



Application of Multi-Agent LLM's to Travel Recommendation System



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Introduction

- **Travel Planning Challenges:**

1. Planning trips involves many factors: destinations, budgets, weather, and activities.
2. High demand for smarter, personalized travel systems.

- **Emerging AI Solutions:**

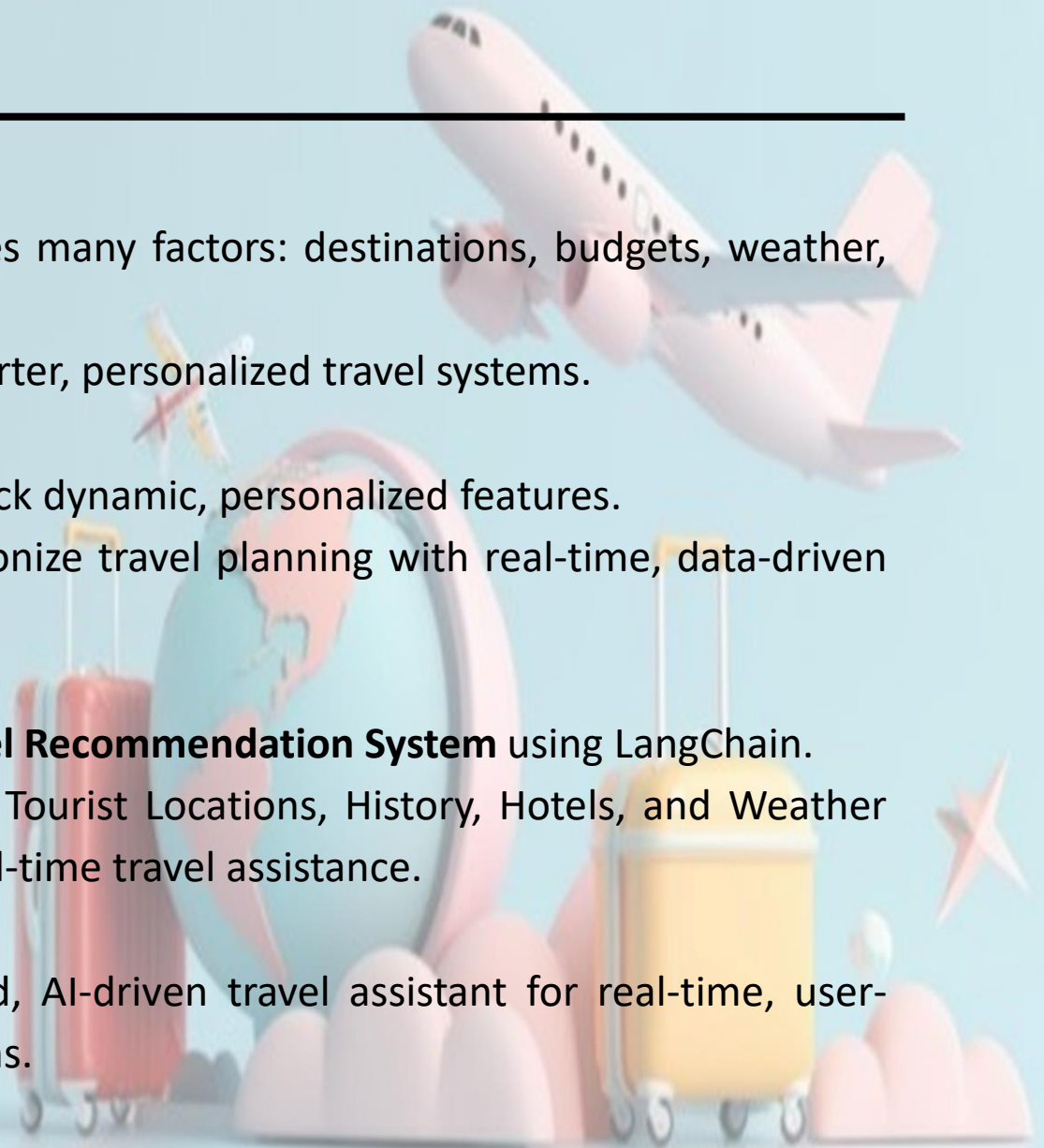
1. Traditional systems lack dynamic, personalized features.
2. AI and LLMs revolutionize travel planning with real-time, data-driven recommendations.

- **Project Overview:**

1. A **Multi-Agentic Travel Recommendation System** using LangChain.
2. Five agents - Flights, Tourist Locations, History, Hotels, and Weather work together for real-time travel assistance.

