

Travel Explorer Architecture Description

Overview

The Travel Explorer application follows a modern, layered architecture with clear separation of concerns, integrating multiple services to provide a comprehensive travel planning experience. The application consists of the following major components:

Architecture Layers

1. Frontend Layer

- **Streamlit UI (app.py):** The user interface built with Streamlit, providing interactive components for hotel exploration, flight search, and trip planning.

2. API Layer

- **FastAPI Server (api/main.py):** RESTful API server handling requests from the frontend and routing them to appropriate services.
- **API Routers:**
 - Flights Router: Handles flight-related endpoints
 - Hotels Router: Handles hotel-related endpoints
 - Trips Router: Handles trip planning endpoints
- **API Services:**
 - Flight Service: Business logic for flight operations
 - Hotel Service: Business logic for hotel operations
 - Trip Service: Business logic for trip planning
- **MCP Integration:**
 - MCP Client: Client for communicating with the MCP server

3. Model Calling Protocol Layer

- **MCP Server (mcp_server.py):** Standalone server for enhanced AI capabilities, interfacing with OpenAI to generate itineraries and recommendations.

4. External Services

- **SerpAPI:** Provides flight and hotel data
- **OpenAI API:** Powers the AI-driven itinerary generation
- **Snowflake DB:** Stores and provides restaurant data
- **Pinecone:** Vector database for semantic hotel search

Data Flow

The architecture diagram shows the complete data flow through the system:

1. **User Interaction:** Users interact with the Streamlit UI to search for flights, hotels, or plan trips
2. **API Requests:** The UI sends requests to the FastAPI server
3. **Service Processing:** API routers direct requests to appropriate services, which contain business logic
4. **External Services:** Services interact with external APIs and databases to fetch necessary data
5. **MCP Integration:** Trip planning requests utilize the MCP server for enhanced AI capabilities
6. **Response Flow:** Data flows back through the layers, with each layer adding value:
 - External services provide raw data
 - Services process and format the data
 - Routers package the data into API responses
 - UI presents the data in a user-friendly format

Key Data Flows

Flight Search Flow

1. User enters flight search parameters in the Streamlit UI
2. Request goes to FastAPI server, then to Flights Router
3. Flight Service queries SerpAPI for flight data
4. Results flow back through the chain to be displayed to the user

Hotel Search Flow

1. User submits hotel search criteria
2. Request goes to FastAPI server, then to Hotels Router
3. Hotel Service queries Pinecone for vector search and/or SerpAPI for additional data
4. Results return through the chain to the UI

Trip Planning Flow (Primary MCP Integration)

1. User selects flight and hotel, then requests itinerary generation
2. Request flows through FastAPI to Trips Router
3. Trip Service:
 - Fetches attractions from SerpAPI
 - Retrieves restaurant data from Snowflake
 - Sends a request to the MCP Client with all necessary data
4. MCP Client forwards the structured request to the MCP Server
5. MCP Server:
 - Processes the request
 - Calls OpenAI API with a specialized prompt
 - Extracts and structures the response (itinerary, highlights, daily plans, costs)
6. The enhanced itinerary flows back through the chain to be displayed to the user

Technical Implementation Details

- **Containerization:** All components can be deployed in Docker containers
- **CI/CD Integration:** GitHub Actions workflows for testing and deployment
- **Error Handling:** Comprehensive error handling with fallback mechanisms
- **Caching:** Restaurant data caching to improve performance
- **Health Checks:** MCP server availability check before usage
- **Cloud Deployment:** Support for Google Cloud VM deployment

This architecture ensures a separation of concerns, maintainability, and scalability while providing a rich user experience with AI-enhanced trip planning capabilities.