



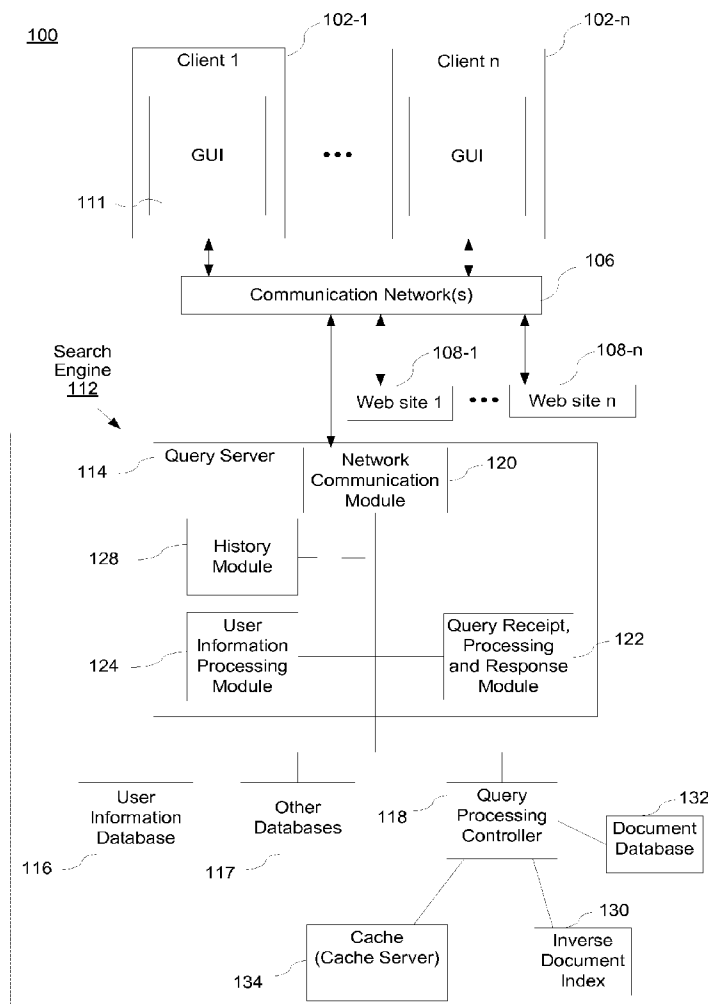
US 20160217173A1

(19) **United States**(12) **Patent Application Publication**
Jeh et al.(10) **Pub. No.: US 2016/0217173 A1**(43) **Pub. Date: Jul. 28, 2016**(54) **METHOD, SYSTEM, AND GRAPHICAL USER INTERFACE FOR ALERTING A COMPUTER USER TO NEW RESULTS FOR A PRIOR SEARCH****Publication Classification**(51) **Int. Cl.**
G06F 17/30 (2006.01)
(52) **U.S. Cl.**
CPC G06F 17/30368 (2013.01); **G06F 17/30371** (2013.01); **G06F 17/30864** (2013.01)(71) Applicant: **Google Inc.**, Mountain View, CA (US)(72) Inventors: **Glen M. Jeh**, San Francisco, CA (US);
Beverly Yang Wong, San Francisco, CA (US)(21) Appl. No.: **15/093,351**(22) Filed: **Apr. 7, 2016****Related U.S. Application Data**

(63) Continuation of application No. 14/179,721, filed on Feb. 13, 2014, now Pat. No. 9,323,846, which is a continuation of application No. 13/043,400, filed on Mar. 8, 2011, now Pat. No. 8,694,491, which is a continuation of application No. 11/323,096, filed on Dec. 30, 2005, now Pat. No. 7,925,649.

(57) **ABSTRACT**

A method, system, and graphical user interface for alerting a computer user to new results for a prior search are disclosed. One aspect of the invention involves a graphical user interface on a computer that includes a plurality of links recommended by a search engine for a computer user. The plurality of links are determined by the search engine by: producing search results by rerunning a plurality of search queries that have been performed previously for the computer user; and evaluating the produced search results to select search results that meet predefined search result selection criteria. At least one of the criteria is based on Internet usage data for the user.