- **Objective:**

To deliver a personalized, AI-driven travel assistant for real-time, user-focused recommendations.



Architecture

Multi-Agent Framework:

Five agents - Flights, Tourist Locations, Location History, Hotels, and Weather operate independently and collaborate via LangChain.

Langchain = LLM + PROMPT

AGENT = Langchain + Tools

LLM-Powered Design:

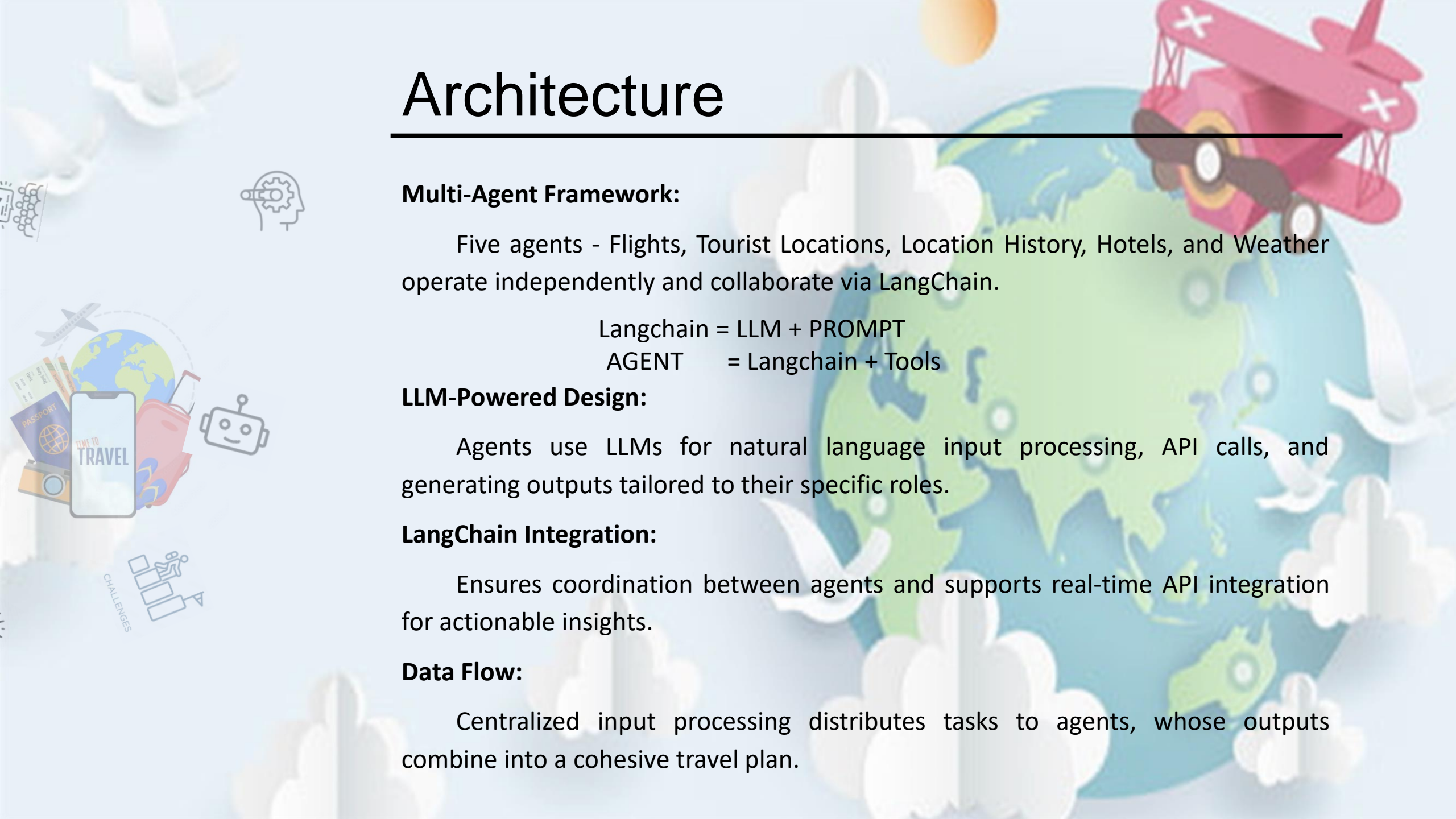
Agents use LLMs for natural language input processing, API calls, and generating outputs tailored to their specific roles.

LangChain Integration:

Ensures coordination between agents and supports real-time API integration for actionable insights.

