SUMMARIZING HISTORY INFORMATION FOR AN INTERACTIVE ASSISTANT

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ABSTRACT

An interactive assistant, referred to herein as “an interactive assistant,” “a virtual assistant,” or simply an “assistant,” may be configured to index, cluster, and/or summarize interaction history information based on interactions with one or more users over time. For example, an interactive assistant may accept queries from these users, search interaction history information, and provide summaries of prior interactions (e.g., via audible output, output in a browser or other viewable window, output in a messaging application communicating with the assistant, etc.) between the interactive assistant and the users based on one or more criteria specified by these queries. In some cases, the interactive assistant may provide summaries of topics of categories (e.g., dining, entertainment, games, unit conversions, television controls, biographies) associated with prior user interactions with the assistant (e.g., over all time or over a specified time period), and the user may optionally drill down to obtain further detailed information about the prior interactions in these topics or categories. In such fashion, the interactive assistant can search the interaction history information and provide a summarization of portions of the history that may be relevant to queries, including not only keywords but also topics and concepts that may be of interest to users of the interactive assistant.

DESCRIPTION

An interactive assistant, such as shown in the example of Figure 1 below, may be included in a computing system that is configured to interact with one or more users. The interactive assistant may be, include, or otherwise be included in a mobile device (e.g., smart
phone, tablet computer, laptop computer, computerized watch, computerized eyewear, computerized gloves), a personal computer, a smart television, a personal digital assistant, a portable gaming system, a media player, a mobile television platform, an automobile navigation and/or entertainment system, a vehicle (e.g., automobile, aircraft) and/or cockpit display, or any other type of wearable, non-wearable, mobile, or non-mobile computing device. In some cases, the interactive assistant may be a voice-assistant that receives audible user commands, processes the commands based on speech recognition operations, and performs corresponding actions, such as providing audible responses to user queries, and the computing system shown in Figure 1 may or may not include a display device. The interactive assistant may provide a user interface with which a user can communicate to cause the assistant to output useful information, respond to a user’s queries, or otherwise perform certain operations to help the user complete a variety of real-world or virtual tasks.

In many cases, a user who has repeatedly interacted with the interactive assistant over time may wish to access interaction history information related to the user’s prior interactions. In a simple case, the user may initiate a keyword search (e.g., via an audible or a manual query). The interactive assistant may perform a search in a database or log of historical interaction information, locally and/or via a remote server, to provide the user (e.g., audibly, visually) with search results that correspond to the keyword search. However, using only keyword searching, the interactive assistant may potentially miss or over report various items, or fail to capture a user’s intent based solely on keywords.

The computing system shown in Figure 1 below provides users with an ability not only to perform keyword but also conceptual searching, whereby the interactive assistant and/or external
computing system(s) may index interaction history information that is saved in a data store, and may access and summarize such information, responsive to user queries, to provide a summary of actual interaction information between users and the interactive assistant.

For example, the interactive assistant may perform a concept search to collect and provide portions of interaction history information that is responsive to a user’s query by
summarizing relevant information or topics associated with the concept search. The results of the summaries may be output in one or more forms. For example, the result summaries may be audibly output, output in a browser or other viewable window, output in a messaging application that communicates with the interactive assistant, and so forth. In some cases, the result summaries may be stored on the local computing system (e.g., in the interaction history) and/or output to one or more external computing systems.

As shown in Figure 1 above, the computing system that includes the interactive assistant may include one or more input devices and one or more output devices. For instance, the input devices may include one or more microphones, a presence-sensitive input device (e.g., a touch-sensitive screen), a mouse, a keyboard, a voice responsive system, a camera, or any other type of device for detecting input from a human or machine. In some cases, the input device may one or more location sensors (GPS components, Wi-Fi components, cellular components), one or more temperature sensors, one or more movement sensors (e.g., accelerometers, gyroscopes), one or more pressure sensors (e.g., barometer), one or more ambient light sensors, and/or one or more other sensors (e.g., camera, infrared proximity sensor, hygrometer, and the like). Other sensors may include a heart rate sensor, magnetometer, glucose sensor, hygrometer sensor, olfactory sensor, compass sensor, step counter sensor, to name a few other non-limiting examples.