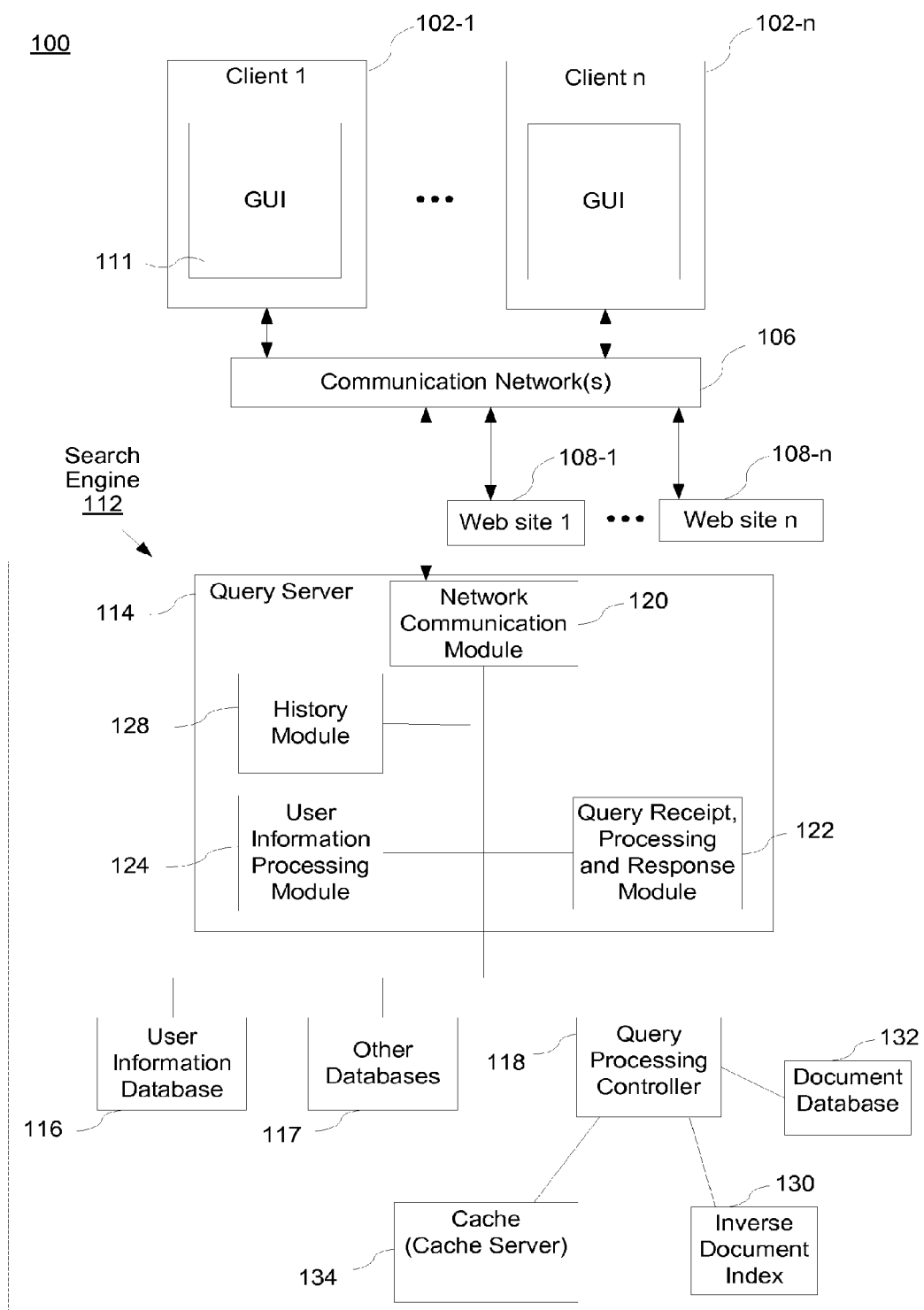


Figure 1

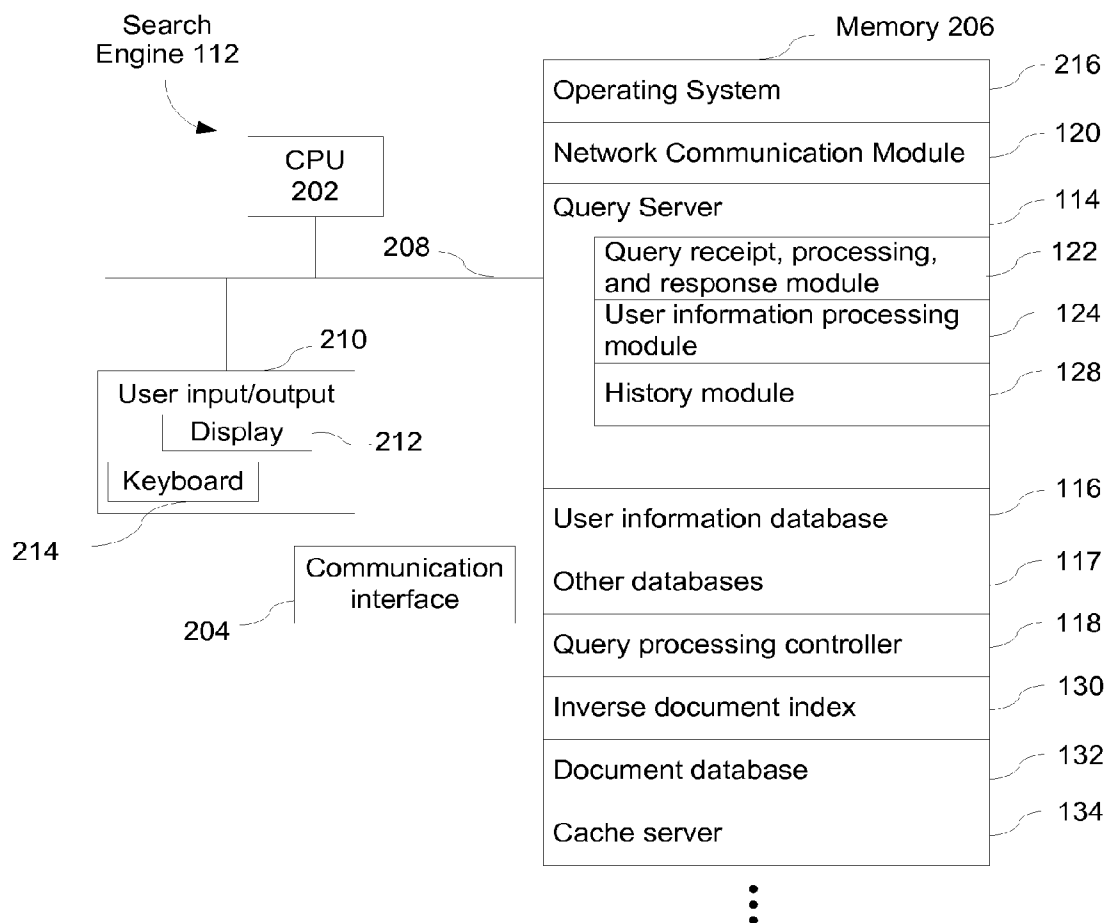


Figure 2

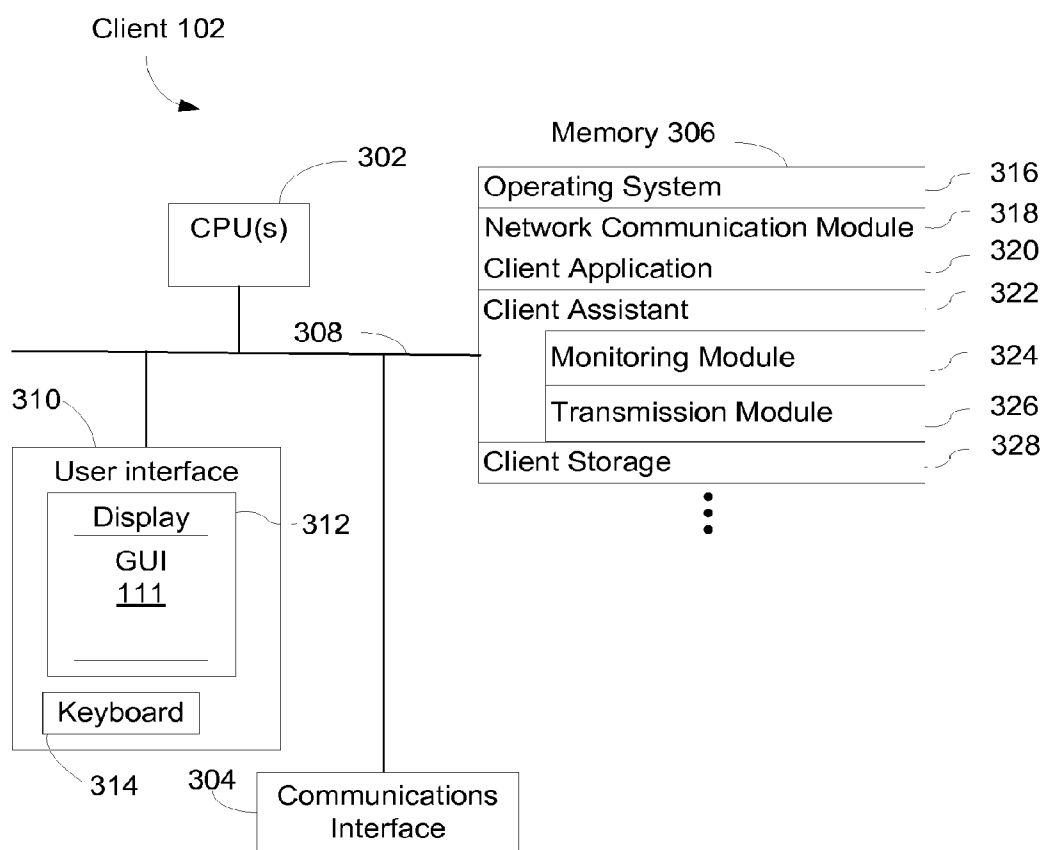
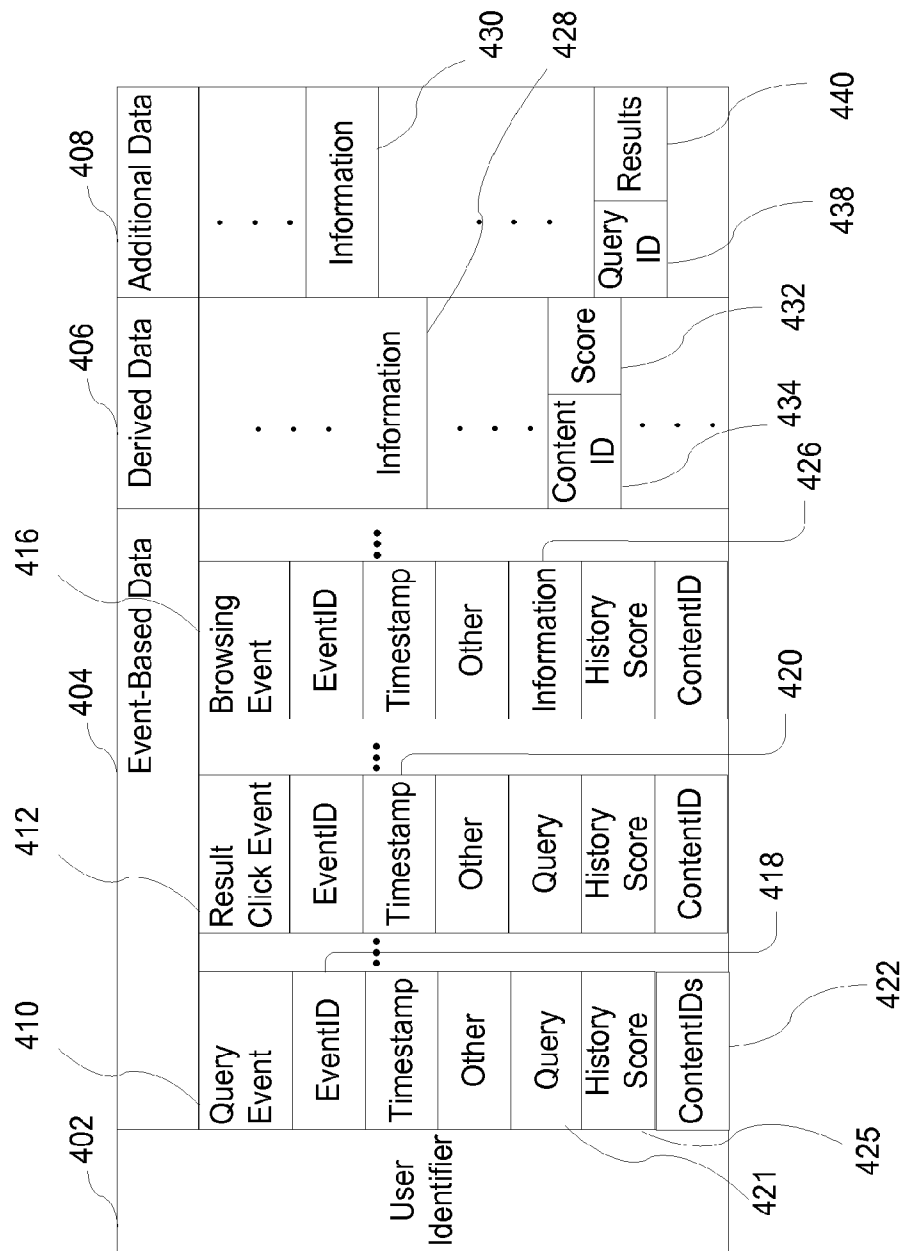
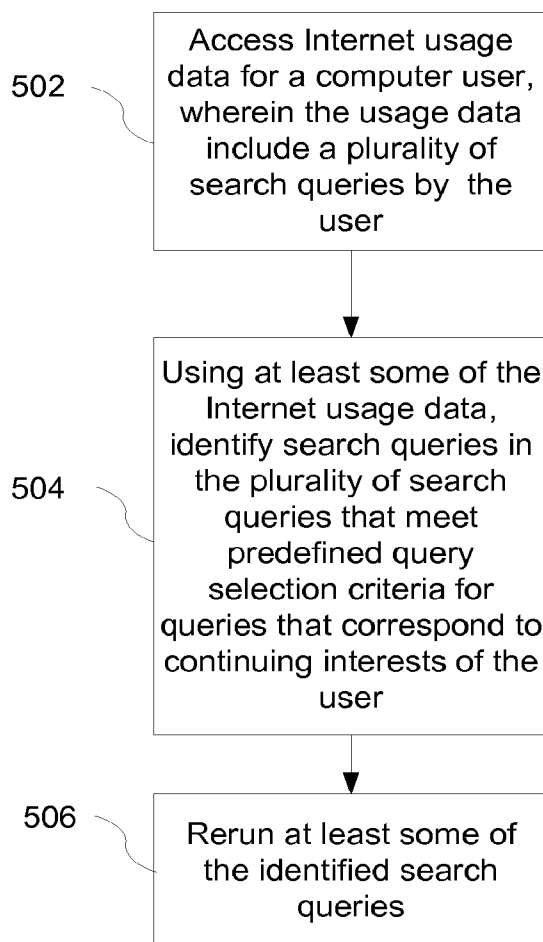


