User Interface for Search

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Reference:
Modern Information Retrieval, Chapter 2 & Teaching material
Introduction

• This lecture focuses on
  – The **human users** of search systems
  – The **search user interface**, i.e., the window through which search systems are seen

• The role of **search user interface** is to aid in the searchers’ understanding and expression of their information need

• Further, the interface should help users
  – Formulate their queries
  – Select among available information sources
  – Understand search results
  – Keep track of the progress of their search
How People Search (1/2)

• User interaction with search interfaces differs depending on
  – The type of task
  – The domain expertise of the information seeker
  – The amount of time and effort available to invest in the process

• Marchionini makes a distinction between information lookup and exploratory search

• Information lookup tasks
  – Are akin to fact retrieval or question answering
  – Can be satisfied by discrete pieces of information: numbers, dates, names, or Web sites
  – Can work well for standard Web search interactions
How People Search (2/2)

• **Exploratory search** is divided into **learning** and **investigating** tasks

• **Learning search**
  – Requires more than single query-response pairs
  – Requires the searcher to spend time
  – Scanning and reading multiple information items
  – Synthesizing content to form new understanding

• **Investigating** refers to a longer-term process which
  – Involves multiple iterations that take place over perhaps very long periods of time
  – May return results that are critically assessed before being integrated into personal and professional knowledge bases
  – May be concerned with finding a large proportion of the relevant information available
How People Search (cont.)

• More broadly, **information seeking** can be seen as being part of a larger process referred to as **sensemaking**
  – **Sensemaking** is an iterative process of formulating a conceptual representation from a large collection

• *Russell et al.* observe that most of the effort in sensemaking goes towards the synthesis of a good representation

• Some sensemaking activities interweave search throughout, while others consist of doing a batch of search followed by a batch of analysis and synthesis
How People Search (cont.)

• Examples of deep analysis tasks that require sensemaking (in addition to search)
  – The legal discovery process
  – Epidemiology (disease tracking)
  – Studying customer complaints to improve service
  – Obtaining business intelligence
Classic vs. Dynamic Models of Information Seeking

• Classic notion of the information seeking process:
  1. problem identification
  2. articulation of information need(s)
  3. query formulation
  4. results evaluation

• More recent models emphasize the dynamic nature of the search process
  – The users learn as they search
  – Their information needs adjust as they see retrieval results and other document surrogates

• This dynamic process is sometimes referred to as the berry picking model of search

Assume that user’s information need is static
Classic vs. Dynamic Models of Information Seeking (cont.)

• The rapid response times of today’s Web search engines allow searchers:
  – To look at the results that come back
  – To reformulate their query based on these results
• This kind of behavior is a commonly-observed strategy within the berry-picking approach
• Sometimes it is referred to as **orienteering**
• *Jansen et al.* made a analysis of search logs and found that the proportion of users who modified queries is 52%
Classic vs. Dynamic Models of Information Seeking (cont.)

• Some seeking models cast the process in terms of strategies and how choices for next steps are made
  -- In some cases, these models are meant to reflect conscious planning behavior by expert searchers
  -- In others, the models are meant to capture the less planned, potentially more reactive behavior of a typical information seeker
Navigation vs. Search

- **Navigation**: the searcher looks at an information structure and browses among the available information.

- This browsing strategy is preferred when the information structure is well-matched to the user’s information need:
  - It is mentally less taxing to recognize a piece of information than it is to recall it.
  - It works well only so long as appropriate links are available.

- If the links are not available, then the browsing experience might be frustrating.
Navigation vs. Search (cont.)

• Spool discusses an example of a user looking for a software driver for a particular laser printer

• Say the user first clicks on printers, then laser printers, then the following sequence of links:
  
  *HP laser printers*
  *HP laser printers model 9750*
  *software for HP laser printers model 9750*
  *software drivers for HP laser printers model 9750*
  *software drivers for HP laser printers model 9750 for the Win98 operating system*

• This kind of interaction is acceptable when each refinement makes sense for the task at hand
Search Process

• Numerous studies have been made of people engaged in the search process
• The results of these studies can help guide the design of search interfaces
• One common observation is that users often reformulate their queries with slight modifications
• Another is that searchers often search for information that they have previously accessed
  – The users’ search strategies differ when searching over previously seen materials
• Researchers have developed search interfaces support both query history and re-visitation
Search Process (cont.)