The computing system may also include one or more output devices, such as one or more speakers or display screens, including a presence-sensitive screen (e.g., touchscreen), or any other type of device for generating output to a human or machine. In some cases, the input devices and/or output devices may include one or more other type of wearable, non-wearable, mobile, or non-mobile computing devices that are also used by the user. One or more of the
input and/or output devices may be external to and communicatively coupled (e.g., via a wired or wireless connection) with the computing system.

The computing system may also include a user interface module that is configured to manage inputs received by the interactive assistant as users interact with it, and may be configured to receive additional instructions from applications, services, platforms, or other modules of the interactive assistant that process user input. The user interface module may also be configured to process output that is provided to users, and may be coupled to the input device(s) and output device(s) of the computing system. The computing system may also include a speech recognition module, which may interface with the user interface module and the interactive assistant. When a user provides audible input to the interactive assistant (e.g., commands, questions, queries), the interactive assistant may use the speech recognition module to process such audible input.

Over the course of time, an individual user, such as the one shown in Figure 1, may interact with the interactive assistant. The user may utilize one or more applications that are executed by the assistant to perform various actions. For example, the user may use the interactive assistant to search for different restaurants in one or more cities of California, and may also make reservations or order delivery of food from one or more of these restaurants. In some cases, the user may even rate one or more of the restaurants based on the user’s experience(s) with these restaurants. The user may perform such operations by, e.g., providing manual, audible, tactile, or other form of user input.
As another example, the user may use the interactive assistant to order one or more packages for delivery to the user’s home or place of business. In this example, the user may use the interactive assistant to place these orders with one or more vendors for delivery.

In these and other examples, while interacting with the user, the interactive assistant may collect, cluster and/or index data for storage in one or more data stores that store interaction history information. In some cases, the interactive assistant may store the interaction history locally on the computing system, while in other cases, the interactive assistant may store at least part of the history on one or more external computing systems, as shown in Figure 1, which are coupled to the interactive assistant via one or more networks (e.g., one or more wired and/or wireless networks).

The interactive assistant may use an indexing module to index or classify the information that is stored in the interaction history. In doing so, the assistant may identify contextual signals that are associated with the interactions with a user, and may index the interaction information based not only on the content of the actual interaction but also on the context of the interaction (e.g., using tags and/or metadata). For example, the assistant may identify any particular actions or types of activity a user performs during a given interaction, or particular applications that are executed by the assistant during the interaction, to name only a few non-limiting examples. The assistant may also identify the location of the user and/or the computing system (e.g., if the computing system is a mobile device), and/or the time at which interactions take place. In addition, the assistant may, in some cases, identify other users or individuals who are present with the user during a given interaction (e.g., via voice recognition or input provided by the user).
The indexing module may utilize any such contextual information, in conjunction with
the interaction content, when indexing or classifying the interaction history information. The
indexing module may also utilize metadata, tags, or other classifiers when indexing or storing the
interaction history information. For example, the indexing module may index or store
interaction history information based on one or more topics or categories associated with the user
interactions based on interaction content and/or context (e.g., dining, entertainment, games,
timers, unit conversions, search queries, television controls, actor or actress biographies, and the
like). Furthermore, the indexing module may index such information on a per-user basis.
Because various different users may, over time, utilize the interactive assistant, and the indexing
module is capable of indexing and storing interaction history information on a user-by-user basis.

In the earlier example described above, where a user may use the interactive assistant to
search for different restaurants in one or more cities of California, as well as making reservations
or ordering delivery of food from one or more of these restaurants, the indexing module may
index interaction history information associated with these user interactions. For example, if the
user searches for Mexican restaurants in Mountain View on March 1st, makes a reservation at a
particular restaurant on March 1st using the assistant, and later inputs a user review or rating of
this particular restaurant, the indexing module may index and store the information associated
with these user interactions in the interaction history. The indexing module may tag or otherwise
associate the contextual information associated with these interactions in the interaction history
(e.g., category of Mexican food/restaurant, location of Mountain View, date of March 1st, date of
reservation/order, name of restaurant, user review/rating).
If the same user subsequently performs a search on March 2nd for Italian restaurants in Mountain View and Sunnyvale, and then orders delivery from an Italian restaurant identified from the search, the indexing module may similarly tag or otherwise associate the contextual information associated with these interactions in the interaction history. The indexing module may index or classify the stored interaction information based on contextual information such as date of restaurant search, date of reservation/order/delivery, name of restaurant, location of restaurant, type of restaurant, number of different times searching/making reservations or orders for a specific restaurant, specific food purchased, types of food purchased, and/or rating of restaurant, to name a few non-limiting examples, and any of this type of information may be used for topic or category clustering of stored interaction information.