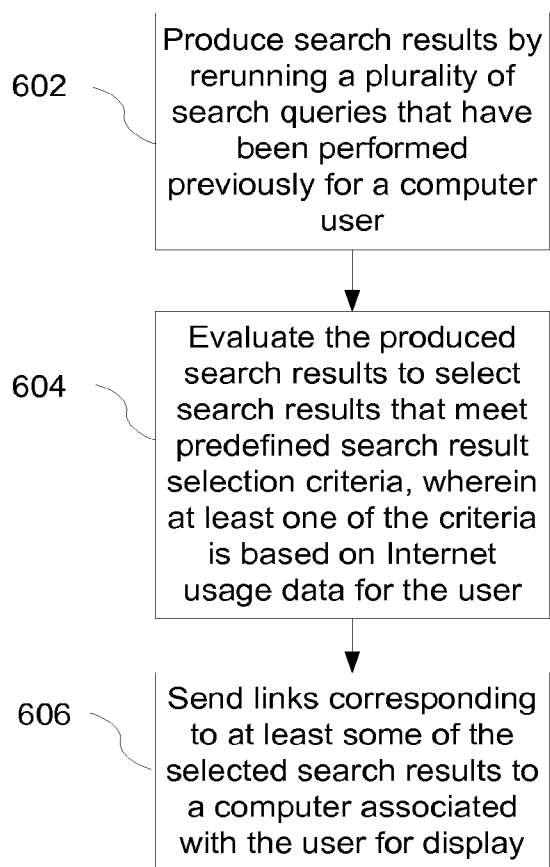
Figure 3



User Record 400 in User Information Database 116

Figure 4

**Figure 5**

**Figure 6**

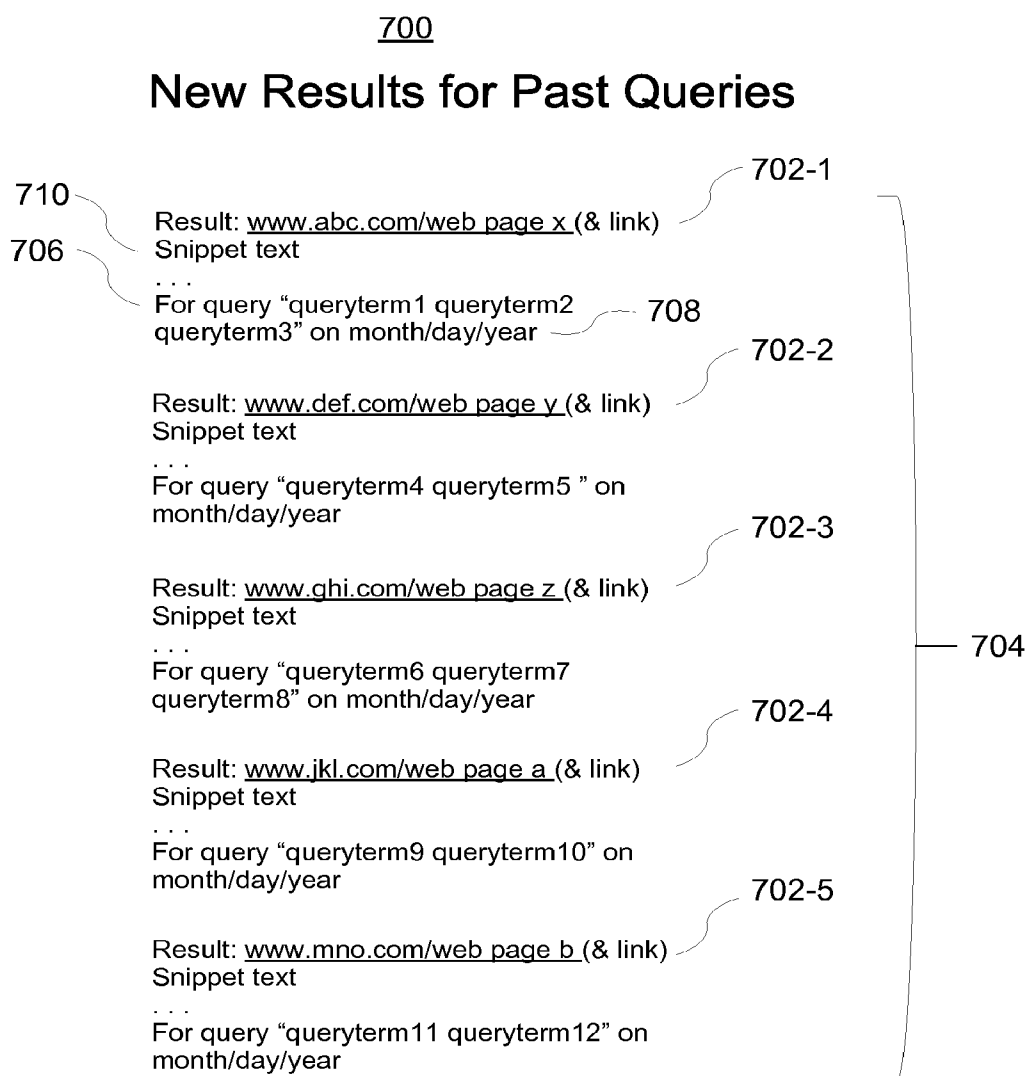


Figure 7

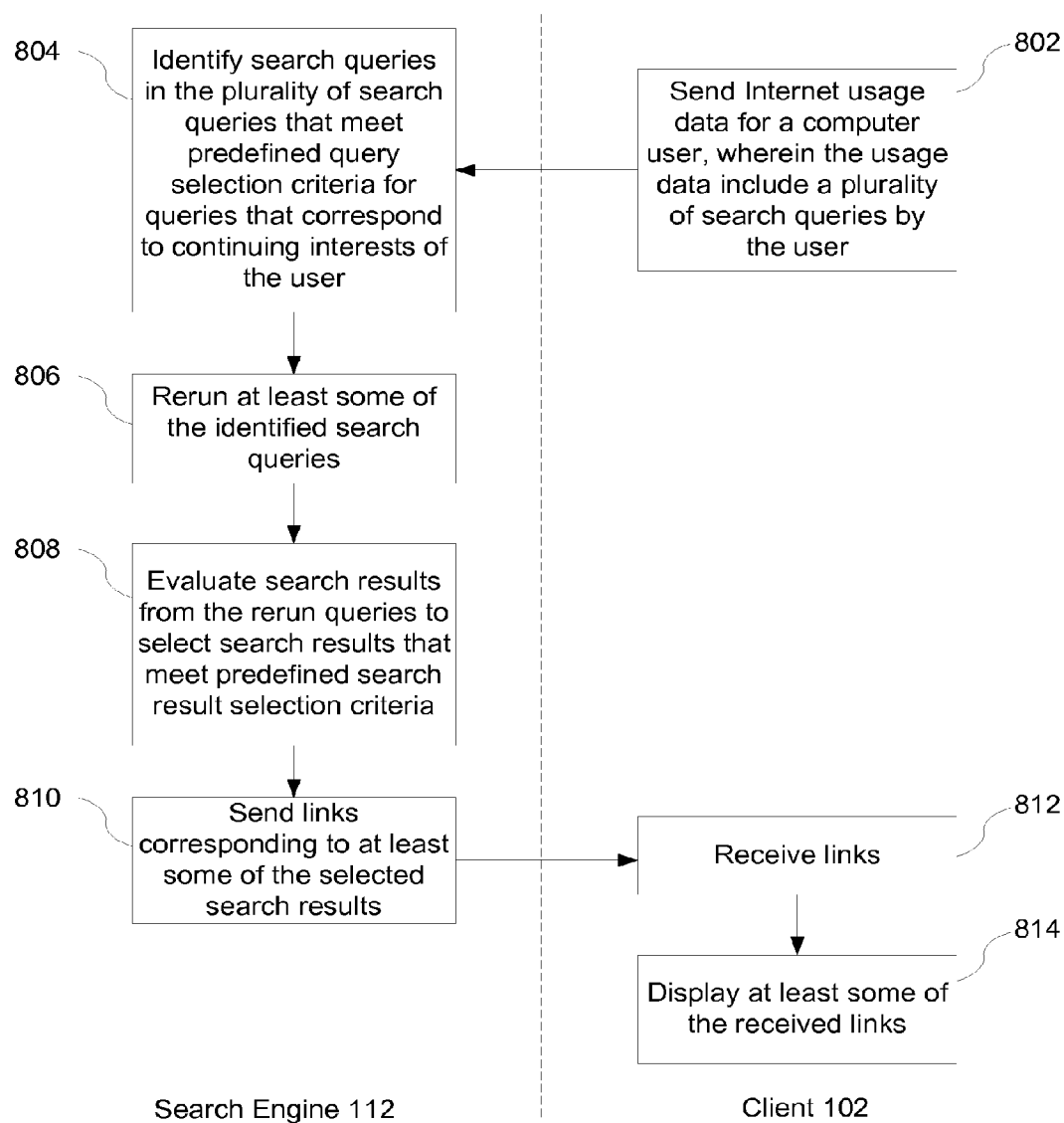


Figure 8

METHOD, SYSTEM, AND GRAPHICAL USER INTERFACE FOR ALERTING A COMPUTER USER TO NEW RESULTS FOR A PRIOR SEARCH

RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 14/179,721, filed Feb. 13, 2014, which is a continuation of U.S. application Ser. No. 13/043,400 filed Mar. 8, 2011, which is a continuation of U.S. application Ser. No. 11/323,096, filed Dec. 30, 2005, the contents of which are incorporated by reference.

TECHNICAL FIELD

[0002] The disclosed embodiments relate generally to search engines. More particularly, the disclosed embodiments relate to methods, systems, and user interfaces for alerting a computer user to new results for a prior search.

