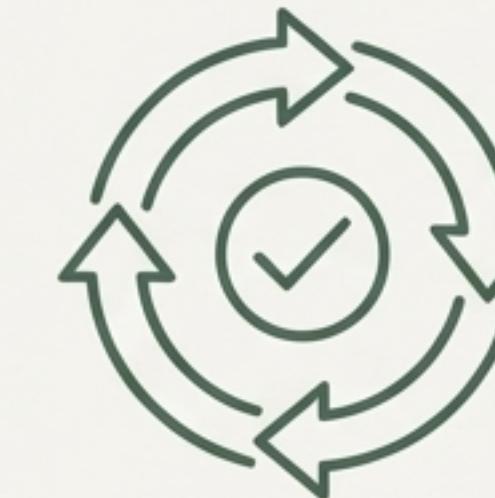
## Multi-Perspective Analysis

Five specialized agents provide a holistic view, identifying strengths and weaknesses across different dimensions of the student's work.



## Cross-Criterion Insights

A dedicated aggregator agent synthesizes feedback, identifying connections and themes that a single human reviewer might miss.



## Faster Learning Loops

Students receive detailed guidance in days, not weeks, enabling more rapid and effective iterative improvement.

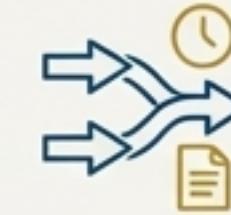
# The Engine: A Hierarchical, Multi-Agent Architecture

The system is built on a hierarchical agent architecture designed for scalability, maintainability, and efficient parallel processing. The workflow is coordinated through distinct layers, from high-level orchestration to specialized agent execution.



## 1. Orchestration Layer

The entry point that coordinates the entire workflow.



## 2. Controller Layer

Composes the root agent workflow (Parallel Review → Aggregation).



## 3. Agent Layer

Contains the specialized reviewer agents and the final aggregator.



## 4. RAG Layer

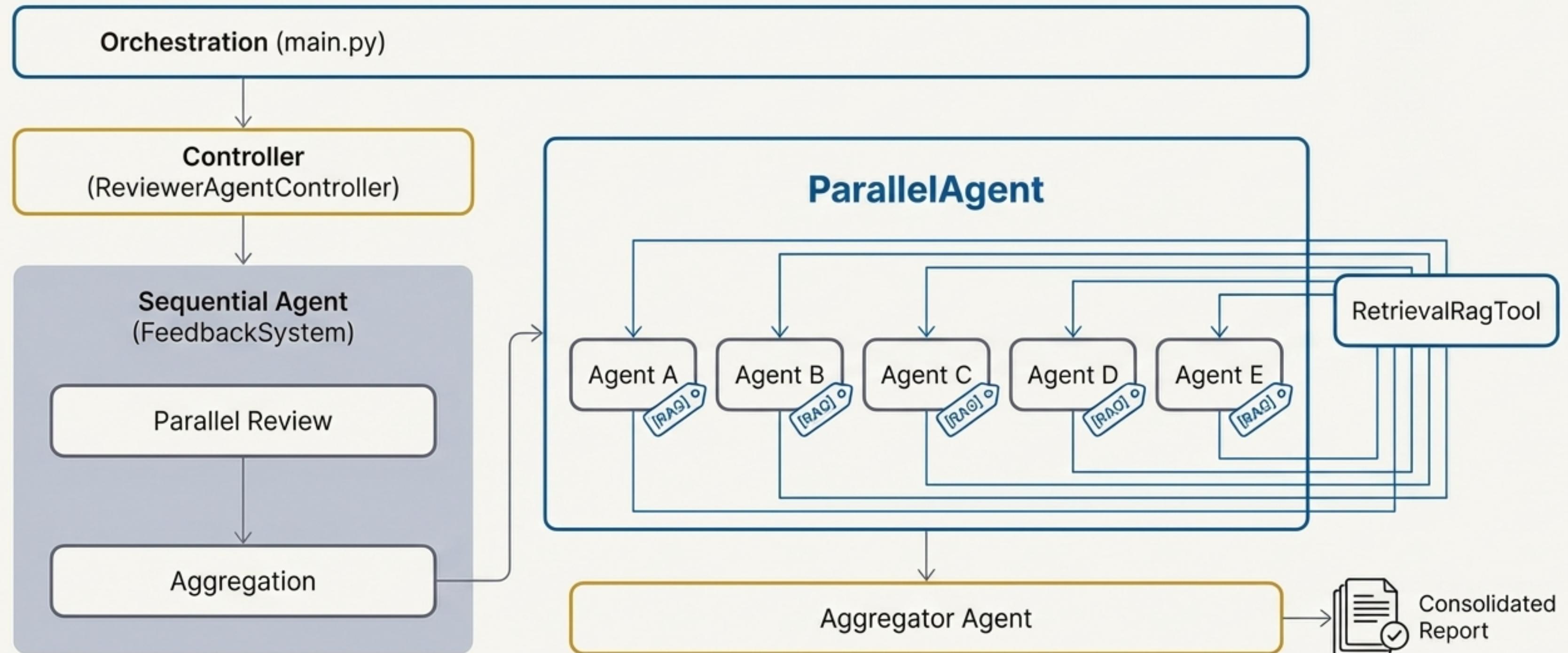
Provides all agents with grounded knowledge from the rubric document.