• Studies also show that it is difficult for people to determine whether or not a document is relevant to a topic
  – The less users know about a topic, the poorer judges they are about if a search result is relevant to that topic

• Other studies found that searchers tend to look at only the top-ranked retrieved results

• Further, they are biased towards thinking the top one or two results are better than those beneath them simply by virtue of their position in the rank ordering
Search Process (cont.)

- Studies also show that people are poor at estimating how much of the relevant material they have found.
- Other studies have assessed the effects of knowledge of the search process itself.
- These studies have observed that experts use different strategies than novices searchers.
- For instance, Tabatabai *et al.* found that
  - Expert searchers were more patient than novices.
  - This positive attitude led to better search outcomes.
Search Interfaces Today: Getting Started

• How does an information seeking session begin in online information systems?
  – The most common way is to use a **Web search engine**
  – Another method is to select a **Web site from a personal collection of already-visited sites**
    • which are typically stored in a **browser’s bookmark**
  – Online bookmark systems are popular among a smaller segment of users
    • Ex: Delicious.com
  – **Web directories** are also used as a common starting point, but have been largely replaced by search engines
Query Specification

• The primary methods for a searcher to express their information need are
  – Either entering words into a search entry form
  – Selecting links from a directory or other information organization display

• For Web search engines, the query is specified in textual form
  – But in future, query specification via spoken commands will most likely become increasingly common, using mobile devices as the input medium

• Typically, Web queries today are very short consisting of one to three words
Query Specification (cont.)

- Short queries reflect the standard usage scenario in which the user *tests the waters*:
  - If the results do not look relevant, then the user *reformulates* their query
  - If the results are promising, then the user *navigates* to the most relevant-looking Web site

- This search behavior is a demonstration of the *orienteering strategy* of Web search
Query Specification (cont.)

• Before the Web, search systems regularly supported **Boolean operators** and **command-based syntax**
  – However, these are often difficult for most users to understand

• *Jansen et al.* conducted a study over a Web log with 1.5M queries, and found that
  – 2.1% of the queries contained Boolean operators
  – 7.6% contained other query syntax, primarily double-quotation marks for phrases

• *White et al.* examined interaction logs of nearly 600,000 users, and found that
  – 1.1% of the queries contained one or more operators
  – 8.7% of the users used an operator at any time
Query Specification (cont.)

• Web ranking has gone through three major phases
  • In the first phase, from approximately 1994–2000:
    – Since the Web was much smaller then, complex queries were less likely to yield relevant information
    – Further, pages retrieved not necessarily contained all query words
    – Information about query term proximity within the page was not used, nor was the information about relative importance of Web pages
  • Around 1997, Google moved to conjunctive queries only
    – The other Web search engines followed, and conjunctive ranking became the norm
    – Google also added term proximity information and page importance scoring (PageRank)
    – As the Web grew, longer queries posed as phrases started to produce highly relevant results
Query Specification Interfaces

• The standard interface for a textual query is a search box entry form

• Studies suggest a relationship between query length and the width of the entry form
  – Results found that either small forms discourage long queries or wide forms encourage longer queries
Query Specification Interfaces (cont.)

• Some entry forms are followed by a form that filters the query in some way
• For instance, at **yelp.com**, the user can refine the search by location using a second form

![yelp.com search form](image)

• Notice that the **yelp.com** form also shows the user’s home location, if it has been specified previously
Query Specification Interfaces (cont.)