BACKGROUND

[0003] Search engines typically provide a source of indexed documents from the Internet (or an intranet) that can be rapidly scanned in response to a search query submitted by a user. As the number of documents accessible via the Internet grows, the number of documents that match a particular query may also increase. However, not every document matching the query is likely to be equally important from a user's perspective. A user may be overwhelmed by an enormous number of documents returned by a search engine, unless the documents are ordered based on their relevance to the user's query. One way to order documents is the PageRank algorithm more fully described in the article "The Anatomy of a Large-Scale Hypertextual Search Engine" by S. Brin and L. Page, 7th International World Wide Web Conference, Brisbane, Australia and U.S. Pat. No. 6,285,999, both of which are hereby incorporated by reference as background information.

[0004] Some queries by a computer user may concern continuing interests of the user. Some search engines, such as Google's Web Alerts, allow the user to explicitly specify such queries and receive alerts when a new web page in the top-ten search results appears for the query. However, it is too inconvenient for most users to explicitly register such queries. Google is a trademark of Google Inc. For example, in an internal study of 18 Google Search History users, out of 154 past queries that the users expressed a medium to strong interest in seeing further results, none of these queries was actually registered as a web alert. In addition, alerting the user to all changes to the search results for the query may cause too many uninteresting results to be shown to the user, due to minor changes in the web or spurious changes in the ranking algorithm.

[0005] Thus, it would be highly desirable to find ways to automatically identify queries in a user's search history that concern continuing interests of the user. In addition, it would be highly desirable to find ways to automatically identify user-relevant results to prior searches by the user that have not been shown to the user and to alert the user to such results.

SUMMARY

[0006] The present invention overcomes the problems described above.

[0007] One aspect of the invention involves a computer-implemented method in which a search engine accesses Inter-

net usage data for a computer user, wherein the usage data include a plurality of search queries by the user; using at least some of the Internet usage data, identifies search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; reruns at least some of the identified search queries; evaluates search results from the rerun queries to select search results that meet predefined search result selection criteria; and sends links corresponding to at least some of the selected search results to a computer associated with the user for display.

[0008] Another aspect of the invention involves a computer-implemented method in which a search engine accesses Internet usage data for a computer user, wherein the usage data include a plurality of search queries by the user; using at least some of the Internet usage data, identifies search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; and reruns at least some of the identified search queries.

[0009] Another aspect of the invention involves a computer-implemented method in which a search engine produces search results by rerunning a plurality of search queries that have been performed previously for a computer user; evaluates the produced search results to select search results that meet predefined search result selection criteria, wherein at least one of the criteria is based on Internet usage data for the user; and sends links corresponding to at least some of the selected search results to a computer associated with the user for display.

[0010] Another aspect of the invention involves a graphical user interface on a computer that includes a plurality of links recommended by a search engine for a computer user. The plurality of links are determined by the search engine by: producing search results by rerunning a plurality of search queries that have been performed previously for the computer user; and evaluating the produced search results to select search results that meet predefined search result selection criteria, wherein at least one of the criteria is based on Internet usage data for the user.

[0011] Another aspect of the invention involves a computer-implemented method in which a client computer sends Internet usage data for a computer user to a server computer, wherein the usage data include a plurality of search queries by the user. The server computer, using at least some of the Internet usage data, identifies search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; reruns at least some of the identified search queries; and evaluates search results from the rerun queries to select search results that meet predefined search result selection criteria. The client computer receives links corresponding to at least some of the selected search results from the server computer and displays at least some of the received links.

[0012] Another aspect of the invention involves a system that includes at least one server. The at least one server is configured to access Internet usage data for a computer user, wherein the usage data include a plurality of search queries by the user; using at least some of the Internet usage data, identify search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; and rerun at least some of the identified search queries.

[0013] Another aspect of the invention involves a client computer that is configured to send Internet usage data for a computer user to a server computer, wherein the usage data include a plurality of search queries by the user. The server computer, using at least some of the Internet usage data, identifies search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; reruns at least some of the identified search queries; and evaluates search results from the rerun queries to select search results that meet predefined search result selection criteria. The client computer is configured to receive links corresponding to at least some of the selected search results from the server computer and display at least some of the received links.

[0014] Another aspect of the invention involves a computer-program product that includes a computer readable storage medium and a computer program mechanism embedded therein. The computer program mechanism includes instructions, which when executed by a server computer, cause the server computer to access Internet usage data for a computer user, wherein the usage data include a plurality of search queries by the user; using at least some of the Internet usage data, identify search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; and rerun at least some of the identified search queries.

[0015] Another aspect of the invention involves a computer-program product that includes a computer readable storage medium and a computer program mechanism embedded therein. The computer program mechanism includes instructions, which when executed by a client computer, cause the client computer to send Internet usage data for a computer user to a server computer, wherein the usage data include a plurality of search queries by the user. The server computer, using at least some of the Internet usage data, identifies search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; reruns at least some of the identified search queries; and evaluates search results from the rerun queries to select search results that meet predefined search result selection criteria. The computer program mechanism also includes instructions, which when executed by the client computer, cause the client computer to receive links corresponding to at least some of the selected search results from the server computer and display at least some of the received links.

[0016] Another aspect of the invention involves a server computer with means for accessing Internet usage data for a computer user, wherein the usage data include a plurality of search queries by the user; using at least some of the Internet usage data, means for identifying search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; and means for rerunning at least some of the identified search queries.

[0017] Another aspect of the invention involves a client computer with means for sending Internet usage data for a computer user to a server computer, wherein the usage data include a plurality of search queries by the user. The server computer, using at least some of the Internet usage data, identifies search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user; reruns at least some of the identified search queries; and evaluates search

results from the rerun queries to select search results that meet predefined search result selection criteria. The client computer also has means for receiving links corresponding to at least some of the selected search results from the server computer and means for displaying at least some of the received links.

[0018] Another aspect of the invention involves a system that includes at least one server. The at least one server is configured to produce search results by rerunning a plurality of search queries that have been performed previously for a computer user; evaluate the produced search results to select search results that meet predefined search result selection criteria, wherein at least one of the criteria is based on Internet usage data for the user; and send links corresponding to at least some of the selected search results to a computer associated with the user for display.

[0019] Another aspect of the invention involves a computer-program product that includes a computer readable storage medium and a computer program mechanism embedded therein. The computer program mechanism includes instructions, which when executed by a server computer, cause the server computer to produce search results by rerunning a plurality of search queries that have been performed previously for a computer user; evaluate the produced search results to select search results that meet predefined search result selection criteria, wherein at least one of the criteria is based on Internet usage data for the user; and send links corresponding to at least some of the selected search results to a computer associated with the user for display.

[0020] Another aspect of the invention involves a server computer with means for producing search results by rerunning a plurality of search queries that have been performed previously for a computer user; means for evaluating the produced search results to select search results that meet predefined search result selection criteria, wherein at least one of the criteria is based on Internet usage data for the user; and means for sending links corresponding to at least some of the selected search results to a computer associated with the user for display.

[0021] Thus, the present invention provides improved methods, systems and user interfaces for alerting a computer user to new results for a prior search.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] For a better understanding of the aforementioned aspects of the invention as well as additional aspects and embodiments thereof, reference should be made to the Description of Embodiments below, in conjunction with the following drawings in which like reference numerals refer to corresponding parts throughout the figures.

[0023] FIG. 1 is a block diagram illustrating an exemplary distributed computer system in accordance with one embodiment of the invention.

[0024] FIG. 2 is a block diagram illustrating a search engine in accordance with one embodiment of the invention.

[0025] FIG. 3 is a block diagram illustrating a client in accordance with one embodiment of the invention.

[0026] FIG. 4 is an exemplary user record in the user information database in accordance with one embodiment of the invention.

[0027] FIG. 5 is a flowchart representing a method of automatically identifying continuing interests of a computer user in accordance with one embodiment of the invention.

[0028] FIG. 6 is a flowchart representing a method of alerting a computer user to new results for a prior search in accordance with one embodiment of the invention.

[0029] FIG. 7 is a schematic screen shot of an exemplary graphical user interface for alerting a computer user to new results for a prior search in accordance with one embodiment of the invention.

[0030] FIG. 8 is a flowchart representing a method of automatically identifying continuing interests of a computer user and alerting the user to new results for a prior search in accordance with one embodiment of the invention.

DESCRIPTION OF EMBODIMENTS

[0031] Methods, systems, user interfaces, and other aspects of the invention are described. Reference will be made to certain embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the embodiments, it will be understood that it is not intended to limit the invention to these particular embodiments alone. On the contrary, the invention is intended to cover alternatives, modifications and equivalents that are within the spirit and scope of the invention as defined by the appended claims.

[0032] Moreover, in the following description, numerous specific details are set forth to provide a thorough understanding of the present invention. However, it will be apparent to one of ordinary skill in the art that the invention may be practiced without these particular details. In other instances, methods, procedures, components, and networks that are well known to those of ordinary skill in the art are not described in detail to avoid obscuring aspects of the present invention.

[0033] FIG. 1 is a block diagram illustrating an exemplary distributed computer system 100 according to one embodiment of the invention. FIG. 1 shows various functional components that will be referred to in the detailed discussion that follows. The system 100 may include one or more client computers 102. Client computers 102 can be any of a number of computing devices (e.g., Internet kiosk, personal digital assistant, cell phone, gaming device, desktop computer, laptop computer, handheld computer, or combinations thereof) used to enable the activities described below. Client 102 includes graphical user interface (GUI) 111. Clients 102 are connected to a communications network 106. The communications network 106 connects the clients 102 to a search engine system 112. Search engine 112 includes a query server 114 connected to the communications network 106, a user information database 116, a query processing controller 118, and optionally other databases 117.

[0034] Search engine 112 generates search results in response to search queries from one or more clients 102 and also provides alerts to new results for some prior searches. It should be appreciated that the layout of the search engine system 112 is merely exemplary and may take on any other suitable layout or configuration. The search engine system 112 is used to search an index of documents, such as billions of web pages or other documents indexed by modern search engines.