## 5. Configuration Layer

Centralizes all system settings for maintainability.

# System Blueprint: The Agentic Workflow



The system executes a sequential workflow: a parallel review by five specialized agents followed by intelligent aggregation, ensuring both speed and comprehensive synthesis.

# Meet the Expert Review Team

## The Parallel Review Team

Five specialized agents, powered by Google's Gemini 1.5 Flash, execute concurrently. Each is an expert in one rubric criterion:



**PresentationReviewerAgent** (Criterion A)



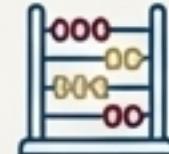
**MathComReviewerAgent** (Criterion B)



**PersEngReviewerAgent** (Criterion C)



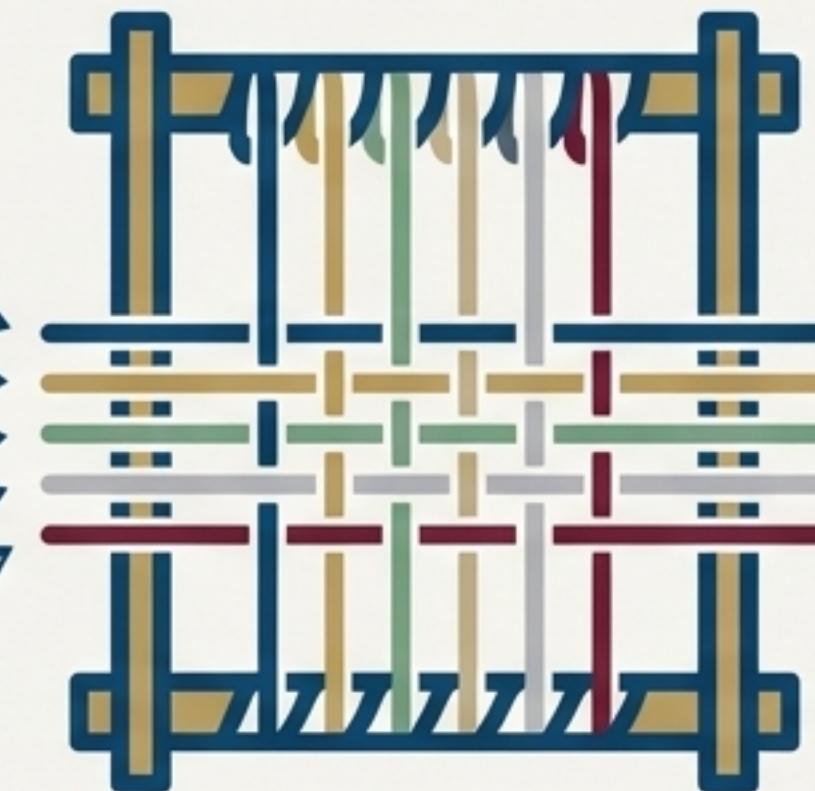
**ReflectionReviewerAgent** (Criterion D)