Data Flow:

Centralized input processing distributes tasks to agents, whose outputs combine into a cohesive travel plan.



Architecture



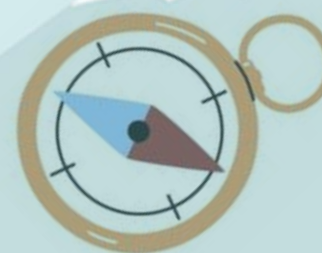
Flight Agent: Fetches flights based on budget, airlines and other preferences.

Hotel Agent: Recommends hotels by filtering options by budget and amenities.

Tourist Locations Agent: Suggests top attractions based on user reviews.

Location History Agent: Summarizes historical insights for attractions.

Weather Agent: Provides real-time weather updates for selected destinations.



Architecture

Workflow:

- Parsing User Input
- Query Decomposition
- Agent Activation
- Tool Interaction
- Response Aggregation

Tools and Technologies:

- **LangChain:** Facilitates workflows and API integration.
- **APIs:** OpenWeather, Amadeus, SerpAPI, Google Maps for real-time data.
- **Libraries:** requests, regex, and Streamlit for data processing and UI.



Agent and their Design [Flight Agent]



Functionality:

- Fetches and filters flights based on user preferences such as budget, travel dates, and preferred airlines.

Workflow:

- Uses airline aggregator APIs like Amadeus to fetch flight options.
- Filters results for direct flights, layovers, and departure/arrival times.

Key Features:

- Supports both domestic and international trips.
- Provides round-trip options and customization for preferred airlines.
- Efficient query optimization to reduce response time.



TIME TO TRAVEL



Hotel Agent



Functionality:

Recommends hotels based on budget, amenities, ratings, and location proximity to tourist attractions.

Workflow:

- Integrates with APIs like Google Maps and Google hotels serpAPI.
- Filters hotels using user-defined criteria such as free Wi-Fi, breakfast, or parking.

Key Features:

- Ensures personalized suggestions based on financial constraints.
- Balances cost and comfort by prioritizing user preferences.
- Utilizes LLM-based optimization for accurate results.



Tourist Locations Agent



Functionality:

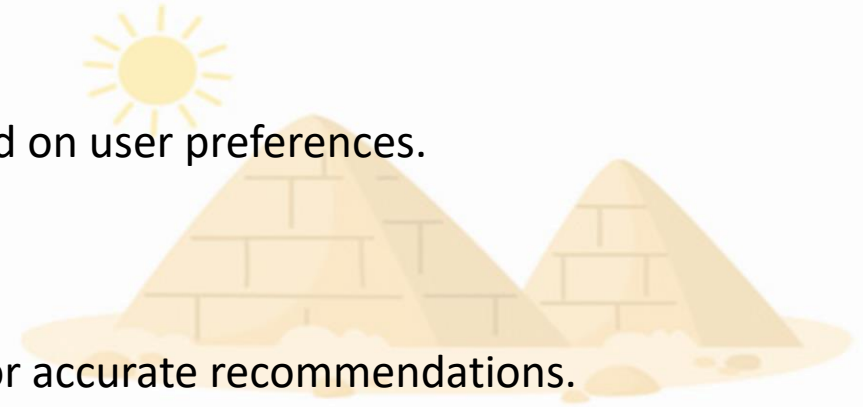
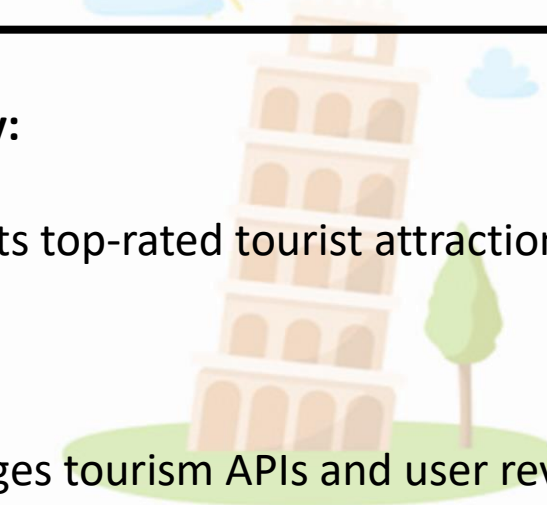
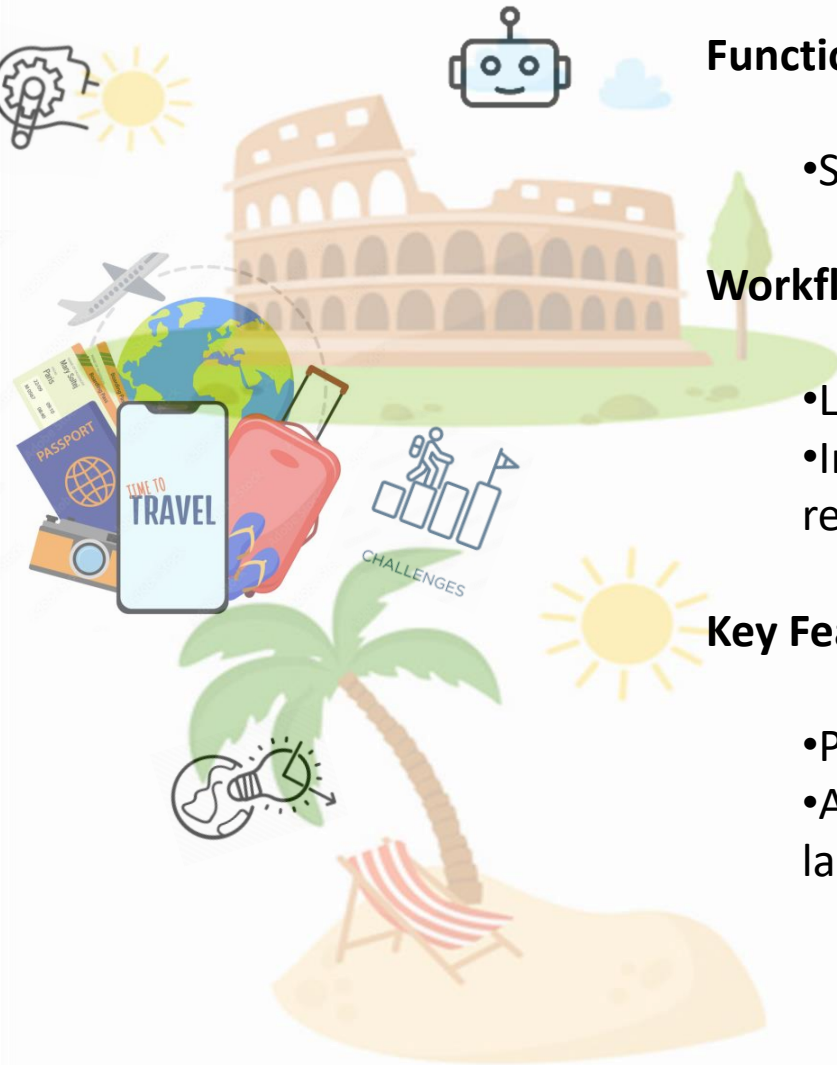
- Suggests top-rated tourist attractions based on user preferences.

Workflow:

- Leverages tourism APIs and user reviews for accurate recommendations.
- Integrates data analytics to rank attractions by popularity, reviews, and relevance.

Key Features:

- Provides links to interesting places with ratings and popularity insights.
- Adapts suggestions based on user interests (e.g., historical, cultural, natural landmarks).



Location history Agent



Functionality:

- Summarizes historical and cultural facts about tourist attractions.

Workflow:

- Uses data from Wikipedia.
- Processes and summarizes information using LLM capabilities.

Key Features:

- Enhances user experience with concise, digestible summaries.
- Adds cultural and historical value to travel recommendations.
- Improves engagement by providing meaningful insights about destinations.



Weather Agent



Functionality:

- Provides real-time weather updates and forecasts for travel destinations.

Workflow:

- Fetches data from OpenWeather API based on user travel dates and locations.
- Formats weather details such as temperature, precipitation, and wind conditions.

Key Features:

- Equips travelers with weather insights for packing and scheduling.
- Real-time updates ensure accurate and actionable information.
- Highlights weather-related contingencies to improve trip planning.



Inter-Agent Communication

Unified Functionality:

- Combines five agents—Flights, Hotels, Tourist Locations, Location History, and Weather—for personalized travel plans.

Workflow:

- **User Input:** Destination, dates, and budget details.
- **Task Allocation:** Distributed to agents.
- **Communication:** Agents share insights for cohesive outputs.

Key Features:

- Real-time data ensures accuracy.
- Personalized recommendations tailored to user needs.