[0035] Note that the search engine system 112 can be used as an Internet search engine, for locating documents on the WWW and/or as an intranet search engine, for locating documents stored on servers or other hosts within an intranet. In addition, the methodology described herein is applicable to

implementations where only portions of documents, such as titles and abstracts, are stored in a database (e.g., 132) of the search engine system 112.

[0036] The search engine system 112 may include multiple data centers, each housing a backend. The data centers are generally widely dispersed from one another, such as across the continental United States. Search queries submitted by users at one of the clients 102 to the search engine system 112 are routed to an appropriate backend as part of the Domain Name System (DNS), based on current load, geographic locality and/or whether that data center is operating.

[0037] Each backend preferably includes multiple query servers, such as query server 114, coupled to a communications network 106 via a network communication module 120. The communications network 106 may be the Internet, but may also be any local area network (LAN) and/or wide area network (WAN). In some embodiments, each query server 114 is a Web server that receives search query requests and delivers search results and alerts to new results for some prior searches in the form of web pages or feeds via HTTP, XML, RSS or similar protocols. Alternatively, if the query server 114 is used within an intranet, it may be an intranet server. In essence, the query servers, such as query server 114, are configured to control the search and alert processes, including searching a document index, analyzing and formatting the search results.

[0038] The query server 114 typically includes a network communications module 120, a query receipt, processing and response module 122, a user information processing module 124, and a history module 128, all interconnected. The network communications module 120 connects the query server 114 to the communication network 106 and enables the receipt of communications from the communication network 106 and the provision of communications to the communication network 106 bound for the client 102 or other destinations. The query receipt, processing and response module 122 is primarily responsible for receiving search queries, processing them and returning responses and alerts to the client 102 via the network communications module 120. In some embodiments, the history module 128 maintains a record of queries submitted by users. In some embodiments, the history module maintains a record of search results sent to the users, independent of whether the users selected the results for viewing or downloading. In some embodiments, the history module also maintains a record of search results selected by the users for viewing or downloading, sometimes called click through information. The click through information may include statistical information, including the number of times that each search result was clicked through and/or the number of times each search result was viewed by users for more than a threshold period of time (i.e., the number of times the users clicked through each search result without navigating away from the resulting page or document in less than the threshold period of time).

[0039] The user information processing module 124 assists in accessing, updating and modifying the user information database 116. The user information database 116 stores various information about the user's activities in a user record (described below). In addition, the user information database 116 may store derived information about the user based on the user's activities. In some embodiments, the user information database 116 stores user profiles, a portion of which are the derived information. The other databases 117 optionally include other databases with which the various modules in

query server **114** may interact, such as a message database (electronic or otherwise), and user-created document databases (e.g., documents created from word processing programs, spreadsheet programs, or other various applications).

[0040] The query processing controller **118** is connected to an inverse document index **130**, a document database **132** and a query cache **134**. The cache **134** is used to temporarily store search queries and search results, and is used to serve search results for queries submitted multiple times (e.g., by multiple users). The inverse document index **130** and document database **132** are sometimes collectively called the document database. In some embodiments, “searching the document database” means searching the inverse document index **130** to identify documents matching a specified search query or term.

[0041] Search rank values for the documents in the search results are conveyed to the query processing controller **118** and/or the query server **114**, and are used to construct various lists, such as a list of ordered search results, a personalized list of recommended web pages, or a list of new results for one or more prior searches by a user. Once the query processing controller **118** constructs the list, the query processing controller **118** may transmit to the document database **132** a request for snippets of an appropriate subset of the documents in the list. For example, the query processing controller **118** may request snippets for the first fifteen or so of the documents in the list. In some embodiments, the document database **132** constructs snippets based on the search query, and returns the snippets to the query processing controller **118**. The query processing controller **118** then returns a list of located documents with their associated links (i.e., hyperlinks) and snippets back to the query server **114**. In some embodiments, the snippets are stored in the cache server **134** along with the search results. As a result, in these embodiments the query processing controller **118** may only request snippets for documents, if any, for which it is unable to obtain valid cached snippets from the cache server **134**.

[0042] In some embodiments, fewer and/or additional modules, functions or databases are included in the search engine **112**. The modules shown in FIG. 1 as being part of search engine **112** represent functions performed in an exemplary embodiment.

[0043] Although FIG. 1 portrays discrete blocks, the figure is intended more as a functional description of some embodiments of the invention rather than a structural description of the functional elements. One of ordinary skill in the art will recognize that an actual implementation might have the functional elements grouped or split among various components. For example, the user information database **116** may be part of the query server **114**. In some embodiments the user information database **116** may be implemented using one or more servers whose primary function is to store and process user information. Similarly, the document database **132** may be implemented on one or more servers whose primary purpose is to store various documents. Moreover, one or more of the blocks in FIG. 1 may be implemented on one or more servers designed to provide the described functionality. Although the description herein refers to certain features implemented in the client **102** and certain features implemented in the search system **112**, the embodiments of the invention are not limited to such distinctions. For example, features described herein as being part of the search system **112** could be implemented in whole or in part in the client **102**, and vice versa.

[0044] FIG. 2 is a block diagram illustrating search engine **112** in accordance with one embodiment of the present invention. Search engine **112** typically includes one or more processing units (CPU's) **202**, one or more network or other communications interfaces **204**, memory **206**, and one or more communication buses **208** for interconnecting these components. The communication buses **208** may include circuitry (sometimes called a chipset) that interconnects and controls communications between system components. Search engine **112** optionally may include a user interface **210** comprising a display device **212** and a keyboard **214**. Memory **206** may include high speed random access memory and may also include non-volatile memory, such as one or more magnetic or optical disk storage devices. Memory **206** may optionally include one or more storage devices remotely located from the CPU(s) **202**. In some embodiments, the memory **206** stores the following programs, modules and data structures, or a subset or superset thereof:

[0045] an operating system **216** that includes procedures for handling various basic system services and for performing hardware dependent tasks;

[0046] a network communication module (or instructions) **120** that is used for connecting search engine **112** to other computers (e.g., clients **102** and web sites **108**) via one or more communication network interfaces **204** (wired or wireless) and one or more communication networks, such as the Internet, other wide area networks, local area networks, metropolitan area networks, and so on;

[0047] a query server **114** for responding to and processing communications from the client **102** and for alerting a computer user to new results for one or more prior searches;

[0048] a user information database **116** for storing information about users as described in reference to FIG. 4;

[0049] other databases **117** that the various modules in query server **114** may interact with, such as a message database (electronic or otherwise), and user-created document databases (e.g., documents created from word processing programs, spreadsheet programs, or other various applications);

[0050] a query processing controller **118** for receiving requests from one of the query servers, such as the query server **114**, and transmitting the requests to the cache **134**, the inverse document index **130** and the document database **132**;

[0051] an inverse document index **130** for storing a set of words contained in document database **132** and, for each word, pointers to documents in document database **132** that contain the word;

[0052] a document database **132** for storing documents or portions of documents such as web pages; and

[0053] a cache server **134** for increasing search efficiency by temporarily storing previously submitted search queries and corresponding search results.

[0054] In some embodiments, the query server **114** includes the following elements, or a subset of such elements: a query receipt, processing and response module **122** for receiving and responding to search queries, for providing alerts to new results for one or more prior searches, and for managing the processing of search queries by one or more query processing controllers, such as query processing controller **118**, that are coupled to the query server **114**; a user information and processing module **124** for accessing and

modifying the user information database **116**, which includes one or more user records **400** (described in more detail in FIG. **4** below); and a history module **128** for processing and handling requests for searching a user's online history (e.g., the user's prior queries, sent URLs, query result click throughs and visited URLs). In some embodiments, the query server **114** and/or the user information database **116** include additional modules.

[0055] FIG. **3** is a block diagram illustrating client **102** in accordance with one embodiment of the invention. Client **102** typically includes one or more processing units (CPUs) **302**, one or more network or other communications interfaces **304**, memory **306**, and one or more communication buses **308** for interconnecting these components. The communication buses **308** may include circuitry (sometimes called a chipset) that interconnects and controls communications between system components. The client system **102** may include a user interface **310**, for instance a display **312** with GUI **111** and a keyboard **314**. Memory **306** may include high speed random access memory and may also include non-volatile memory, such as one or more magnetic or optical storage disks. Memory **306** may include mass storage that is remotely located from CPUs **302**. Memory **306** may store the following elements, or a subset or superset of such elements:

[0056] an operating system **316** that includes procedures for handling various basic system services and for performing hardware dependent tasks;

[0057] a network communication module (or instructions) **318** that is used for connecting the client system **102** to other computers via the one or more communications interfaces **304** (wired or wireless) and one or more communication networks, such as the Internet, other wide area networks, local area networks, metropolitan area networks, and so on;

[0058] a client application **320** such as a browser application;

[0059] a client assistant **322** (e.g., a toolbar, iframe (inline frame), or browser plug-in), which includes a monitoring module **324** for monitoring the activities of a user, and a transmission module **326** for transmitting information about the user's activities to and receiving information from the search system **112**; and

[0060] client storage **328** for storing data and documents, including web pages or feeds with search results received in response to a search query and alerts to new results for one or more prior searches.

[0061] Each of the above identified modules and applications in FIGS. **2-3** correspond to a set of instructions for performing a function described above. These modules (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules may be combined or otherwise re-arranged in various embodiments. In some embodiments, memories **206** and **306** may store a subset of the modules and data structures identified above. Furthermore, memories **206** and **306** may store additional modules and data structures not described above.