**UseMathReviewerAgent** (Criterion E)

## The Synthesizer

**ParallelReviewersAggregatorAgent**



After the parallel review, this agent receives all individual feedback. It synthesizes the inputs, identifies common themes, highlights cross-criterion connections, and generates the final, cohesive summary report.

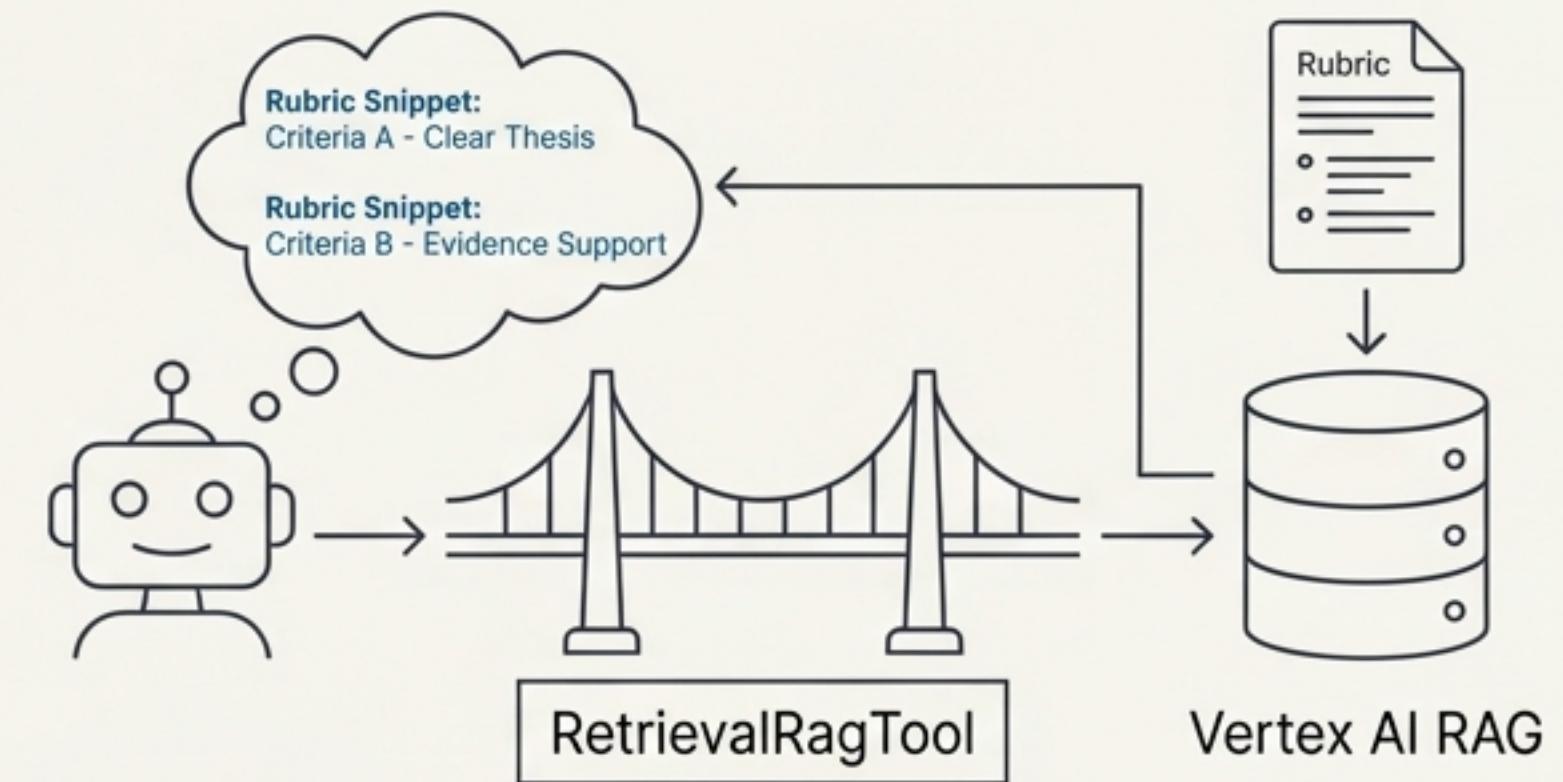
# Grounded by Design: Rubric-Driven RAG

How do we ensure agent evaluations are based on the *actual* rubric, not just the LLM's general knowledge?