User Interaction



User Prompt: *Recommend flights for round trip from Baltimore to Dallas on December 24th, 2024 and return on January 4th, 2025 within \$500.*

Observation: **Airline: Spirit Airlines**
Price: \$128.04
Departure: 2024-12-24T07:00:00
Arrival: 2024-12-24T09:17:00
Duration: 3 hours 17 minutes
Return Departure: 2025-01-04T21:18:00
Return Arrival: 2025-01-05T01:28:00
Return Duration: 3 hours 10 minutes

User Prompt: *Recommend me hotels in Dallas, Texas within \$250 per day and with Rating > 4.0*

Observation: **Hotel: Omni Dallas Hotel**

Rating: 4.5

Address: 555 S Lamar St, Dallas, TX 75202, United States

Price: \$228

Description: Sleek Lodging with dining & a pool. Sophisticated modern hotel offering a rooftop terrace with an infinity pool, plus dining & a spa.

User Interaction



User Prompt: *Recommend me tourist places and information regarding each of the tourist place in puducherry*

```
Thought: Now I have the list of tourist places in Puducherry
Action: Wikipedia History
Action Input: Serenity Beach
Observation:
There are many beaches on the Indian coast which stretches
Thought: The history of Serenity Beach is not available. I will
Action: Wikipedia History
Action Input: Rock Mountains - Picture Spot
Observation: Space Mountain is a space-themed indoor roller
```

> Finished chain.

Here are some tourist places in Puducherry:

1. Serenity Beach: It is located at XRFV+8W, Kottakuppam, Puducherry, T
2. Rock Mountains - Picture Spot: It is located at 9, St Louis St, Whit
3. Rock Beach: It is located at 23, Laporte St, MG Road Area, Puducherr
4. Arulmigu Manakula Vinayagar Devasthanam: It is located at WRPM+8F7,
5. Serenity Beach Sunrise Point: It is located at Villa La Serenity Cor

User Prompt: *What is the weather condition at Palakkad, Kerala?*

```
> Entering new AgentExecutor chain...
I need to use the Weather tool to get the current weather in Palakkad, Kerala.
Action: Weather
Action Input: Palakkad
Observation: The weather in Palakkad is scattered clouds with a temperature of 23.44°C.
Thought: I now know the final answer
Final Answer: The weather in Palakkad is scattered clouds with a temperature of 23.44°C.

> Finished chain.
The weather in Palakkad is scattered clouds with a temperature of 23.44°C.
```


Additional Agents



User Prompt: *Recommend restaurants with chicken biryani in Austria*

Observation: *Restaurant: Schloss Gabelhofen*

Rating: 4.7

Address: Schloßgasse 54, Fohnsdorf

Restaurant: Restaurant & Cafe Passhöhe

Rating: 4.5

Address: Für das Navi: Hohentauern 110 Offizielle Adresse:, Tauernstraße 21, Hohentauern

Restaurant: Familiengasthof Maier

Rating: 4.4

Address: Hauptstraße 2, Mautern in Steiermark



Restaurant Agent

Additional Agents



User Prompt: *What is the address of metro railway station near Royapuram, Chennai*

Observation: *Transport Hub: Royapuram*

Categories: building, building.historic, building.transportation, public_transport, public_transport.train

Address: North Terminus Road, Zone 5 Royapuram, Chennai - 600001, Tamil Nadu, India

User Prompt: *Recommend me public transportation in Vanasthalipuram, Hyderabad*

Transport Hub: Panama

Categories: public_transport, public_transport.bus

Address: Panama, National highway 65, Ward 15 Vanasthalipuram, Hyderabad - 500963, Telangana, India

Transport Hub: Vanasthalipuram

Categories: public_transport, public_transport.bus

Address: Vanasthalipuram, NH65, Hayathnagar mandal, Hyderabad - 500070, Telangana, India

Local Public Transport Agent



Challenges



❑ Latency Issues:

- Flight Agents face delays from real-time data fetching and aggregation, causing slow responses and affecting user experience.

❑ Cost of API Usage:

- Optimize API calls for flights, hotels, and weather to lower costs while maintaining accurate results.

❑ Real-Time Updates:

- Ensuring accurate, dynamic data for flights, weather, and attractions is challenging due to potential delays or inaccuracies.

❑ API Dependency:

- Reliance on third-party APIs risks downtime, format changes, or data unavailability.



Future Improvements

➤ **Enhanced Personalization:**

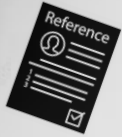
- Leverage advanced ML models to predict user preferences and recommend activities based on interests and behavior.

➤ **Scalability:**

- Optimize system for higher user volume with caching to reduce latency and API dependency.

