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Destination Search With User-specified Constraints

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ABSTRACT

When issuing destination-related queries users sometimes include on or more constraints within the query. Even though a search engine can be used to search for data regarding each constraint individually, users need to integrate the individual results manually based on separate searches for different types of data. This disclosure describes techniques to retrieve and present search results for destination-related queries based on user-specified constraints present within a user query. The results are obtained by performing separate searches based on various constraints specified in the user query and combining and filtering the results to include only those results that match all constraints. The results are sorted based on specific criteria prior to presentation to the user.

KEYWORDS

- Destination search
- Search engine
- Search query
- User-specified search constraint
- Search result filtering
- Search result sorting

BACKGROUND

Users often use search functionality to issue queries regarding activities and/or destinations. For example, a user planning an outdoors activity may search for “nearby hiking trails.” Such queries that are connected to a user’s underlying intention to go to various places (e.g., parks, hiking trails, malls, restaurants, sports arenas, etc.) to engage in various activities (e.g., walking, hiking, mountain biking, shopping, dining, entertainment, etc.) are considered destination queries.

When issuing destination queries, users sometimes include one or more constraints within the query. For example, a user can include distance, time, and/or temperature constraints for desired hiking trails by issuing the query “hiking trails within 50 miles with temperature under 80F this weekend.” Typically, inclusion of such specific constraints within the query is a specification that is intended to filter the set of results that are returned in response.

Even though a search engine can be used to search for data regarding each constraint (e.g., distance, time, temperature, etc.) individually, current search engines do not necessarily take into account all constraints at the same time, which requires that the user conduct multiple separate searches for different types of data and then integrate the results. For example, the user may first search for and view a map of hiking trails within 50 miles, and then conduct a separate search for local temperature at each hiking trail of interest.

Destination search functionality within specific services, such as travel, often includes the ability for users to filter and/or sort results based on relevant features, such as item characteristics (e.g., difficulty level of hiking trails), amenities (e.g., hotel pool), etc. However, such services are limited to the set of features provided, and these may not include the constraints of interest. Further, the provided features and their underlying values are usually derived from a static database. As a result, sometimes, the information may not match current conditions. For example, a pool at a hotel may be under renovation and not available for use during the dates of the user’s stay at the hotel. Moreover, mechanisms based on a database of static information cannot support query constraints that are evaluated based on frequently changing dynamic data, such as temperature, traffic, etc.

DESCRIPTION

This disclosure describes techniques to retrieve and present search results for destination queries based on user-specified constraints present within the queries. With user permission, the base query and constraints are identified by parsing the query using standard techniques.

Search results are first retrieved for the base destination query and the set of results is progressively filtered to retain only those results that match each user-specified constraint within the query. The search engine can obtain results that match a given constraint via separate searches specific to the constraint. The constraint-specific searches can be general-purpose Internet searches and/or lookups of sources providing specific types of data, such as weather, traffic, maps, etc.

The set of results that remain after all constraint-specific filtering is performed can be shown to the users. The display can include the results sorted in a default order based on a specific criterion, such as relevance, or in a user-specified order, e.g., based on priority ordering between the different constraints.

For example, consider the destination-related user query “hiking trails within 1-hour driving distance with temperature less than 80F and no rain.” In this case, the results retrieved for the base destination (“hiking trails”) are filtered to retain only those results that match both user-specified constraints: (i) distance (“within 1-hour driving distance”), determined based on obtaining the user’s current location, with user permission; and (ii) weather (“temperature less than 80 F and no rain”). The final results can be shown in the same order as the results for the base destination query, after removal of results that don’t match the constraints.

In some cases, one or more of the user-specified constraints within the query can be used for result sorting instead of filtering. Typically, constraints that do not specify an exact value or an exact range of values are suitable to be used as criteria for sorting. For instance, the query "less crowded grocery stores selling seafood within 20 miles" can show results for the base destination ("grocery stores") that match the two user-specified constraints with precise values: (i) distance ("within 20 miles") calculated based on digital maps; and (ii) food availability ("seafood" obtained or inferred based on online store information, such as description, reviews, photos, etc. Since no precise desired value or range is provided for the third constraint ("crowdedness"), it is used to sort the results using relevant data, such as nearby or in-store traffic.

