User Interface for Search

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

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

• The user interface role 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

• 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 (cont.)

- **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
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

- 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
Retrieval Results Display (cont.)

- A query on the name of a sports team (e.g., “rockets”) might retrieve the latest game scores and a link to buy tickets.
Retrieval Results Display (cont.)

- 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**
Retrieval Results Display (cont.)

• 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
Retrieval Results Display (cont.)

• 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 facetted 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