➤ **Integration of More Features:**

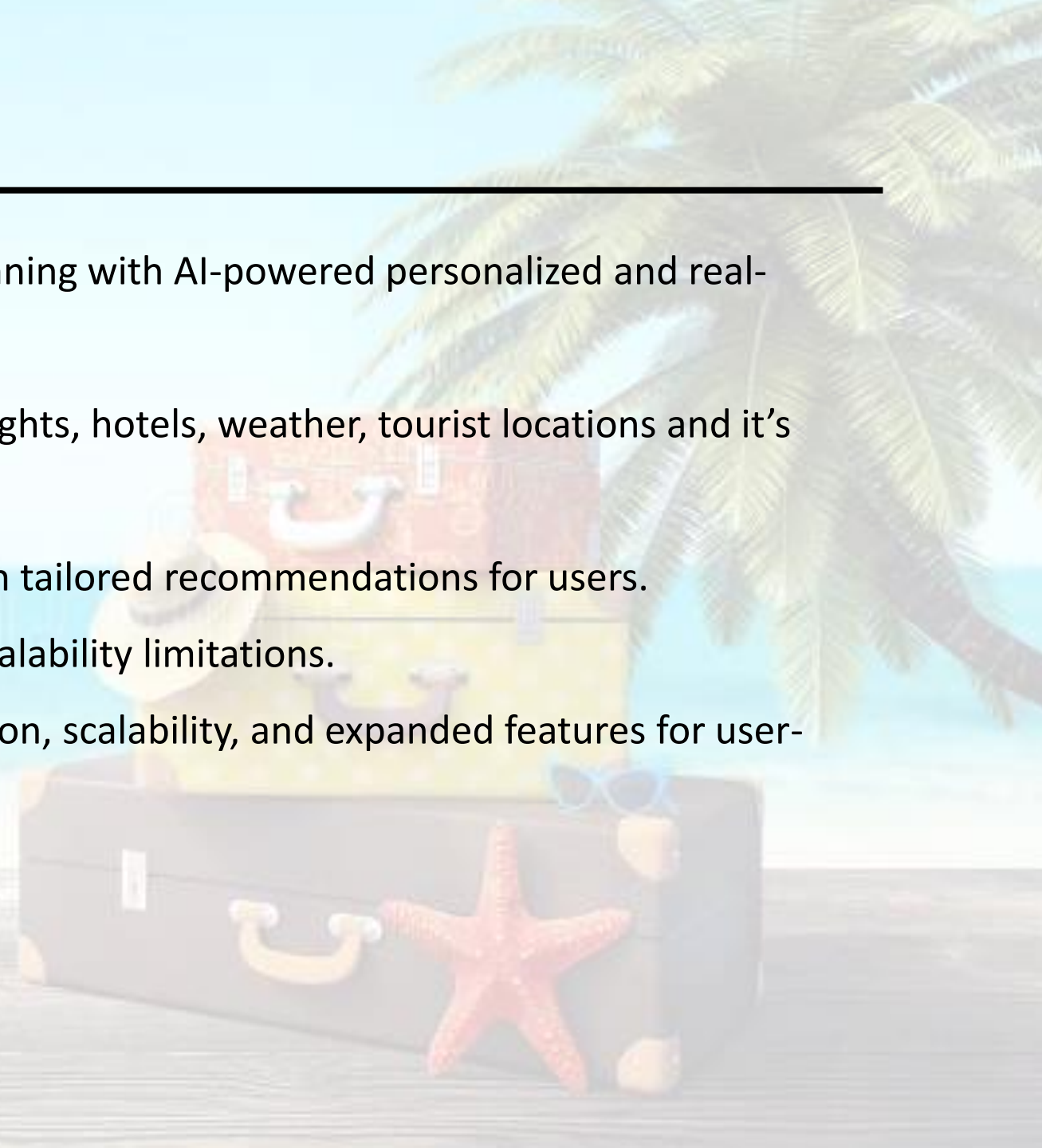
- Add local events, transportation, and group travel planning with collaborative itinerary sharing and adjustment tools.



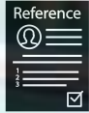
Conclusion



- ✓ Revolutionizes trip planning with AI-powered personalized and real-time assistance.
- ✓ Integrates agents for flights, hotels, weather, tourist locations and it's history via LangChain.
- ✓ Simplifies planning with tailored recommendations for users.
- ✓ API dependency and scalability limitations.
- ✓ Enhanced personalization, scalability, and expanded features for user-centric travel planning.



References



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