USER SEARCH INTERFACES

Design and Application
KEEP IT SIMPLE

• Search is a means towards some other end, rather than a goal in itself.

• Search is a mentally intensive task.

  – Task Example:

    • You have a friend who asked you to provide her with valuable information about a Canadian university that she may consider for a graduate degree in business. What kind of information would you like to send to your friend providing her with a comparison of at least two universities? State your choice of the university and the reasons behind your choices. Provide a copy of all the supporting information you find on the Web.
KEEP IT SIMPLE

• Interface design must be:
  – Understandable
  – Appealing to a wide variety of users of all
    • Ages
    • Cultures
    • Backgrounds
  – Applied to an enormous variety of information needs
Search results listings from Infoseek in 1997 (left) and Google in 2007 (right), courtesy Jan Pedersen.
A HISTORICAL SHIFT IN SEARCH INTERFACE DESIGN

Before the Web
BEFORE THE WEB

• Computerized information retrieved by members of a narrow demographic and highly educated users.
  – Paralegals
  – Librarians
  – Journalists

• Search is done over highly specialized and high-quality information-oriented text collections.
  – Bibliographic records for university libraries
  – legal cases
  – newswire articles

• Search over full text was not usually allowed.

• Interfaces were command line based.
AFTER THE WEB

• Almost everyone can access the Web.
• Search is done over full text.
• The desired information is immediately accessible.
• The Web contains more than just text???
• No need for formal education
  – High access
  – Free access
  – Higher competition
THE PROCESS OF SEARCH INTERFACE DESIGN

- **Usability**: Refers to those properties of the interface that determine how easy it is to use.
- **Learnability**: How easy is it for users to accomplish basic tasks the first time they encounter the interface?
- **Efficiency**: How quickly can users accomplish their tasks after they learn how to use the interface?
- **Memorability**: After a period of non-use, how long does it take users to re-establish proficiency?
- **Errors**: How many errors do users make, how severe are these errors, and how easy is it for users to recover from these errors?
- **Satisfaction**: How pleasant or satisfying is it to use the interface?
DESIGN GUIDELINES FOR SEARCH INTERFACES

• From Human-Computer Interaction, several guidelines are proposed:
  – Offer informative feedback.
  – Support user control.
  – Reduce short-term memory load.
  – Provide shortcuts for skilled users.
  – Reduce errors; offer simple error handling.
  – Strive for consistency.
  – Permit easy reversal of actions.
  – Design for closure.
• However,
  – Difficult to follow:
    • They do not usually say how to achieve the guideline's goals.
    • Some guidelines conflict with each other.
      – Feedback and consistency in the case of a search interface that offers no results to a query.
      – Saying that: no feedback terms are available distracts the user while keeping consistency present.
    • There is no complete list of guidelines.
    • For a given interface, some guidelines are wasteful.
(1) OFFER EFFICIENT AND INFORMATIVE FEEDBACK

• Feedback is a general principle.
  – Example: the wait symbol.

• Search Interfaces:
  – Cognitively intensive

• Feedback should consider:
  – Query reformulation
  – Why particular results were retrieved
  – Next step to be taken by the user
(1) OFFER EFFICIENT AND INFORMATIVE FEEDBACK

HOW?
1.a. Show Search Results Immediately

• Helps users understand where they are
  – Show query suggestions clearly
  – Require the least amount of information for continuation
  – Avoid clutter and enhance usability when visualization is in place
1.b. Show Informative Document Surrogates; Highlight Query Terms

• Document Surrogates include:
  – Document information
  – Where it was retrieved
  – Title, URL, and Summary

• Query terms should be shown in the surrogate to reflect context.

• When all (or most) query terms appear in the title, the summary should include other useful relevant information.

• Query terms appearing in the URL can also be useful.
1.b. Show Informative Document Surrogates; Highlight Query Terms, cont’d

• Highlighting query terms can also be useful.
• Done by:
  – Boldface
  – Color background
  – Different color
• Helps in:
  – Drawing the searcher’s attention to the query-relevant documents
  – Shows how close the document to the query is
  – However,
    • Highlighting too many terms may be a disadvantage. Why?
1.b. Show Informative Document Surrogates; Highlight Query Terms, cont’d

• Tradeoffs:
  – Long informative vs. Short screen space saver summaries
  – Showing fragments of sentences where the query terms appear vs. showing coherent sentences
  – The following figure shows search results in the BioText system (Hearst et al., 2007), in which rich document surrogate information is shown, including figures extracted from the articles, query term highlighting and boldfacing, and an option to expand or shorten extracted document summaries. From http://biosearch.berkeley.edu.
The small molecule Mek1/2 inhibitor U0126 disrupts the chordamesoderm to notochord transition in zebrafish


Abstract
Key molecules involved in notochord differentiation and function have been identified through genetic analysis in zebrafish and mice, but MEK1 and 2 have so far not been implicated in this process due to early lethality (Mek1/-/-) and functional redundancy (Mek2/-/-) in the knockout animals. ... Show Full Abstract

Full-text Excerpts
...develops from the chordamesoderm, a derivative of dorsal mesoderm, and is ultimately incorporated into the forming vertebrae as the nucleus pulposus. Here we report the analysis of zebrafish embryos treated with the Mek1/2 inhibitor U0126 which causes an almost 100% penetrant, dose-dependent and reproducible phenotype consisting of short trunk and tail, lack of dark pigmentation, and abnormal...