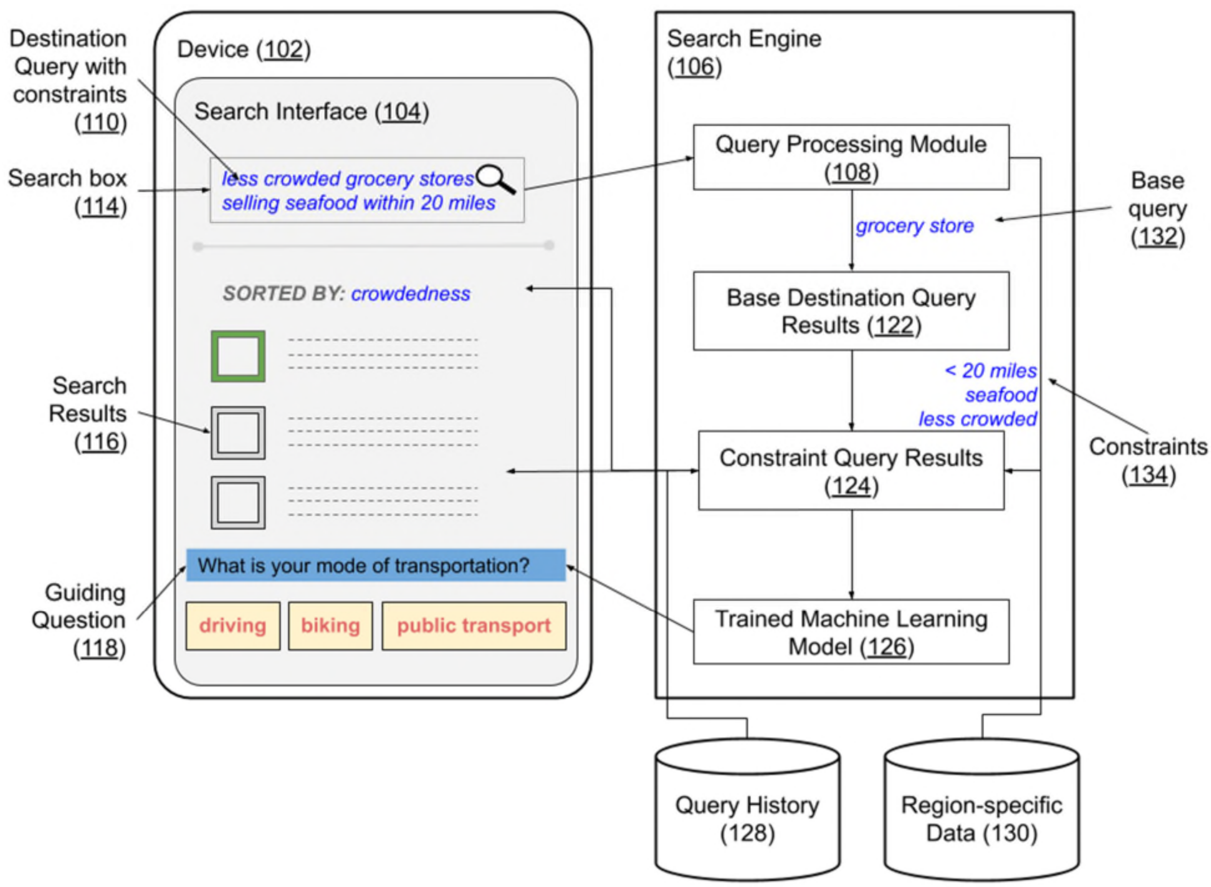

Fig. 1: Filtering and sorting search results based on constraints included within the query

Fig. 1 shows an example of operational implementation of the techniques described in this disclosure. A user employs a search interface (104) on a device (102) to enter a destination query (110) in the search box (114). Along with the base destination (132) (grocery store), the query specifies constraints (134) pertaining to distance (within 20 miles), food type (seafood), and traffic (less crowded).

