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Machine Learning Based Virtual Concierge for Planning Group Activities

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ABSTRACT

When a group of individuals attempt to plan a group activity such as a joint trip to a common destination, the presence of conflicting constraints makes it difficult to arrive at a plan that is agreeable to all. This disclosure describes a virtual concierge that accepts as input multiple, potentially conflicting constraints from multiple individuals planning collective travel (or other group activity) and outputs optimized recommendations tailored for the individuals in the group. The virtual concierge application can leverage large language models (LLM) for language understanding and for natural user interactions. The virtual concierge can generate prompts for an LLM that has been efficiently tuned using techniques such as adapter layers, few-shot prompt tuning, etc. Machine learning (ML) can be used to generate a set of recommendations based on the preferences of different individuals in the group.

KEYWORDS

- Virtual concierge
- Virtual assistant
- Machine learning
- Large language model (LLM)
- Group travel
- Group activity
- Travel planning
- Multifactor optimization
- Complex optimization

BACKGROUND

When a group of individuals attempt to plan a joint trip to a common destination (or another activity together), the presence of conflicting constraints or variables (e.g., cost constraints, origin locations, activity preferences, etc.) makes it difficult to arrive at a plan that is agreeable to all. With a complex set of constraints, the complete set of available options needed to arrive at informed decisions may be difficult to find or may be overlooked, resulting in a suboptimal plan or no feasible plan at all.

While travel websites that enable searching for travel tickets, hotels, and other services can be used to plan for a group of individuals, such planning requires manual effort and is tedious. Also, manually created plans are only feasible if the members of the group have some flexibility with their travel plans. Currently, a group of individuals with multiple starting points and a common destination may choose to engage a travel agency or a (human) advisor, who accounts for the multiple inputs (time, budget, origin/destinations, etc.), searches for results for various combinations of options, and summarizes the set of optimal options. Hiring a human advisor for such labor-intensive and time-consuming tasks can be expensive.

DESCRIPTION

This disclosure describes a virtual concierge that accepts as input multiple, potentially conflicting requests from multiple individuals planning collective travel or other joint activity and outputs optimized recommendations that take into account preferences of various individuals in the group. The virtual concierge can be offered as a service provided by a virtual assistant, or via a separate software application, e.g., web or mobile application. The virtual concierge application takes multiple inputs such as time, budget, activities of interest, origin/destinations,

etc. from multiple users and generates outputs that are optimized to prioritized requirements of the group of users.

Example user journey with virtual concierge

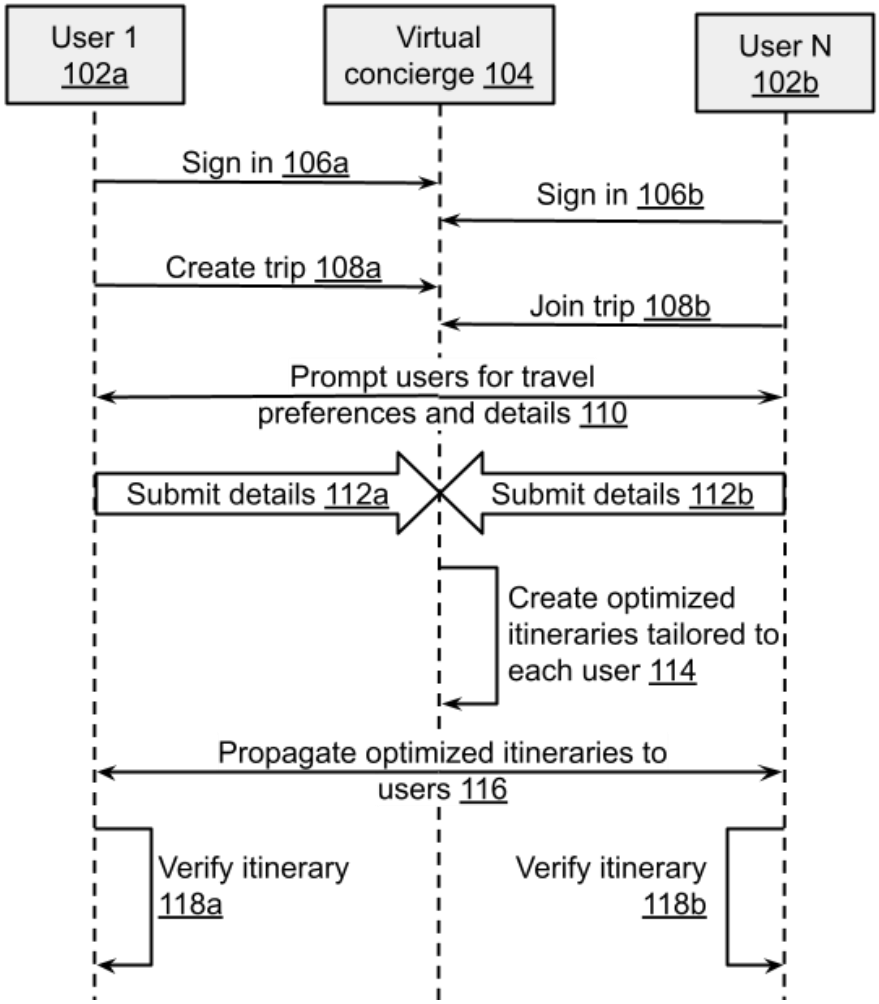

Fig. 1: Automatic travel recommendations to a group of individuals with varying preferences

An example user journey is illustrated in Fig. 1. Each user (102a, 102b, and any number of other users) of the group signs in to (106a, 106b) their respective virtual concierge application (104). The user is prompted to either create a new trip (108a) or join an existing trip (108b) initiated by their co-travelers. Users can create a new trip and share the trip ID to enable others in

the group to join. Trip creators are prompted to allow or deny other users requesting to join their trip.

