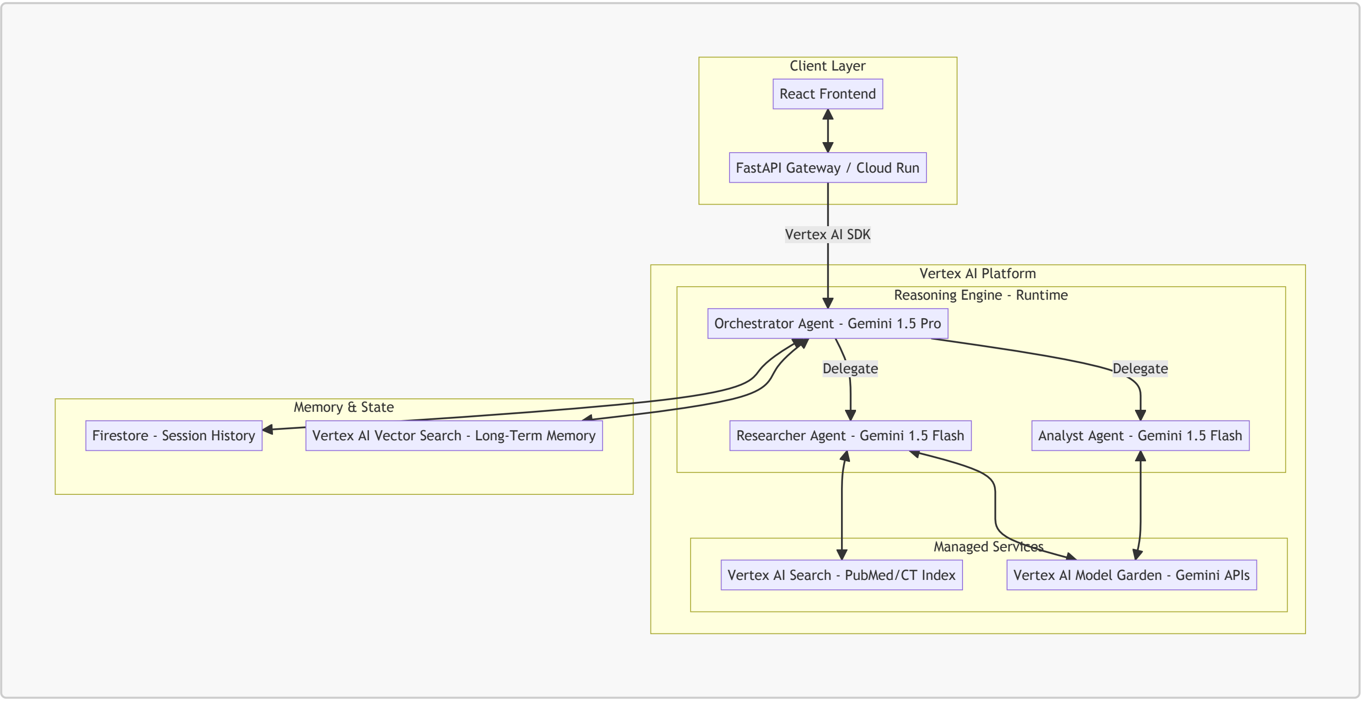
Treg Research Assistant - Google ADK & Vertex AI Design

1. System Overview

The system is a **Multi-Agent System (MAS)** built using **Google Agent Development Kit (ADK)** patterns and deployed on **Google Vertex AI Platform**.

It leverages **Vertex AI Reasoning Engine** for the agent runtime and **Gemini 1.5 Pro/Flash** for intelligence.

2. Architecture Diagram



Client Layer
React Frontend
FastAPI Gateway / Cloud Run
Vertex AI SDK
Vertex AI Platform
Reasoning Engine - Runtime
Orchestrator Agent - Gemini 1.5 Pro
Delegate
Delegate
Researcher Agent - Gemini 1.5 Flash
Analyst Agent - Gemini 1.5 Flash
Memory & State
Firestore - Session History
Vertex AI Vector Search - Long-Term Memory
Managed Services
Vertex AI Search - PubMed/CT Index
Vertex AI Model Garden - Gemini APIs

3. Component Mapping (ADK & Vertex AI)

A. Multi-Agent System (ADK Pattern)

- **Framework**: Python (using `google-cloud-aiplatform` and ADK best practices).
- **Orchestrator**:
  - Implemented as a **Reasoning Engine** application.
  - Uses **Gemini 1.5 Pro** for planning and delegation.
- **Sub-Agents**:
  - **Researcher**: Specialized in information retrieval using Vertex AI Search.
  - **Analyst**: Specialized in data processing using **Vertex AI Code Interpreter** (if available) or local Python sandbox.

B. Tools (Vertex AI)

- **Knowledge Retrieval**:

    - Instead of a local ChromaDB, we use **Vertex AI Search** (Agent Builder) to index PubMed/ClinicalTrials data.
    - *Benefit*: Managed, scalable, and semantic search out-of-the-box.
- **Google Search**:
    - Use **Vertex AI Grounding** with Google Search.
- **Code Execution**:
    - Use **Gemini's Code Execution** capability (built-in tool).

C. Sessions & Memory (ADK)

- **Session State**:
    - Stored in **Google Firestore** (NoSQL), following ADK's "Session" schema.
- **Long-Term Memory**:
    - **Vertex AI Vector Search** for storing user preferences and past successful experiments.

D. Observability (Vertex AI)

- **Tracing**: **Vertex AI TensorBoard** or **Cloud Trace** for agent steps.
- **Evaluation**: **Vertex AI Evaluation Service** (AutoSxS) to compare agent answers against a golden set.

E. Deployment

- **Runtime**: **Vertex AI Reasoning Engine**.
    - Allows deploying the Python agent code as a managed service.
- **Frontend**: Deployed on **Google Cloud Run**.

4. Implementation Steps (Revised)

1. **Setup**: Enable Vertex AI, Firestore, and Cloud Run APIs.
2. **Data**: Upload PubMed/CT JSON to **Vertex AI Search** datastore.
3. **Agent**:
    - Define `Orchestrator` class using Vertex AI SDK.
    - Register tools (Search, Code).
    - Deploy to Reasoning Engine.
4. **Frontend**: Update React app to call the Reasoning Engine endpoint (via a lightweight proxy if needed).