After the query is relayed to the search engine (106), it is first parsed (108) to extract the base query and constraints. For example, such parsing can be performed using natural language processing techniques, e.g., implemented via one or more machine learning models. Search results corresponding to the search query (122) are filtered based on results matching the constraints (124). If users permit, the results can be further filtered based on user search history (128) and/or relevant region-specific data (130) as described further below. The user is shown the filtered result set (116). Since the constraint on traffic does not include an exact value or range, it is used for sorting the displayed results. As further detailed below, a trained machine learning model (126) can be used with permission to generate relevant guiding questions (118) to help the user specify additional constraints that can be used to further refine the result set. In this case, Fig. 1 illustrates that the user is asked for the mode of transportation to the destination.

If constraints in the query are determined to be underspecified and/or missing, users can be prompted for clarification or asked to provide additional relevant information in order to refine the search results obtained for the initial query. For example, if a user issues the query “cool temperature activity within 1-hour distance,” additional user input can be sought to refine the results based on one or more guiding questions, such as:

- What is your mode of transportation: driving, walking, biking or using public transportation?

- What temperature do you consider to be sufficiently cool?
- Which of the following activities would you prefer: hiking, shopping, going to the beach, picnicking?

Results can then be filtered and/or sorted based on the user responses to such guiding questions or suggestions. Though the answers to the questions may change over time, the user's prior answers can be stored (with permission) and used as defaults for future queries. Users can modify the defaults as they desire.

With user permission, the guiding questions or suggestions to refine the search criteria and/or sort order can be generated using a suitably trained machine learning model. The model can be used to generate the guiding questions or suggestions based on user permitted factors such as:

- Search history;
- Current events or situations that can impact available destinations and routing (e.g., a marathon that blocks off specific roads, a weather-related advisory affecting outdoor activities, etc.); and
- Local regulations that affect potential choices (e.g., fishing restrictions for a lake, permissible hours for construction activity, etc.).

With user permission, the guiding questions or suggestions can be presented using any suitable user interface (UI) such clickable search suggestions shown along with the initial search results or questions within corresponding input boxes that show example answers. For instance, the query “activity within 1-hour distance,” can result in the user being presented two input boxes with the following text:

Box 1: "What is your mode of transportation?: *driving, walking, biking...*"

Box 2: "What type of activity?: *outdoors, indoors…*"

The search results and sort order can be based on past selections for similar queries. For instance, such decisions can be inferred based on information such as data regarding interaction with the search results, navigation within a digital map application, location history, etc. obtained and utilized with specific user permission.

Locations corresponding to a query can be aggregated and used as results for similar queries from users in the same geographic region. For example, a lookup table can be constructed that maps queries to locations such that the locations corresponding to a query can be aggregated and used as results for similar queries from users in the same geographic region. For example, if most users in a given region searching for "outdoor activities in temperatures under 80F on a weekend" chose to go hiking at a particular nearby state park, hiking trails at the park can be shown as the top search results to anyone within that region searching for nearby weekend outdoor activities in cool temperature.

The described techniques can be incorporated to support search mechanisms within a general-purpose search engine as well as within specific destination-seeking applications, such as digital maps, travel portals, restaurant review websites, etc. Further, with user permission, the techniques can be integrated within a virtual assistant that can be used via a smartphone, smart speaker, smart display, or other smart appliance. When the constrained search as described herein is performed using a voice activated virtual assistant, users can issue queries and provide constraints via voice input.

The described techniques can reduce the time and effort needed to perform multiple destination searches and to manually combine results from separate destination-related searches for different sets of constraints, thus enhancing the search user experience (UX).

Further to the descriptions above, a user is provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's search history, 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 is 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 has 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 techniques to retrieve and present search results for destination-related queries based on user-specified constraints present within a user query. The results are obtained by performing separate searches based on various constraints specified in the user query and combining and filtering the results to include only those results that match all constraints. The results are sorted based on specific criteria prior to presentation to the user. If constraints in the query are underspecified, users can be provided suggestions to select or clarify constraints. The described techniques can be used in general-purpose as well as vertical search engines and can also be used to respond to queries provided to a virtual assistant.