[0062] Although FIGS. **2-3** show search engine **112** and client **102** as a number of discrete items, FIGS. **2-3** are intended more as a functional description of the various features which may be present in search engine **112** and client **102** rather than as a structural schematic of the embodiments described herein. In practice, and as recognized by those of ordinary skill in the art, items shown separately could be

combined and some items could be separated. For example, some items shown separately in FIG. **2** could be implemented on single servers and single items could be implemented by one or more servers. The actual number of servers in search engine **112** and how features are allocated among them will vary from one implementation to another, and may depend in part on the amount of data traffic that the system must handle during peak usage periods as well as during average usage periods.

[0063] FIG. **4** is an exemplary user record **400** from the user information database **116** (FIG. **1**) in accordance with one embodiment of the invention. In some embodiments, user record **400** contains a subset or a superset of the elements depicted in FIG. **4**. User record **400** contains a user identifier **402** that associates the information in user record **400** to a particular user or user identifier. In some embodiments, the user identifier **402** is associated with a particular instance of a client application **320**. In some embodiments, the user identifier is associated with a computer user (e.g., when the user logs in with a username and password). Some of the information that can be associated with a user includes event-based data **404**, derived data **406**, and additional data **408**. Event-based data **404** includes one or more events, each of which has a data type associated with it. In some embodiments, event-based data includes: one or more queries **410**; one or more result clicks **412** (i.e., the results presented in a set of search results on which the user has clicked); and one or more browsing data **416** (e.g., URLs visited, URL visit duration data, etc.). Event-based data **404** includes one or more elements relevant to the event. For example, in some embodiments the events in the event-based data **404** includes either or both an eventID **418** and a timestamp **420**. The eventID **418** is a unique identifier associated with the particular event which may be assigned by the search system in some embodiments (e.g., a 64-bit binary number). The timestamp **420** is a value (e.g., a 64-bit binary number) representing the date and/or time at which the particular event record in event-based data **404** was created or at which the particular event occurred.

[0064] In some embodiments, one or more of the query events **410**, and one or more of the result clicks **412**, include a query portion **421** which includes zero or more query terms associated with the recorded event. In some embodiments, the query portion indicates the query string to which the event is associated (e.g., what query produced the results that the user clicked-through). In some embodiments, the query portion **421** includes a pointer or identifier to the query event **410** associated with the result click (e.g., an eventID). In some embodiments, the query portion **421** may additionally identify a "related query". For example, the related query may be a query related to an initial query that contains a misspelling. In some instances it is more desirable to associate the event with the corrected query rather than the query containing the spelling mistake. In some embodiments, the search system **112** may generate "related queries" automatically based on the user's entered query.

[0065] In some embodiments, one or more of the queries **410**, result clicks **412**, and/or browsing data **416** include one or more contentIDs **422** that identify content associated with the particular event. For a query **410**, the contentIDs **422** can represent the URLs or URIs (Uniform Resource Identifier) of search results that have been sent to the user. For a result click **412**, the contentID **422** can represent the URL or URI that has been clicked on by the user. For browsing event **416**, the contentID **422** can be the content identifier used to identify

the location of the browse event (e.g., URL, data location, or other similar identifier). In some embodiments, the contentID **422** may be a document identifier that identifies a document in a document repository.

[0066] In some embodiments, the event-based data has a history score **425**. An event's history score **425** may be calculated in any of a number of different ways or combinations of ways. For example, the history score **425** may be a time-based ranking value that may be periodically modified based on a length of time that has passed since the event was recorded. In some embodiments, the value of the history score decreases as the time from the recordation increases. In some embodiments, event data having a time-based ranking value below a threshold may be deleted. The values can be determined and re-determined periodically at various points in time. In some cases, removal of one or more events triggers a re-determination of one or more derived values as described above. In some embodiments, the history score **425** is determined in response to a request instead of being determined during batch or off-line processing.

[0067] In some embodiments, a browsing event **416** indicates a particular browsing event not associated with a query, but instead, with some other user activity (e.g., user selection of a link in a web page, or an email message, or a word processing document). This other user activity can be identified in an information field **426**. In some embodiments, the information field **426** stores ranking values associated with the event. Such ranking values can be system generated, user created, or user modified (e.g., PageRank for URLs, or a value assigned to the event by the user). Other examples of user activity include, but are not limited to web browsing, emailing, instant messaging, word processing, participation in chat rooms, software application execution and Internet telephone calls.

[0068] In some embodiments, derived data **406** includes one or more information fields **428** containing information derived from the event-based data **404**. For example, in some embodiments, the information field **428** represents a user profile which is generated from one or more of the user's query events **410**, results click events **412**, and browsing events **416**. For example, by examining one or more of the various events a user profile may be created indicating levels of interest in various topic categories (e.g., a weighted set of Open Directory Project ("<http://dmoz.org>") topics").

[0069] In some embodiments, the derived data **406** includes one or more pairs of a score **432** associated with particular contentID **434**. The score **432** represents a derived score assigned to the content associated with the contentID **434** (e.g., a web page). The score **432** can be based on one or more of a number of different factors. In some embodiments, the score **432** incorporates the number of times that a user has clicked on the contentID over a period of time (which may include click throughs as a result of search queries and/or browsing activities). In some embodiments, the score **432** incorporates a time duration that the user is estimated to have been looking at the content (a stay-time). In some embodiments, the score **432** incorporates a time since the user last viewed the content. In some embodiments, the score **432** may be modified based on user activities. In some embodiments, the score **432** is negatively affected if the user is presented the content in a series of search results, but fails to select the content from the results page. In some embodiments, the score **432** is positively affected when the user visits locations or pages or clicks on results that are similar to the content.

Similarity can be determined by a number of well-known techniques (e.g., text classifier, ODP categorization, link structure, URL, edit distance, etc.). In some embodiments, a site is defined as a logically related group of pages, or physically related pages such as pages belonging to the same URL or related URLs. In some embodiments, the score **432** incorporates the number of past queries of the user for which the content was presented (e.g., a higher number of times certain content is presented to the user correlates with a higher score **432**). In some embodiments, the score **432** incorporates the number of past queries of the user for which related content was presented (e.g., a higher number of times related content is presented to the user as a result of the user's queries correlates with a higher score **432**). In some embodiments, derived data **406** includes aggregate scores. For example, the same query may be generated by the user multiple times and in some embodiments each occurrence will have a different eventID. Accordingly, in some embodiments, an aggregate score is maintained for events that occur multiple times. The aggregate score can be computed by any of a number of different methods. A reference to the multiple events and to the aggregate score can be maintained in the derived data **406**.

[0070] FIG. 5 is a flowchart representing a method of automatically identifying continuing interests of a computer user in accordance with one embodiment of the invention. FIG. 5 shows processes performed by search engine **112**. It will be appreciated by those of ordinary skill in the art that one or more of the acts described may be performed by hardware, software, or a combination thereof, as may be embodied in one or more computing systems.

[0071] In some embodiments, prior to sending Internet usage data for a computer user, client **102** receives login information for the user, such as a username and password, and sends the information to search engine **112** via communications network **106**. Search engine **112** receives and verifies the login information, thereby enabling search engine **112** to associate subsequent data received from client **102** (e.g., Internet usage data such as event-based data **404**) with a particular user record **400** in user information database **116**. In some embodiments, the user may be identified using a cookie stored on the client **102**, or by a user identifier that is stored by and associated with a browser toolbar or browser extension. In some embodiments, the user may pre-approve the use of the user's Internet usage data.

[0072] Query server **114** in search engine **112** accesses (502) Internet usage data for a computer user (e.g., data in user record **400**). The usage data include a plurality of search queries by the user (e.g., queries **421** in query events **410**). In some embodiments, the Internet usage data are grouped into query sessions, as described below.

[0073] Using at least some of the Internet usage data, query server **114** identifies (504) search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user. In some embodiments, the identifying of search queries is performed without explicit input from the user identifying search queries that are continuing interests of the user. In some embodiments, the predefined query selection criteria include a score derived from a combination of at least some of the Internet usage data.

[0074] To see how the user's Internet usage data can be used to identify the user's continuing interests, consider the sample query session in Table 1.

TABLE 1

Sample Query Session
html encode java (8 s)
* RESULTCLICK (91.00 s) -- 2. "http://www.java2html.de/docs/api/de/java2html/util/HTMLTools.html"
* RESULTCLICK (247.00 s) -- 1. "http://www.javapractices.com/Topic96.cjp"
* RESULTCLICK (12.00 s) -- 8. "http://www.trialfiles.com/program-16687.html"
* NEXTPAGE (5.00 s) -- start = 10
o RESULTCLICK (1019.00 s) -- 12. "http://forum.java.sun.com/thread.jspa?threadID=562942..."
o REFINEMENT (21.00 s) -- html encode java utility + RESULTCLICK (32.00 s) -- 7. "http://www.javapractices.com/Topic96.cjp"
o NEXTPAGE (8.00 s) -- start = 10
* NEXTPAGE (30.00 s) -- start = 20
(Total time: 1473.00 s)

[0075] The user initially submitted the query "html encode java"—presumably to find out how to encode html in a java program. After 8 seconds of browsing the search results, she clicks on the second result presented, and remains viewing that page for 91 seconds. She then returns to the results page and views the first result for 247 seconds. Finally, she views the 8th result for 12 seconds. She then performs a next page navigation, meaning that she views the next page of results, starting at position 11. She views the 12th result for a long time—1019 seconds. However, perhaps because she is still unable to find a satisfactory result, she submits the query refinement "html encode java utility"—she is explicitly looking for an existing java utility that will allow her to encode html. After a single result click for 32 seconds, the user looks at the next page of results ranked 11-20, and immediately looks at the following page of results ranked 21-30. She then ends the query session.

