Information Retrieval

• The (monotonically) increasing amount of electronically available information has turned information retrieval into a major application domain requiring well-thought-out interaction design

• “Information retrieval” was traditionally the domain of library science — a field that has largely now merged with computer science as a specialization

• The current “state of the field” represents a merger of “traditional” information retrieval with database management as well as visualization

Key Terms

• Terms like retrieval, querying, and reporting are giving way to information gathering, seeking, filtering, and visualization

• Per Shneiderman’s OAI model, real-world task objects get represented as interface objects within a system:
  ◊ Task objects in this domain include as paper documents, images, and video
  ◊ Interface objects include databases (of records or tuples) and digital libraries (of documents); attributes or metadata, respectively, hold additional detail on these objects

• Similarly, task actions translate into interface actions:
  ◊ Task actions include all forms of browsing and searching, including specific or extended fact finding, exploration of availability, and open-ended browsing/analysis
  ◊ These actions map into interface actions such as scrolling, zooming, joining, or linking
Text Searches

• Searches based on text content have historically been the primary way to find information, and will probably remain so for a while

• Text-based searches started within the database realm, using (relatively) complex languages — e.g., despite SQL’s English-like syntax, effective use of SQL requires relational database concepts and operations

• The Worldwide Web has broadened the applicability of searches, now largely simplified to simple keywords (with more advanced functions available as an option)

Text Query Approaches

• Formal query languages like SQL correspond to the command-line interaction style

• *Natural-language queries* hold the same appeal as the natural-language interaction style, but as such also have the same challenges

• *Form-fillin queries* correspond to the menus/forms/dialogs interaction style, facilitating queries on different attributes with some, but not all, boolean combinations

◊ The *query-by-example* variant of form-fillin was an early ease-of-use milestone but has lost its prominence, probably caught in between the power of a full query language and the specificity of custom query forms
Five-Phase Search Framework

Shneiderman offers up a five-phase framework for searches, with parallels to Norman’s seven stages of action:

• **Formulation** determines the fundamental parameters of a search, including the sources to use, the fields that can be used to limit the search, the meaningful phrases in the search, and possible variants on these phrases (capitalization, stemming, synonyms, etc.)

• **Initiation of action** is the actual execution of the search; *explicit initiation* waits for a command from the user, while *implicit initiation* performs the search during formulation

• **Review of results** presents found items to the user; helpful capabilities for this phase include previews or summaries, sorting of results (alphabetical, ranking, etc.), paging of results (e.g., “10 out of 12,000 shown”), and clustering (e.g., by type of item, by information source, etc.)

• The *refinement phase* allows incremental or progressive changes to the original search — users may want to restrict the search further, or perhaps expand it; fixes due to spelling or other errors may be needed; a search history may be provided so that the user can see prior search attempts and their results

• Finally, the *use of results* captures the actual reason behind the search in the first place — inclusion in a paper, sharing with collaborators, purchasing, etc.
Multimedia Searches

• As the diversity of available information has expanded, so has its form — digital information sources are no longer restricted to words and numbers, but include images, sounds, video, and more

• Searches over multimedia sources are still relatively new, with a key challenge lying in algorithms for automatically recognizing items by content, thus spilling into computer vision, signal processing, and other fields

• One can always attach keywords or metadata to multimedia sources, thus “converting” to text searches

Nevertheless, searches by content remain a much-sought-after and active research area:

◊ **Image search** seeks to express and locate images by their visual appearance; it is sometimes known by the acronym QBIC (“query by image content,” or “retrieve images that look like this,” in terms of color, appearance, or other visual similarity)

◊ **Map search** seeks to find physical locations using meaningful spatial, geographic, or statistical data (e.g., restaurants within an area that serve a particular cuisine, airports with a certain level of traffic, regions with a higher risk of wildfires, etc.)

◊ **Design or diagram search** seems similar to image search, but focuses instead on structural or semantic elements (e.g., layouts without ads, floor plans with a certain number of rooms, schematics with certain parts, etc.)

◊ **Sound search** seeks to locate audio artifacts based on “similar” audio, either provided by the user or copied from another source; a variant of sound search is **speech search**, which is similar to text search but over recordings instead of documents

◊ **Video search** combines image and sound searches as applied to the multiple still frames and tracks within a video, but also includes elements unique to video, such as composition or sequencing of scenes, as well as visual components such as the presence of captions

◊ **Animation search** integrate moving structural elements, such as spinning, fades, or zooms — e.g., “find Flash animations with spinning globes”
Challenges and Variations in Information Retrieval

The area of information retrieval offers a wide range of challenges that relate directly to interaction design:

• *Complex boolean queries* have, so far, been achievable only through a (relatively) complex and restrictive language; visual or direct manipulation approaches to such queries remain as a research area

• *Automatic filtering* seek to integrate *implicit* filters based on *user preferences* or a *user profile* — in other words, it *always* performs some query behind the scenes, to tailor information for that user

• *Dynamic queries* are equivalent to the direct manipulation interaction style, combining rapid feedback and visual controls to “sculpt” searches on the fly

• *Faceted metadata search* may sound fancy, but it is simply the ability to query simultaneously along multiple attributes or dimensions

• *Collaborative filtering* uses the input (ratings) of other users to offer suggestions to another user — frequently used for recommending products, music, or movies

• *Multilingual searches* involve documents in different languages, including translation services as appropriate

• *Visual searches* represent query parameters in a non-textual format where applicable, for example with airline seats or calendar displays