

# 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