[0076] How can query server 114 determine whether the user found what she was looking for, and how interested she is in seeing new results? First, it would appear that the user was interested in finding an answer, since she spent a considerable amount of time in the session, viewed a number of pages, and performed a large number of refinements (query refinements, next pages, etc.). Second, query server 114 might also guess that the user did not find what she was looking for, because the session ended with her looking at a number of search results pages, but not actually clicking on anything. Finally, it is not as clear what the duration of the user's information need is. However, because this query topic seems to address a work-related need, query server 114 might guess that the user needs to find a solution immediately, or in the near future. Thus, from this example we can see how query server 114 might determine search queries that correspond to continuing interests with signals such as duration of the session, number of actions, ordering of actions, and so on.

[0077] In some embodiments, rather than focusing on individual queries, which may be related to one another, query server 114 evaluates a "query session", i.e., all actions associated with a given initial query. Such actions can include result clicks, spelling corrections, viewing additional pages of results, and query refinements. A query is a "query refinement" of the previous query if both queries contain at least one common term. Here, we will use the term refinement to more broadly refer to spelling corrections, next pages, and query refinements.

[0078] If query server 114 evaluates a user's continuing interest in a query session, rather than a specific query, it needs to determine the actual query to make recommendations for. A session may consist of many query refinements, so which should be used? In some embodiments, query server 114 uses the query refinement that is directly followed by the largest number of result clicks. If two or more query refinements are tied (with respect to number of result clicks), then query server 114 chooses the refinement for which the total duration of clicks is longest. For example, in the query session shown in Table 1, query server 114 will register the query "html encode java" because it has four result clicks, while "html encode java utility" has only one.

[0079] Query selection criteria that query server 114 can use to identify queries that correspond to continuing interests of the user include, without limitation, the following Internet usage data of the user:

[0080] Number of query terms—A larger number of terms tends to indicate a more specific need, which in turn might correlate with shorter interest duration and lower likelihood of prior fulfillment.

[0081] Number of clicks and number of refinements—The more actions a user takes on behalf of a query (e.g., clicks on query results), the more interested she is likely to be in the query. In addition, a high number of refinements probably implies low likelihood of prior fulfillment.

[0082] History match score—If a query matches the interests displayed by a user through past queries and clicks, then interest level is probably high. A history match score may be generated in a number of ways, such as that described by Sugiyama, Hatano, and Yoshikawa in "Adaptive web search based on user profile constructed without any effort from users" in Proc. of WWW, 2004.

[0083] Navigational queries—A navigational query is one in which the user is looking for a specific web site, rather than information from a web page. In some embodiments, it is assumed that if the user clicks on only a single result and makes no subsequent refinements, the query is either navigational, or answerable by a single good website. In this case, there is a high likelihood of prior fulfillment and low interest level.

[0084] Repeated non-navigational queries—If a user repeats a query over time, she is likely to be interested in seeing further results. Note, however, that navigational queries which are often repeated, but for which the user does not care to see additional results, should be eliminated. In some embodiments, query server 114 only considers a query that has been repeated, and for which the user has clicked on multiple or different clicks the most recent two times the query was submitted.

[0085] Session duration—Longer sessions might imply higher interest.

[0086] Query topic—Leisure-related topics such as sports and travel might be more interesting than work-related topics.

[0087] Number of "long clicks"—A user might quickly click through many results on a query she is not interested in, so the number of long clicks—where the user views a page for many seconds—may be a better indicator than the number of any kind of click.

[0088] Whether the session ended with a refinement—Sessions that end with a refinement may be indicative of queries for which the user would want to see further results.

[0089] In some embodiments, an interest score for query sessions is defined that correlates with the continuing interest the user has in a query session. In some embodiments, the interest score is given by:

$$i_{score} = a \log(\#clicks + \#refinements) + b \cdot b \log(\#repetitions) + c \cdot (\text{history match score})$$

where a, b, and c are constants. It should be clear that this score is merely exemplary. Other scores can be constructed where higher score values correlate with higher continuing user interest. In some embodiments, the predefined query selection criteria for queries that correspond to continuing interests of the user may require that the interest score be above a threshold value.

[0090] In some embodiments, Boolean criteria (e.g., threshold conditions) are not incorporated into the interest score, but can still be used as part of the query selection criteria.

[0091] Query server 114 reruns (506) at least some of the identified search queries. In some embodiments, the rerunning is performed automatically by search engine 112 at predefined times. In some embodiments, the predefined times include the times of periodic events (e.g., monthly, weekly, daily, twice per day, hourly, or the like) or the times of episodic events (e.g., in response to the occurrence of any one of a predefined set of trigger conditions, such as when the user logs in to the search engine or to another server or service).

[0092] FIG. 6 is a flowchart representing a method of alerting a computer user to new results for a prior search in accordance with one embodiment of the invention. FIG. 6 shows processes performed by search engine 112. It will be appreciated by those of ordinary skill in the art that one or more of the acts described may be performed by hardware, software, or a combination thereof, as may be embodied in one or more computing systems.

[0093] Prior to sending Internet usage data for a computer user, client 102 receives login information for the user, such as a username and password, and sends the information to search engine 112 via communications network 106. Search engine 112 receives and verifies the login information, thereby enabling search engine 112 to associate subsequent data received from client 102 (e.g., Internet usage data such as event-based data 404) with a particular user record 400 in user information database 116. In some embodiments, the user may pre-approve the use of the user's Internet usage data.

[0094] Query server 114 in search engine 112 produces (602) search results by rerunning a plurality of search queries that have been performed previously for a computer user (e.g., one or more of the queries 421 in query events 410 in user record 400).

[0095] Query server 114 evaluates (604) the produced search results to select search results that meet predefined search result selection criteria. At least one of the criteria is based on Internet usage data for the user (e.g., data such as event-based data 404 for the user). In some embodiments, the criteria include a requirement that selected search results are not present in query event data 410 for the user. In some embodiments, the criteria include a requirement that selected search results are not present in the Internet usage data for the user. In some embodiments, the predefined search result selection criteria identify search results deemed likely to be relevant to the computer user.

[0096] Exemplary search result selection criteria may include, without limitation:

[0097] History presence—In some embodiments, some or all the URLs sent to a user for her past queries are stored, for example in user record 400. If a page appears in this history, it is not selected. In some embodiments, if a page appears anywhere in the user record (e.g., as a contentID 422 in user record 400), it is not selected. In some embodiments, to err on the side of high precision but low recall, a URL from any domain the user has seen is not recommended.

[0098] Rank—If a result R is ranked very highly by a search engine, it may be concluded that R is a good page relative to other results for the query. In addition, if it is also a new result, this indicates that the result R is new or was recently promoted.

[0099] Popularity and relevance (PR) score—Results for keyword queries are assigned relevance scores based on the relevance of the document to the query—for example, by term frequency inverse document frequency (TFxIDF) analysis, anchor text analysis, etc. In addition, major search engines utilize static scores, such as PageRank, that reflect the query-independent popularity of the page. The higher the absolute values of these scores, the better a result should be.

[0100] Above Dropoff—If the PR scores of a few results are much higher than the scores of all remaining results, these top results might be authoritative with respect to this query. In some embodiments, a result R is “above the dropoff” if there is a 30% PR score dropoff between two consecutive results in the top 5, and if R is ranked above this dropoff point. This dropoff formula is merely exemplary. Analogous formulas can be used to create other dropoff criteria.

[0101] Days elapsed since query submission—This selection criterion is based on the hypothesis that the more days that have elapsed since the query was submitted, the more likely it is for interesting new results to exist. However, to date this criterion has not effected the recommendation quality.

[0102] Sole changed result—This criterion refers to a result that is the only new result in the top N results, where N is an integer (e.g., N=6). This selection criterion is based on the hypothesis that such results are not a product of rank fluctuation. However, to date this criterion has been inversely correlated with recommendation quality.

[0103] All poor signal—This criterion refers to when all top N results (e.g., N=10) for a query have PR scores below a threshold value. This selection criterion is based on the hypothesis that if every result for a query has low score, then the query has no good pages to recommend.

[0104] In some embodiments, a quality score for the search results is defined that correlates with search results deemed likely to be relevant to the computer user. In some embodiments, the quality score is given by:

$$q_{score} = a \cdot (PR \text{ score}) + b \cdot (\text{rank})$$

where a and b are constants

[0105] In some embodiments, because initial data indicated that rank may be inversely correlated with relevance to the user, the quality score is given by:

$$q_{score} = c \cdot (PR \text{ score}) + d \cdot (1/\text{rank})$$

where c and d are constants,

[0106] It should be clear that these quality scores are merely exemplary. Other scores can be constructed where

higher score values correlate with higher likelihood of relevance to the user. In some embodiments, the predefined result selection criteria for results that correspond to relevant new pages to the user may require that the quality score be above a threshold value.

[0107] In some embodiments, Boolean criterion (e.g., “above dropoff”, whether the PR scores were above a threshold value, and/or whether the new result appeared in the top N (e.g., N=3)) are not incorporated into the quality score, but can still be used as part of the result selection criteria.

[0108] Query server 114 sends (608) links corresponding to at least some of the selected search results to a computer associated with the user for display, such as the client 102 that the user has used for login. In some embodiments, the links are sent without explicit input from the user requesting the selected search results.

[0109] FIG. 7 is a schematic screen shot of an exemplary graphical user interface 700 for alerting a computer user to new results for a prior search in accordance with one embodiment of the invention. In some embodiments, GUI 700 includes a plurality 704 of links 702 recommended by a search engine for a computer user. The plurality 704 of links 702 are determined by the search engine by: producing search results by rerunning a plurality of search queries that have been performed previously for the computer user; and evaluating the produced search results to select search results that meet predefined search result selection criteria. At least one of the criteria is based on Internet usage data for the user.