In the other earlier example described above, where the user may use the interactive assistant to order one or more packages for delivery to the user’s home or place of business, the indexing module may index and store similar information in the interaction history. For example, the indexing module may index or classify the stored interaction information based on contextual information such as date of order, name of vendor, requested or anticipated delivery date, address of expected delivery (e.g., home or business), products purchased, and/or method of shipment, to name a few non-limiting examples, and any of this type of information may be used for topic or category clustering of stored interaction information.

At a later point, such as shown in the example of Figure 1, the user may issue a query to the interactive assistant to perform a search. For instance, the user may audibly speak the query, or may alternatively input the query via manual or touch input. In any case, the interactive assistant may use a search/summarization module to perform a search of the indexed interaction
history and provide summarized search results that may be relevant to the user’s query. The summarized search results may provide user access to a summary of actual interaction information between users and the interactive assistant. For example, the interactive assistant may use the search/summarization module to perform a concept search to collect and provide portions of interaction history information that are responsive to the query by summarizing relevant information or topics associated with the concept search. The results of the summaries may be output in one or more forms. For example, the result summaries may be audibly output, output in a browser or other viewable window, output in a messaging application that communicates with the interactive assistant, and so forth. In some cases, the result summaries may be stored on the local computing system (e.g., in the interaction history) and/or output to one or more external computing systems.

As shown in the non-limiting examples of Figure 1, a user, for instance, may submit a query in the form of an audible question when interacting with the assistant. Figure 1 shows the user asking the following question: “What are my favorite restaurants in Mountain View?”

The user interface module and/or speech recognition module may process the audible input and determine the query associated with the audible question. The search/summarization module may then search for relevant information in the interaction history (e.g., stored either locally on the computing system and/or one or more external computing systems) and provide summarized results back to the user.

In this instance, the assistant may first discern the identity of the user. In some cases, the assistant may identify the user based on login or other information that has been previously input by the user into the system. In other cases, the assistant may use speech recognition module to
discern the identity of the user (e.g., based on previously collected voice samples or trained acoustic model data).

The search/summarization module may then obtain pertinent information from the interaction history that has been previously indexed or classified for the particular user who has asked the question. The question itself includes the concepts of favorite restaurants in Mountain View. The search/summarization module may parse the query to identify one or more concepts and/or keywords and may search the interaction history for interaction data of the user related to these concepts or keywords (e.g., restaurant searching, reservations, orders, deliveries, ratings, locations, and the like), which are pertinent to the user’s query. The search/summarization module may identify interaction history data for interactions the user has had related to restaurants located in Mountain View for which the user has frequently accessed, searched, made reservations/orders, rated highly, and the like.

As described previously, the user may have previously interacted with the assistant to search for different restaurants in one or more cities of California, and also make reservations or order delivery of food from one or more of these restaurants. The search/summarization module may search the interaction history for prior user interactions associated with restaurants in Mountain View, as opposed to interactions associated with other entities (e.g., bowling alleys) or interactions associated with restaurants in other cities of California.

In some cases, the search/summarization module may output (e.g., via visual and/or audible feedback at the output devices) a synthesized list of any restaurants that the user has searched for or identified in Mountain View, along with related interaction information associated with prior interactions with these restaurants. For example, the summary may include
a list of such restaurants and a brief history of prior user interactions associated with these restaurants (e.g., date of interaction, what type of search was performed, name/location of restaurant, whether the user made a reservation or ordered food from these restaurants, which food was ordered). The search/summarization module may include various information for the search results, such as interaction date, type of restaurant (e.g., Mexican, Italian), whether the user made a reservation or ordered food from a given restaurant, restaurant location, and the like.

Because the user requested a list of the user’s favorite restaurants in Mountain View, the search/summarization module may order the search results based, for example, on the number of the times the user has searched for particular restaurants, made reservations or ordered food from particular restaurants, or provided positive ratings/feedback for particular restaurants. For those restaurants determined to be more popular or favorites of the user, the search/summarization module may include summarized search results associated with these restaurants and/or interactions at the top of the list.