Before RAG



Solution: Retrieval-Augmented Generation



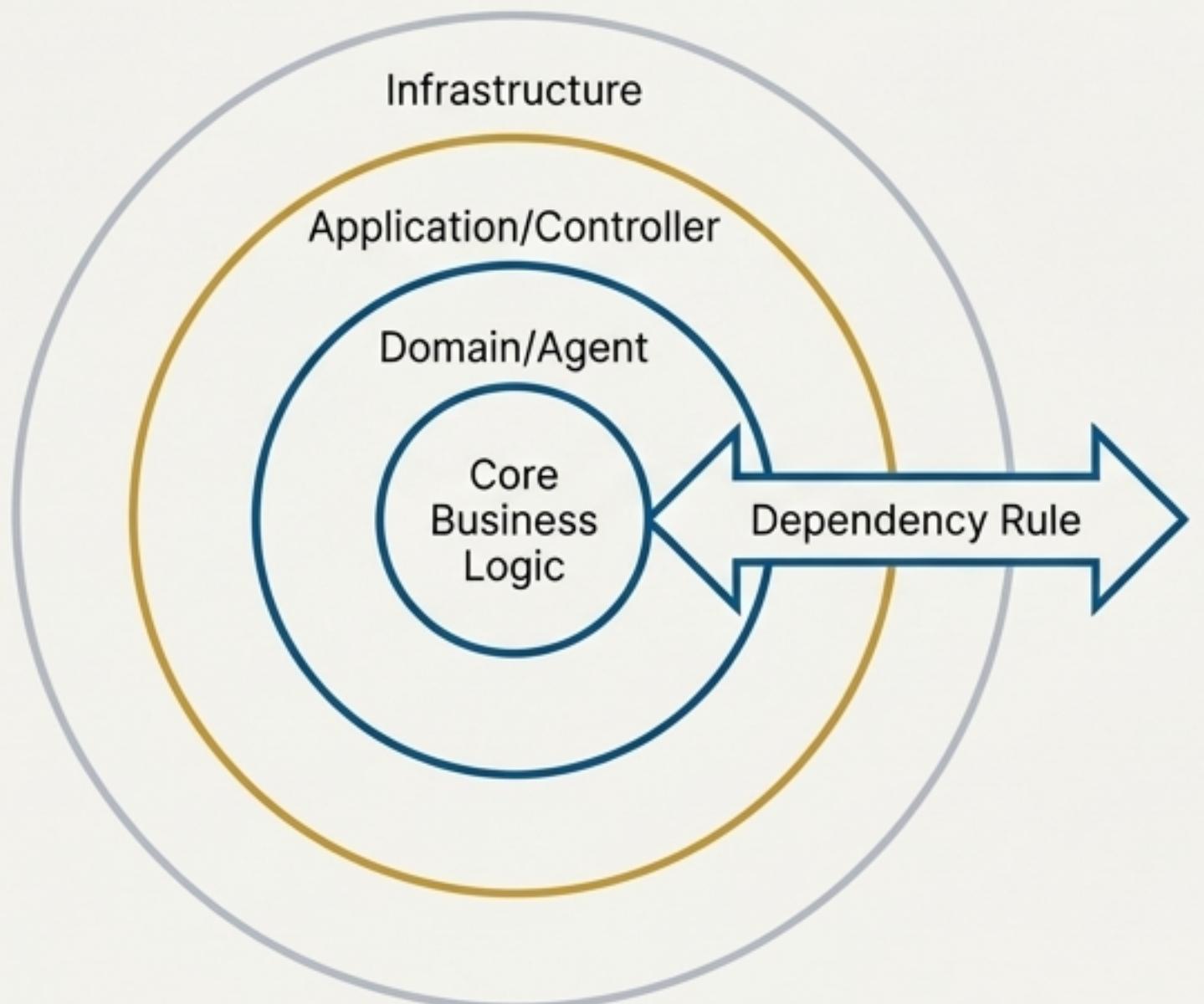
## Result

All feedback, scores, and recommendations are directly grounded in the institution's official standards, guaranteeing accuracy and consistency.

- Each of the five reviewer agents is equipped with a custom **RetrievalRagTool**.
- This tool connects to a **Vertex AI RAG** infrastructure containing the complete rubric document in a vector database.
- During evaluation, agents use **semantic search** to dynamically retrieve the most relevant sections of the rubric.

# Engineered for the Future: A Foundation of Clean Architecture & SOLID Principles

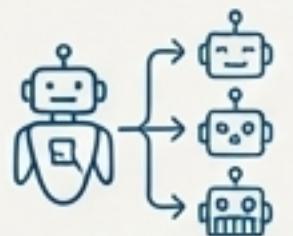
This project is more than a functional prototype; it is a robust system built following **Clean Architecture** and **SOLID** design principles. This approach is critical for complex multi-agent systems, ensuring they are maintainable, testable, and scalable.



## Key Advantages of this Approach for Agentic Systems:

- **Independent Development & Testing:** Agents can be developed and debugged in isolation.
- **Technology Independence:** The core agent logic is protected from changes in underlying infrastructure (e.g., swapping LLM providers or vector databases).
- **Maintainability & Evolution:** The system can grow and adapt to new requirements without architectural refactoring or accumulating technical debt.

# SOLID Principles in Practice: Building a Reliable Agentic System

Principle	Implementation	Benefit
 <b>S - Single Responsibility Principle</b>	Each class has one job (`ReviewerAgent` evaluates, `ReviewerAgentController` orchestrates).	Failures are isolated. Changes to one component don't break others.