• Some interfaces show a list of query suggestions as the user types the query
  – This is referred to as auto-complete, auto-suggest, or dynamic query suggestions
  – Anick et al. found that users clicked on dynamic Yahoo suggestions one third of the time

• Often the suggestions shown are those whose prefix matches the characters typed so far
  – However, in some cases, suggestions are shown that only have interior letters matching

• Further, suggestions may be shown that are synonyms of the words typed so far
Query Specification Interfaces (cont.)

- Dynamic query suggestions, from Netflix.com
Query Specification Interfaces (cont.)

• The dynamic query suggestions can be derived from several sources, including:
  – The user’s own query history
  – A set of metadata that a Web site’s designer considers important
  – All of the text contained within a Web site
Retrieval Results Display

- When displaying search results, either
  - The documents must be shown in full, or else
  - The searcher must be presented with some kind of representation of the content of those documents

- The **document surrogate** refers to the information that summarizes the document
  - This information is a key part of the success of the search interface
  - The design of document surrogates is an active area of research and experimentation
  - The quality of the surrogate can greatly effect the perceived relevance of the search results listing
Retrieval Results Display (cont.)
Retrieval Results Display (cont.)

• In Web search, the page title is usually shown prominently, along with the URL and other metadata.

• In search over information collections, metadata such as date published and author are often displayed.

• Text summary (or snippet) containing text extracted from the document is also critical.

• Currently, the standard results display is a vertical list of textual summaries.

• This list is sometimes referred to as the SERP (Search Engine Results Page).
Retrieval Results Display (cont.)

• In some cases the summaries are excerpts drawn from the full text that contain the query terms

• In other cases, specialized kinds of metadata are shown in addition to standard textual results
  – This technique is known as **blended results** or **universal search**
  – For example, a query on a term like “rainbow” may return sample images as one entry in the results listing
- A query on the name of a sports team (e.g., “rockets”) might retrieve the latest game scores and a link to buy tickets.
• Nielsen notes that in some cases the information need is satisfied directly in the search results listing
  – This makes the search engine an “answer engine”

• Displaying the query terms in the context in which they appear in the document:
  – Improves the user’s ability to gauge the relevance of the results
  – It is sometimes referred to as **KWIC** - keywords in context
  – It is also known as **query-biased summaries, query-oriented summaries**, or **user-directed summaries**
• The visual effect of query **term highlighting** can also improve usability of search results listings
  – Highlighting can be shown both in document surrogates in the retrieval results and in the retrieved documents

• Determining which text to place in the summary, and how much text to show, is a challenging problem

• Often the summaries contain all the query terms in close proximity to one another

• However, there is a **trade-off** between
  – Showing contiguous sentences, to aid in coherence in the result
  – Showing sentences that contain the query terms
Retrieval Results Display (cont.)

• Some results suggest that it is better to show full sentences rather than cut them off
  – On the other hand, very long sentences are usually not desirable in the results listing

• Further, the kind of information to display should vary according to the intent of the query
  – Longer results are deemed better than shorter ones for certain types of information need
  – On the other hand, abbreviated listing is preferable for navigational queries
  – Similarly, requests for factual information can be satisfied with a concise results display
• Other kinds of document information can be usefully shown in the search results page
  – E.g., the page results below show figures extracted from journal articles alongside the search results
Query Reformulation

• There are tools to help users reformulate their query
  – One technique consists of showing terms related to the query or to the documents retrieved in response to the query

• A special case of this is spelling corrections or suggestions
  – Usually only one suggested alternative is shown: clicking on that alternative re-executes the query
  – Some years ago, the search results were shown using the purportedly incorrect spelling
Query Reformulation (cont.)

- Microsoft Live’s search results page for the query “IMF”
Query Reformulation (cont.)

- **Term expansion**: search interfaces are increasingly employing related term suggestions

- Log studies suggest that term suggestions are a somewhat heavily-used feature in Web search

- *Jansen et al.* made a log study and found that 8% of queries were generated from term suggestions

- *Anick et al.* found that 6% of users who were exposed to term suggestions chose to click on them
Query Reformulation (cont.)