In such fashion, the search/summarization module may generate a summary of interaction history associated with the user’s query based on topics of concepts that are relevant to the query. In addition, the user may adjust, filter, sort, or otherwise modify the search results per the user’s preferences based on any of the criteria noted above. For example, the user may only want to see summarized results for Mexican restaurants in Mountain View at which the user has actually made reservations in the last month (e.g., by providing an additional audible or other input-based query). In this case, the search/summarization module may alter the summarized search results based on the user’s updated query. The user may then sort the search results based on reservation date, restaurant location, restaurant name, rating, and the like.
If the user wishes to filter the summarized list by restaurants of a particular type (e.g., Mexican, Italian) that are closest to the user’s location and that the user has previously rated highly, the search/summarization module may adjust the search results accordingly. In such fashion, the user may retrieve history information based on one or more data dimensions for search criteria or filters. In addition, if the user wishes to see expanded information not included in the summary for one or more of the prior interactions, the user may provide a request or updated query to see expanded information for one or more identified prior interactions not initially included in the summary. As a result, the interactive assistant is capable of providing useful summary information but also detailed interaction information at the request of the user, and depending on the user’s preferences.

As also shown in the non-limiting examples of Figure 1, in another example, a user may submit another, separate query in the form of the following audible question: “What is the status of the different items I ordered online last Tuesday?” In response to this query, the search/summarization module may search for relevant information in the interaction history (e.g., stored either locally on the computing system and/or one or more external computing systems) and provide summarized results that are specific to the user. For example, the search/summarization module may search the interaction history for interaction data related to package orders made by the user with the assistant last Tuesday in which the user requested delivery to the user’s home or place of business.

The summary may include a list of such package orders and a brief history of the prior user interactions with the assistant associated with such orders (e.g., date of order, name of vendor, requested or anticipated delivery date, address of expected delivery, product(s)
purchased, and/or method of shipment). The summary may also include a current status of each order (e.g., ordered, delivered, en route). The user may adjust, filter, sort, or otherwise modify the search results per the user’s preferences based on any of the criteria noted above. For example, the user may only want to see summarized results for packages ordered for a particular vendor, in which case the search/summarization module may adjust the search results that are output to the user accordingly. In addition, if the user wishes to see expanded information not included in the summary for one or more of the prior interactions, the user may provide a request or updated query to see expanded information for one or more identified prior interactions not initially included in the summary.

In some cases, the search/summarization module is also capable of silencing or removing items from the interaction history in order to keep the history compact and clear. For example, in the first example above in which the user has asked for information about the user’s favorite restaurants in Mountain View, the search/summarization module may remove any interaction history information associated with restaurants that have gone out of business or that are no longer located in Mountain View, even if the user previously made reservations at these restaurants. The assistant may determine that these restaurants have gone out of business or are no longer located in Mountain View based, e.g., on updated information received from the Internet regarding these restaurants.

In the second example above in which the user has inquired about the status of items ordered online last Tuesday, the search/summarization module may filter out and/or remove any interaction history information associated with orders for packages that have been delivered.
The assistant may determine that these packages have been delivered based on user feedback and/or other information, such as online tracking information.

Furthermore, as noted earlier, in some cases, the interactive assistant may provide summaries of topics of categories associated with prior user interactions with the assistant (e.g., over all time or over a specified time period), and the user may optionally drill down to obtain further detailed information about the prior interactions in these topics or categories. For example, rather than speaking a specific question via one of the queries shown in Figure 1, the user may instead generally ask for the types of interactions the user has actually had with the interactive assistant over time (e.g., over all time or only over a specified period of time, such as the last two days). In response, the interactive assistant may use the search/summarization module to search the interaction history and output a list of only the topics or categories of prior user interactions (e.g., dining, entertainment, games, timers, unit conversions, search queries, television controls, online orders, actor or actress biographies, and the like) with the assistant. The results may optionally include the number of items in each topic or category. The user can then optionally provide one or more supplemental queries to drill down into one or more of these topics or keywords, such as by keyword, date or both. For example, in response to receiving general category information for online orders, the user may request more specific order information for all interactions associated with online orders placed last Tuesday. As another example, in response to receiving general category information for dining or restaurants, the user may request more specific information for all interactions associated with a particular restaurant or date. As yet another example, in response to receiving general category information for actor
or actress biographies, the user may request more specific information for all interactions associated with a particular actress name mentioned in the last month.