...in zebrafish [33]. Consistent with those analyses, treatment of Show Full Excerpts

Distinct Functions for Different scl Isoforms in Zebrafish Primitive and Definitive Hematopoiesis


Abstract
The stem-cell leukemia (SCL, also known as TAL1) gene encodes a basic helix-loop-helix transcription factor that is essential for the initiation of primitive and definitive hematopoiesis, erythrocyte and megakaryocyte differentiation, angiogenesis, and osteocyte development. Here we report that the zebrafish embryo, through an
1.c. Allow Sorting of Results by Various Criteria

- Allow for ranking according to different ranking criteria:
  - Recency
  - Relevance
  - Author
  - Price
  - Location
  - ...
- Usually uses sortable columns format
- Allow the user to visually compare criteria
- More effective than choices hidden in drop-down menus

<table>
<thead>
<tr>
<th>Size</th>
<th>Identifier</th>
<th>Title</th>
<th>Creator/Author(s)</th>
<th>Pub Date</th>
<th>Adopt.A Doc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>US 4768152</td>
<td>Oil well bore hole surveying by kinematic navigation</td>
<td>Egli, W.H., Vallot, L.C.</td>
<td>1966 Aug 30</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>CA 972556</td>
<td>Apparatus for surveying bore holes</td>
<td>Templeton, F.E.</td>
<td>1975 Aug 12</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>UCD-17852</td>
<td>BIFUR II, a program for calculating borehole gravity caused by two-dimensional structure</td>
<td>Hearst, J.R.</td>
<td>1976 Jul 13</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>CONF-6305286-7</td>
<td>Present stand of coal deposit exploration techniques</td>
<td>Bonnet, M.</td>
<td>1964 Jan 01</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>US 4406332</td>
<td>Rotary earth boring tool</td>
<td>Dismukes, N.B.</td>
<td>1963 Sep 27</td>
<td>-</td>
</tr>
<tr>
<td>422 K</td>
<td>DOE/CE/15600-T2</td>
<td>Commercialization of atom interferometers for borehole gravity gradiometry, Quarterly report, January--March 1993</td>
<td>Clauser, J.F.</td>
<td>1993 May 01</td>
<td>-</td>
</tr>
<tr>
<td>0 K</td>
<td>LA-VR-86-2351; CONF-8806193-1</td>
<td>The inverse-square law and quantum gravity</td>
<td>Nieto, M.M., Goldman, T., Hughes, R.J.</td>
<td>1966 Jan 01</td>
<td>-</td>
</tr>
<tr>
<td>3 Mb</td>
<td>DOE/BC/14951-5</td>
<td>Integrated approach towards the Application of Horizontal Wells to Improve Waterflooding Performance, Annual report</td>
<td>Kelkar, M., Liner, C., Kerr, D.</td>
<td>1994 Jun 01</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>US 4436168</td>
<td>Thrust generator for boring tools</td>
<td>Dismukes, N.B.</td>
<td>1964 Mar 13</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>US 3993146</td>
<td>Apparatus for mining coal using vertical bore hole and fluid (9 claims; magnetite slurry to dislodge and float coal)</td>
<td>Poundstone, W.N., Miller, W.J.</td>
<td>1976 Nov 23</td>
<td>-</td>
</tr>
<tr>
<td>2 Mb</td>
<td>DOO-4715-1</td>
<td>Preliminary targeting of geothermal resources in Delaware, Progress report, July 15, 1978-July 14, 1979</td>
<td>Woodruff, K.D.</td>
<td>1979 Jul 01</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>CA 1154429</td>
<td>Method and apparatus for forming lateral passageways</td>
<td>Dismukes, N.B.</td>
<td>1983 Sep 27</td>
<td>-</td>
</tr>
</tbody>
</table>
Clustering is Different than Ranking
1.d. Show Query Term Suggestions

- Automatically-generated query term suggestions and refinements are shown to be useful after the first user query.