• Some **query term suggestions** are based on the entire search session of **the particular user**

• Others are based on behavior of **other users** who have issued the same or similar queries in the past
  – One strategy is to show similar queries by other users
  – Another is to extract terms from documents that have been clicked on in the past by searchers who issued the same query
Query Reformulation (cont.)

- **Relevance feedback** is another method whose goal is to aid in query reformulation.

- The main idea is to have the user indicate which documents are relevant to their query:
  - In some variations, users also indicate which terms extracted from those documents are relevant.

- The system then computes a new query from this information and shows a new retrieval set.
Query Reformulation (cont.)

• Nonetheless, this method (i.e., relevance feedback) has not been found to be successful from a usability perspective
  – Because that, it does not appear in standard interfaces today

• This stems from several factors:
  – People are not particularly good at judging document relevance, especially for topics with which they are unfamiliar
  – The beneficial behavior of relevance feedback is inconsistent
Organizing Search Results

• Organizing results into meaningful groups can help users understand the results and decide what to do next

• Popular methods for grouping search results: category systems and clustering

• **Category system**: meaningful labels organized in such a way as to reflect the concepts relevant to a domain
  – Good category systems have the characteristics of being coherent and relatively complete
  – Their structure is predictable and consistent across search results for an information collection
Organizing Search Results (cont.)

• The most commonly used category structures are **flat**, **hierarchical**, and **faceted** categories.

• **Flat categories** are simply lists of topics or subjects.
  – They can be used for grouping, filtering (narrowing), and sorting sets of documents in search interfaces.

• Most Web sites organize their information into general categories.
  – Selecting that category narrows the set of information shown accordingly.
Organizing Search Results (cont.)

• Some experimental Web search engines automatically organize results into flat categories
  – Studies using this kind of design have received positive user responses (*Dumais et al.*, *Kules et al.*)

• However, it can difficult to find the right subset of categories to use for the vast content of the Web

• Rather, category systems seem to work better for more focused information collections
Organizing Search Results (cont.)

• In the early days of the Web, **hierarchical directory systems** such as Yahoo’s were popular
  – **Hierarchy** can also be effective in the presentation of search results over a book or other small collection

• An alternative representation is the **faceted metadata**
  – Unlike flat categories, faceted metadata allow the assignment of multiple categories to a single item
  – Each category corresponds to a different facet (dimension or feature type) of the collection of items
Organizing Search Results (cont.)

- Figure below shows an example of faceted navigation
Organizing Search Results (cont.)

• **Clustering** refers to the grouping of items according to some measure of similarity

• It groups together documents that are similar to one another but different from the rest of the collection
  – Such as all the document written in Japanese that appear in a collection of primarily English articles

• The greatest advantage of clustering is that it is fully automatable

• The disadvantages of clustering include
  – An unpredictability in the form and quality of results
  – The difficulty of labeling the groups
  – The counter-intuitiveness of cluster sub-hierarchies
Organizing Search Results (cont.)

- Output produced using Findex clustering
Visualization in Search Interfaces

• Experimentation with visualization for search has been primarily applied in the following ways:
  – Visualizing Boolean syntax
  – Visualizing query terms within retrieval results
  – Visualizing relationships among words and documents
  – Visualization for text mining
Design and Evaluation

• User interface design: a field of Human-Computer Interaction (HCI)

• This field studies how people think about, respond to, and use technology

• User-centered design: a set of practices developed to facilitate the design of interfaces

• The design process begins by determining what the intended users’ goals are

• Then, the interface is devised to help people achieve those goals by completing a series of tasks
Design and Evaluation (cont.)

• Goals in the domain of information access can range quite widely

• The design of interfaces is an iterative process, in which the goals and tasks are elucidated via user research

• Evaluating a user interface is often different from evaluating a ranking algorithm or a crawling technique
  – The quality of a user interface is determined by how people respond to it
  – If a person has a choice between two systems, they will use the one they prefer
  – The reasons for preference may be determined by a host of factors: speed, familiarity, aesthetics, preferred features, or perceived ranking accuracy