Users who have joined a trip are prompted to submit their details as input variables (110). Next to a variable are input elements, e.g., yes/no checkboxes, sliding scales, etc. that enable the user to provide an indication of the degree of flexibility with the variable. Some examples of variables that the user may provide details for are: dates/times of availability; geographic location; total budget in aggregate and/or for each component; travel preferences (e.g., airline, hotel, etc.); preferred activities (e.g., concert tickets, theme parks, hiking, etc.); preferred restaurants; etc.

The users submit their travel preferences and other details (112a, 112b). Depending on the type of variable (binary, numerical, enumerated, etc.), users can indicate their preference for the variable using yes/no checkboxes, sliding scales, etc. Users can limit search results to given time periods, costs, etc. Users can also type in lower-end/upper-end times, costs, etc.

Based on the preferences and inputs submitted by users, the virtual concierge application automatically generates optimized options of sample itineraries, with projected total costs for the trip and for each individual (114). Details generated by the virtual concierge application include logistics and times between events/activities (e.g., time to airport, flight times, times to get from hotels to restaurants, etc.); costs of each component and of the entire trip; etc.

For example, traveler A can have an optimized flight option leaving from origin X at time Y, while traveler B can have a different option leaving from origin U at time V. Both A and B are scheduled to meet at the same destination at about the same time for a group trip. The virtual concierge application can leverage a large language model (LLM) for language understanding

and for natural interactions with the users. Machine learning (ML) can be used to generate a set of recommendations based on users' preferences and inputs.

A sub-module of the virtual concierge can generate prompts for the LLM backend. LLM parameters can be efficiently tuned using techniques such as adapter layers, few-shot prompt tuning, etc. To filter out misleading or inaccurate information that may inadvertently be generated by the LLM, the output (given a certain prompt) is verified (118a, 118b) for correctness, e.g., using real-time, web-based verification of the itinerary and of costs. The real-time check can be done by querying online airline, hotel, and/or other travel-booking services.

The ML model can be trained using travel reviews. With user permission, the ML model can also determine and leverage similarities between the set of co-travelers on the trip and a general pool of travelers. A confidence score can accompany a generated recommendation. Options provided to users can show the basis for optimization, e.g., 'Trip X recommendation is optimized for costs across users'; 'Trip Y recommendation is optimized for dates across users'; 'Trip Z recommendation is optimized for location across users'; etc. Options suppressed or excluded to enable the reaching of a consensus are shown alongside activities that can be manually included or excluded by users to reach a different consensus. To assure themselves that they are on the same page, users can confirm the details of the trip with co-travelers. Links can be provided to appropriate sites (hotel, airline, itinerary, etc.) to verify booking and to enable users to make additional associated travel arrangements as necessary.

Interface

The described virtual concierge can be implemented as a web application, a mobile application, etc. A virtual assistant can be used as the initial interface for creating group trips. For example, a user can initiate a conversation with the virtual assistant with a prompt such as

"Hello virtual assistant, let's take a trip." Upon detecting the prompt, the assistant starts the virtual concierge application.

Alternatively, a virtual assistant can detect, with user permission, that the user is looking for travel or vacation options, based, e.g., on recent search histories that indicate searches for flights, hotels, etc. Upon detection of user intent, the virtual assistant can prompt the user via a notification and, if the user clicks on the notification, the virtual assistant can start the virtual concierge application (or mode). Furthermore, the virtual assistant can determine, via interaction with the user, the names of co-travelers. With user permission, messages are sent to the virtual assistants of the co-travelers, and, with the permissions of the co-travelers, their virtual concierge applications are started.

The virtual concierge service can be made accessible from such services as travel booking services, map applications, calendar applications, form applications, email or chat applications, etc. With user permission, the virtual concierge can query applications such as maps, calendars, forms, etc. to determine user constraints.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs, or features described herein may enable the collection of user information (e.g., information about a user's calendar, email or chat messages, search activity, activities of interest, social network, social actions or activities, profession, a user's preferences, or a user's current location), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is

obtained (such as to a city, ZIP code, or state level) so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

This disclosure describes a virtual concierge that accepts as input multiple, potentially conflicting constraints from multiple individuals planning collective travel (or other group activity) and outputs optimized recommendations tailored for the individuals in the group. The virtual concierge application can leverage large language models (LLM) for language understanding and for natural user interactions. Machine learning (ML) can be used to generate a set of recommendations based on the preferences of different individuals in the group.

REFERENCES

1. Zaken, Elad Ben, Shauli Ravfogel, and Yoav Goldberg. "Bitfit: Simple parameter-efficient fine-tuning for transformer-based masked language-models." *arXiv preprint arXiv:2106.10199* (2021).
2. Hu, Edward J., Yelong Shen, Phillip Wallis, Zeyuan Allen-Zhu, Yuanzhi Li, Shean Wang, Lu Wang, and Weizhu Chen. "Lora: Low-rank adaptation of large language models." *arXiv preprint arXiv:2106.09685* (2021).
3. “LaMDA: our breakthrough conversation technology” available online at https://blog.google/technology/ai/lamda/ accessed August 10, 2023.
4. “Google Bard” available online at https://bard.google.com/ accessed August 10, 2023.