 <b>O - Open/Closed Principle</b>	The system is open for extension (add a new agent for a new rubric criterion) but closed for modification.	New features can be added with minimal risk to existing functionality.
 <b>L - Liskov Substitution Principle</b>	All specialized reviewer agents adhere to the same base `ReviewerAgent` contract.	Enables flexible composition and swapping of agents without system-wide changes.
 <b>I - Interface Segregation Principle</b>	Agents and tools expose minimal, focused interfaces.	Reduces coupling, making components easier to understand, test, and modify.
 <b>D - Dependency Inversion Principle</b>	High-level modules (Controller) depend on abstractions, not concrete agent implementations.	Enables easy testing with mocks and future-proofs the architecture.

# A Strategic Advantage for Modern Education

- ✓ **Unmatched Time Efficiency:** Parallel agent processing reduces review cycles from hours to minutes.
- ✓ **Guaranteed Accuracy & Consistency:** RAG-enhanced evaluations ground all feedback in official rubric criteria, ensuring fairness.
- ✓ **Scalable & Maintainable by Design:** A modular architecture allows for easy extension and adaptation to new rubrics or requirements.
- ✓ **Comprehensive & Actionable Feedback:** A multi-agent approach delivers detailed, multi-faceted insights that drive student improvement.
- ✓ **A Foundation of Engineering Excellence:** Built on Clean Architecture and SOLID principles for long-term reliability and evolution.



# Project Repository & Team

## GitHub Repository



<https://github.com/JaphetHerzVaq/AgentsCapstoneProject>

## Developed By

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