- Include:
  - Spelling correction suggestions
  - Suggestions of related or alternative query terms
  - Dynamic query term suggestions
    - Good intermediate approach between:
      - Requiring the user to think of terms
      - Requiring the user to select among long lists of alternatives

- However,
  - Too many suggestions may cause harm
Example of an interface for showing two types of search assistance, from Yahoo. The left hand column shows suggestions dynamically as the user types their query. These suggestions usually match the prefix characters of the query. The right hand column shows suggestions of related terms after the query has been submitted. These need not contain characters from the original query. (Reproduced with permission of Yahoo! Inc. 2009 Yahoo! Inc. YAHOO! and the YAHOO! logo are registered trademarks of Yahoo! Inc.)
1.d. Show Query Term Suggestions, cont’d
1.e. Use Relevance Indicators Sparingly

- In the past, indicators included numerical values, bars, and rows of starts indicating relevance.
- Now, the vertical position of a document is a good enough indicator of relevance.
- Indicators are still used for reviews.
- In visualization, showing graphic distributions of the query terms in documents has been developed.
Example: A visual technique to indicate overall and component relevancy of search-engine results (Grewal et al., 2000)
1.f. Support Rapid Response

• Rapid response is critical for effective feedback.
• Permits the user to work with “flow”
• Allows for rapid query reformulation
• In case the system provides final results, a little delay is not bad.
  – Showing a graphical animation may reduce user frustration.
(2) BALANCE USER CONTROL WITH AUTOMATED ACTIONS

HOW?
http://www.youtube.com/watch?v=DHMJJwouq5I

The video shows the use of *prefuse* (visualization toolkit) for a tagged photo collection (retrieval and display purposes)
(2) BALANCE USER CONTROL WITH AUTOMATED ACTIONS

• **Greene et al., 2000** indicate that “Users prefer comprehensible, predictable, and controllable environments.

• However, it is a tradeoff.
  
    – (Bad Case): Less powerful or less effective designs that are easily understandable and give the user control over system behavior.
    
    – (Good Case): Clever but opaque operations (design) that correctly anticipate searcher's needs most of the time and give the user control for sophisticated actions.
Types of Search Interface Design Decisions
2.a. Rank Ordering in Web Search

• Ranking Preview
  – Most users have little understanding of how search technologies work.
  – Statistical ranking (vector space) is designed for long queries.
  – Web queries are 2.4 words on average (Spink et al. 2001).

• Ranking on the screen real estate (on the Web)
  – Higher results in the list are more important (conventional)

• Chronological order may be preferred by certain groups such as those searching for personal information.

• Recency is preferred by researchers looking for articles.
Multiple clustering criteria

Where is the user control?
2.b. Query Transformations

- Search engines may have control over query transformation by:
  - Subtle changes to queries (Microsoft).
    - **vs.** to versus
  - Some search engines use stemming.
    - May cause unnoticeable changes
      - Spelling correction should **not** be forced by the search engine.
- But if the system consistently overrules the user's intention, the user may become justifiably frustrated.
(3) REDUCE SHORT-TERM MEMORY LOAD
(3) REDUCE SHORT-TERM MEMORY LOAD

• Important for information-rich system interfaces.

• Critical: show users what is important
  – Do not require them to keep track of everything.

Example of a query form that provides a reminder of which set of content is being searched over, from The New York Times.
(3) REDUCE SHORT-TERM MEMORY LOAD

Techniques to Follow
3.a. Suggest the Search Action in the Entry Form

• Suggest grayed text in the search box.
• Useful in:
  – showing what collection is being searched
  – searching within results
3.b. Support Simple History Mechanisms

- Users click on results they previously visited (40%).
  - 87% in another study.
- They use the same queries (71% of the time).
- Not being able to go to a previous page is a big problem in Web search.
- Web browsers provide re-visitation mechanisms such as:
  - Bookmarks
  - History
    - Back Button
    - Most Recently Visited pages
      - Disadvantages?
- **Search engines should provide history mechanisms.**
  - It is worth further investigation
3.c. Integrate Navigation and Search

• It is useful to prompt the searcher with information related to their information need.
• Search by navigation can be seen in the example provided on the next slide.
• The site hierarchy is utilized for searching.
• The user smoothly navigates while searching for information.
The VLN Interface (Alhenshiri et al., 2010)
The VLN Interface (Alhenshiri et al., 2010)
Walk2web: search by navigation
3.c. Integrate Navigation and Search, cont’d

• In search interfaces, category systems are the main tool for navigating information structures and organizing search results.

• Category system structure (example on next slide) in search interfaces is usually one of **flat**, **hierarchical**, or **faceted**.