[0110] In some embodiments, the links 702 are displayed in a web page that is separate from a search result web page. In some embodiments, the links 702 are displayed in a search result history web page. In some embodiments, the links 702 are displayed in a web page (e.g., a home web page, login splash page or other web page) personalized to the user. In some embodiments, the links 702 are part of an RSS feed and are displayed using an RSS reader or other compatible interface. In some embodiments, information about the previous query (e.g., the query terms 706 and the date of the previous query 708) is displayed near the corresponding recommended link 702 so that the user can recognize the context for the recommendation. In some embodiments, there is a link (e.g., one or more of query terms 706) that the user can click on to re-run the corresponding previous query. In some embodiments, additional information about the new search result, such as a snippet 710 of text from the new result, is displayed near the corresponding recommended link 702 to help the user decide whether to click on the link.

[0111] Query server 114 will also receive implicit user feedback in the form of clicks on recommended links. Such data can be incorporated into a feedback loop to refine and adjust subsequent recommendations.

[0112] FIG. 8 is a flowchart representing a method of automatically identifying continuing interests of a computer user and alerting the user to new results for a prior search in accordance with one embodiment of the invention. FIG. 8 shows processes performed by search engine 112 and client 102. It will be appreciated by those of ordinary skill in the art that one or more of the acts described may be performed by hardware, software, or a combination thereof, as may be embodied in one or more computing systems. In some embodiments, portions of the processes performed by search engine 112 can be performed by client 102 using components analogous to those shown for search engine 112 in FIG. 2.

[0113] Prior to sending Internet usage data for a computer user, client 102 receives login information for the user, such as a username and password, and sends the information to search engine 112 via communications network 106. Search engine 112 receives and verifies the login information, thereby enabling search engine 112 to associate subsequent data received from client 102 (e.g., Internet usage data such as event-based data 404) with a particular user record 400 in user information database 116. In some embodiments, the user may pre-approve the use of the user's Internet usage data.

[0114] Client 102 sends (802) Internet usage data for a computer user to a server computer, such as query server 114 in search engine 112, via communications network 106. The Internet usage data include a plurality of search queries by the user (e.g., queries 421 in query events 410). In some embodiments, the Internet usage data include one or more of: the top N search results produced in response to each search query, and click data indicating users selections (clicks) of search results and URL visit duration times of the user on each user selected search result. In some embodiments, the Internet usage data are grouped into query sessions. In some embodiments, client 102 is the computer used by the user to enter login information for the search engine 112. In some embodiments, the user has previously registered with the search engine 112.

[0115] Accessing and using at least some of the Internet usage data, query server 114 identifies (804) search queries in the plurality of search queries that meet predefined query selection criteria for queries that correspond to continuing interests of the user. In some embodiments, the identifying of search queries is performed without explicit input from the user identifying search queries that are continuing interests of the user. In some embodiments, the predefined query selection criteria include a score derived from a combination of at least some of the Internet usage data.

[0116] Query server 114 reruns (806) at least some of the identified search queries. In some embodiments, the rerunning is performed automatically by search engine 112 at predefined times. In some embodiments, the predefined times include the times of periodic events (e.g., monthly, weekly, daily, twice per day, hourly, or the like) or the times of episodic events (e.g., in response to the occurrence of any one of a predefined set of trigger conditions, such as when the user logs in).

[0117] Query server 114 evaluates (808) search results from the rerun queries to select search results that meet predefined search result selection criteria. In some embodiments, the predefined search result selection criteria identify search results deemed likely to be relevant to the computer user.

[0118] Query server 114 sends (810) links corresponding to at least some of the selected search results to a computer associated with the user for display, such as the client 102 that the user has used for login. In some embodiments, the links are sent without explicit input from the user requesting the selected search results. In some instances, only the X highest ranked links are sent, where X is an integer (e.g., a number between 1 and 10) that is either predefined or chosen based on various system features (e.g., the type of client device, or the size of the display or display region in which the response is to be shown) or user preferences.

[0119] Client 102 receives (812) links corresponding to at least some of the selected search results from query server 114 and displays (814) at least some of the received links (e.g., as shown in FIG. 7). In some embodiments, the links

702 are displayed in a web page that is separate from a search result web page. In some embodiments, the links 702 are displayed in a search result history web page. In some embodiments, the links 702 are displayed in a web page (e.g., a home web page, login splash page or other web page) personalized to the user. In some embodiments, the links 702 are part of an RSS feed and are displayed using an RSS reader or other compatible interface. In some embodiments, information about the previous query (e.g., the query terms 706 and the date of the previous query 708) is displayed near the corresponding recommended link 702 so that the user can recognize the context for the recommendation. In some embodiments, additional information about the new search result, such as a snippet 710 of text from the new result, is displayed near the corresponding recommended link 702 to help the user decide whether to click on the link.

[0120] Query server 114 will also receive implicit user feedback in the form of clicks on recommended links. Such data can be incorporated into a feedback loop to refine and adjust subsequent recommendations.

[0121] The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated.

1. (canceled)

2. A computer-implemented method comprising:

providing, from a user device to a search system, a search query;

receiving, at the user device, a first set of search results in response to a first submission of the search query to the search system;

providing, from the user device to the search system and in response to the first set of search results, data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for;

in response to an automatic second submission of the search query to the search system, receiving, at the user device, an updated set of search results that includes at least one search result that is different from search results included in the first set of search results; and

displaying, at the user device, the updated set of search results with an indication that the updated set of search results are responsive to the search query.

3. The method of claim 2, wherein the automatic second submission of the search query to the search system occurs after a predetermined time lapses from the first submission of the search query to the search system.

4. The method of claim 2, further comprising:

determining a duration of a search session associated with the search query and the first set of search results,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for is based on at least the duration of a search session associated with the search query and the first set of search results satisfying a threshold.

5. The method of claim 2, wherein displaying, at the user device, the updated set of search results with an indication that the updated set of search results are responsive to the search query comprises displaying, at the user device, a search results page that includes a subset of the updated set of search results.

6. The method of claim 2, further comprising:

determining a number of selections of the first set of search results corresponding to the first submission of the search query,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for is based on at least the number of selections of the first set of search results satisfying a threshold.

7. The method of claim 2, further comprising:

determining a quantity of search results of the first set of search results that have been selected and displayed, at the user device, for more than a predetermined amount of time,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for is based on at least the quantity of search results of the first set of search results that have been selected and displayed, at the user device, for more than a predetermined amount of time satisfying a threshold.

8. The method of claim 2, wherein the updated set of search results that includes at least one search result that is different from search results included in the first set of search results comprises search results having a relevance score indicating relevance to the search query that satisfies a threshold.

9. A non-transitory computer-readable medium storing instructions that, when executed by one or more processors, cause the one or more processors to perform operations comprising:

providing, from a user device to a search system, a search query;

receiving, at the user device, a first set of search results in response to a first submission of the search query to the search system;

providing, from the user device to the search system and in response to the first set of search results, data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for;

in response to an automatic second submission of the search query to the search system, receiving, at the user device, an updated set of search results that includes at least one search result that is different from search results included in the first set of search results; and

displaying, at the user device, the updated set of search results with an indication that the updated set of search results are responsive to the search query.

10. The computer-readable medium of claim 9, wherein the automatic second submission of the search query to the search system occurs after a predetermined time lapses from the first submission of the search query to the search system.

11. The computer-readable medium of claim 9, the operations further comprising:

determining a duration of a search session associated with the search query and the first set of search results,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information

the user was looking for is based on at least the duration of a search session associated with the search query and the first set of search results satisfying a threshold.

12. The computer-readable medium of claim **9**, wherein displaying, at the user device, the updated set of search results with an indication that the updated set of search results are responsive to the search query comprises displaying, at the user device, a search results page that includes a subset of the updated set of search results.

13. The computer-readable medium of claim **9**, the operations further comprising:

determining a number of selections of the first set of search results corresponding to the first submission of the search query,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for is based on at least the number of selections of the first set of search results satisfying a threshold.

14. The computer-readable medium of claim **9**, the operations further comprising:

determining a quantity of search results of the first set of search results that have been selected and displayed, at the user device, for more than a predetermined amount of time,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for is based on at least the quantity of search results of the first set of search results that have been selected and displayed, at the user device, for more than a predetermined amount of time satisfying a threshold.

15. The computer-readable medium of claim **9**, wherein the updated set of search results that includes at least one search result that is different from search results included in the first set of search results comprises search results having a relevance score indicating relevance to the search query that satisfies a threshold.

16. A system comprising:

one or more computers; and

one or more storage devices storing instructions that are operable, when executed by the one or more computers, to cause the one or more computers to perform operations comprising:

providing, from a user device to a search system, a search query;

receiving, at the user device, a first set of search results in response to a first submission of the search query to the search system;

providing, from the user device to the search system and in response to the first set of search results, data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for;

in response to an automatic second submission of the search query to the search system, receiving, at the user device, an updated set of search results that includes at least one search result that is different from search results included in the first set of search results; and

displaying, at the user device, the updated set of search results with an indication that the updated set of search results are responsive to the search query.

17. The system of claim **16**, wherein the automatic second submission of the search query to the search system occurs after a predetermined time lapses from the first submission of the search query to the search system.

18. The system of claim **16**, the operations further comprising:

determining a duration of a search session associated with the search query and the first set of search results,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for is based on at least the duration of a search session associated with the search query and the first set of search results satisfying a threshold.

19. The system of claim **16**, wherein displaying, at the user device, the updated set of search results with an indication that the updated set of search results are responsive to the search query comprises displaying, at the user device, a search results page that includes a subset of the updated set of search results.

20. The system of claim **16**, the operations further comprising:

determining a number of selections of the first set of search results corresponding to the first submission of the search query,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for is based on at least the number of selections of the first set of search results satisfying a threshold.

21. The system of claim **16**, the operations further comprising:

determining a quantity of search results of the first set of search results that have been selected and displayed, at the user device, for more than a predetermined amount of time,

wherein the data that indicates a user of the user device did not find, from the first set of search results, information the user was looking for is based on at least the quantity of search results of the first set of search results that have been selected and displayed, at the user device, for more than a predetermined amount of time satisfying a threshold.

* * * * *