• **Flat list of categories:**
  – Works well for presenting a list of choices.
  – Needs to be limited to a small set in order to be scannable.
Category-based Navigation for Search
Hierarchical (or tree-structured) category systems:

- Useful and can be easy to understand for relatively simple information structures
- Documents are assigned to single categories
- However, information items are best described by multiple different categories simultaneously
3.c. Integrate Navigation and Search, cont’d

- **Hierarchical faceted metadata**
  - Allows users to browse information collections according to multiple categories simultaneously.
  - The main idea is to build a set of category hierarchies.
    - Each of which corresponds to a different facet (dimension or feature type) that is relevant to the collection to be navigated.
    - Each facet has a set of labels associated with it,
    - If this set is large, it may be organized into a hierarchy.
    - After the facet hierarchies are designed, each item in the collection can be assigned any number of labels from any number of facets.
    - The user can browse the information collection from any of the different facets as a starting point.
    - After starting with one facet, the user can then navigate using any other facet.
  - Usability results suggest that this kind of interface is highly usable for navigation of information collections with somewhat **homogeneous** content.
Faceted navigation interface for the zvents.com local events web site. The user has selected the city of “Berkeley” from the Location facet and “Community” from the eventCategory facet, and each of these selections can be further refined (by “Neighborhood” for Locationor by type of community activity). Beside each narrowing category is shown in parentheses how many items will result from selecting that category. Or the user can opt to narrow by another faceted entirely, such as When.
(4) PROVIDE SHORTCUTS

To Whom?
PROVIDE SHORTCUTS

• Provide alternative interface mechanisms for practiced users of an interface.
  – But they require memorization.
• Provide targeted hints about where to go next
• Pages on a result hint indicating that such pages are frequently visited.
  – Saves the user some time.
• Search engines guess the information need from past queries similar to the current one.
  – Intention prediction is a form of “shortcut”
  – Reduces the need for further navigations to external sites
(5) REDUCE ERRORS

HOW?
5.a. Avoid Empty Results Sets

- Spelling correction and suggestions can help.
- Many different attributes from different categories simultaneously result in an empty set.
  - (e.g., for a recipes interface, selecting dessert and low-fat and cheese).
  - A faceted interface with query previews would show the user that after selecting dessert and low-fat, the list of ingredients has zero hits on cheese.
  - So the user would know they have to relax one of the already chosen constraints to get non-empty results.
- Use preliminary results whenever possible.
5.b. Address the Vocabulary Problem

- The problem of “productivity of language”.
- AKA “the vocabulary problem”.
- Asking about the price of a camera can be done in one of the following ways:
  - How much does that camera cost?
  - How much for that camera?
  - That camera. How much?
  - What is the price of that camera?
  - Please price that camera for me.
  - What're you asking for that camera?
  - How much will that camera set me back?
  - What are these cameras going for?
  - What's that camera worth to you?
  - That camera. How much does it cost?
(6) RECOGNIZE THE IMPORTANCE OF SMALL DETAILS
(6) RECOGNIZE THE IMPORTANCE OF SMALL DETAILS

• Details in search interfaces can make a big difference.
• For example:
  – Wider entry search box encourages searchers to type longer queries.
  – Varying the order of document surrogates affects how much searchers learn about the information.
  – Changing how searchers perceive the presentation of search results may reduce (or improve) performance.
  – Google changed “If you didn't find what you were looking for ...” to “Did you mean ....”. They also added the question to the bottom of the screen. The results were amazing.
http://search-cube.com/
www.nexplore.com
(7) RECOGNIZE THE IMPORTANCE OF AESTHETICS IN DESIGN
(7) RECOGNIZE THE IMPORTANCE OF AESTHETICS IN DESIGN

• The design should balance:
  – The choices of layout
  – The placement and amount of blank space
  – The placement and amount of color, contrasts among fonts' style, weight, and size

• Aesthetic impressions play an important role in user acceptance.

• It also correlates with perceptions of an interface's quality, user satisfaction, and overall impression.

• Regular users of Yahoo! And MSN search engines had better experience with Google. Why?
  – Design issues.
  – Google revealed information “scent” better by showing more descriptive document summaries that are relevant to the queries
  – Subtle graphics details
  – Surrounding ads with lines and not putting those ads among the top results
Design search interfaces that take into consideration the above principles and guidelines.
REFERENCES

• User Search Interfaces.
  – Available online at: http://searchuserinterfaces.com/book/sui_ch1_design.html

• Chapter 1 includes several references that are not stated here on the slides. Credit goes to the authors of the corresponding articles.

• Read Chapter ONE.
Questions?

• How can IR benefit from Visualization?
• How can the Interface Design benefit IR?
• What aspects of the search interface can be improved to:
  — Increase the user understanding of Web search results?
  — Improve the presentation of document features?
  — Improve clustering by providing better topical overviews?
• Do more, I want suggestions?
• ............
Papers to Read

• A User-Interface Framework for Text Searches

• Evaluation of user interface designs for information retrieval systems: a computer-based experiment