

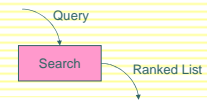
LBSC 796/INFM 718R: Week 9  
User Interaction



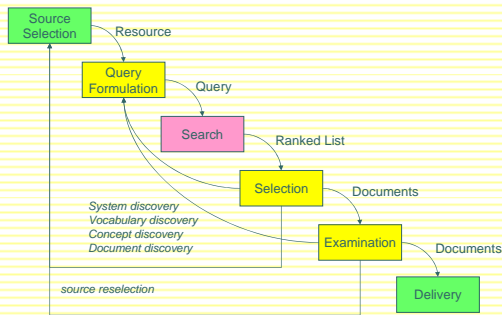
**Jimmy Lin**  
College of Information Studies  
University of Maryland

Monday, April 3, 2006

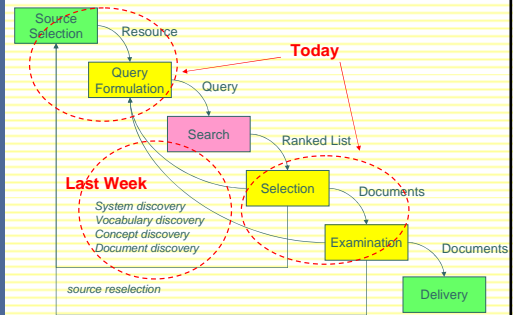
### The IR Black Box



### The Information Retrieval Cycle



### Overview



### Information Seeking Behavior

- o Two parts of a process:
  - search and retrieval
  - analysis and synthesis of search results
- o Standard (naïve?) assumptions:
  - Maximizing precision and recall simultaneously
  - The information need remains static
  - The value is in the resulting document set

### Problematic Assumptions

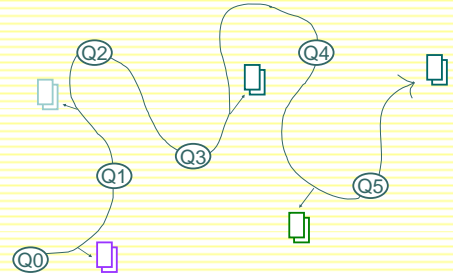
- o Users learn during the search process:
  - Scanning titles of retrieved documents
  - Reading retrieved documents
  - Browsing lists of related topics/thesaurus terms
  - Navigating hyperlinks
- o The end goal isn't necessary the document set
  - Recall Belkin's Anomalous States of Knowledge
- o Lists of documents may not be the best presentation method

## An Alternative Model

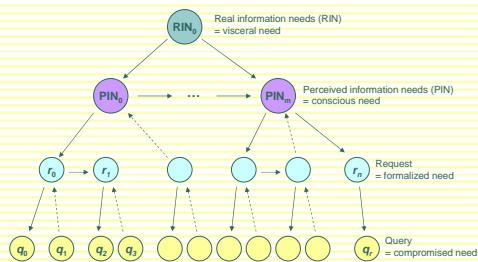
- Standard IR model
  - Assumes the information need remains the same throughout the search process
- Berry-picking model (Marcia Bates)
  - Interesting information is scattered like berries among bushes
  - The query is continually shifting

## Picking Berries

A sketch of a searcher... "moving through many actions towards a general goal of satisfactory completion of research related to an information need."



## Recall Mizzaro's Model

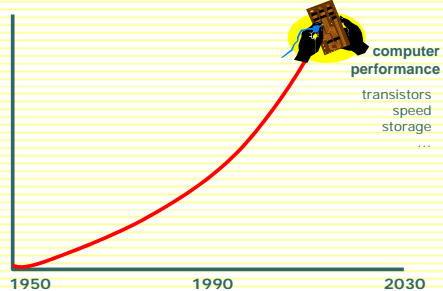


Stefano Mizzaro. (1999) How Many Relevances in Information Retrieval? *Interacting With Computers*, 10(3), 305-322

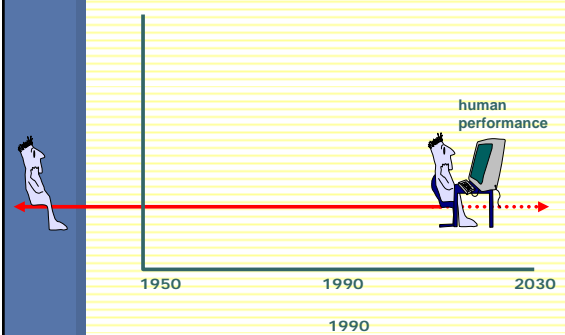
## Implications

- Interfaces should make exploration of the information space easy
- Interfaces should relate information objects with why they are retrieved
- Interfaces should highlight the relationships between multiple information objects
- Makes evaluation more difficult

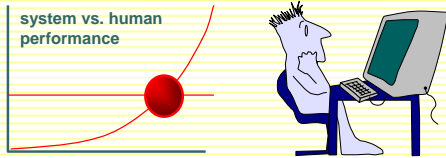
## Moore's Law



## Human Cognition



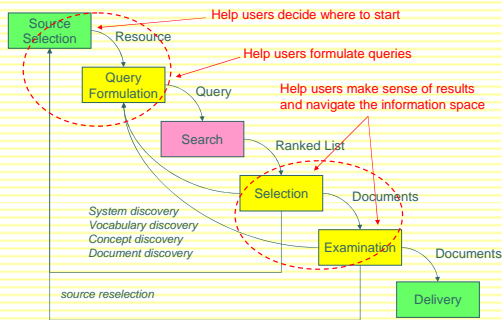
## Where is the bottleneck?



## Interface Support

- Starting points
  - How do I know where to start?
  - How do I know what to search?
- Query formulation
  - How do I specify a query?
- Results selection
  - How do I make sense of the results?
  - How do I grasp the content of retrieved items?
- Navigation
  - How do I move around in the information space?

## The Role of Interfaces



## Ben's Principles

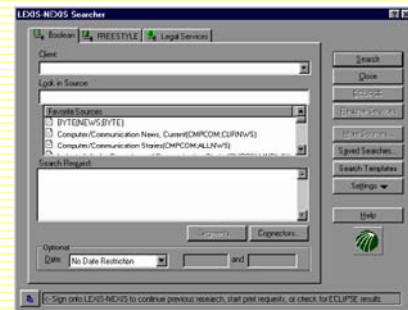
- Informative feedback
- Easy reversal
- User in control
  - Anticipatable outcomes
  - Explainable results
  - Browsable content
- Limited working memory load
- Alternatives for novices and experts

## Automated Source Selection

- A few ideas:
  - Compare the query against summaries of what is contained in the collection
  - Predict most likely source based on instances of the query terms in each collection
  - Use implicit feedback
- But today's focus is on interfaces...

## The Simplest "Starting Point"

- List the options:



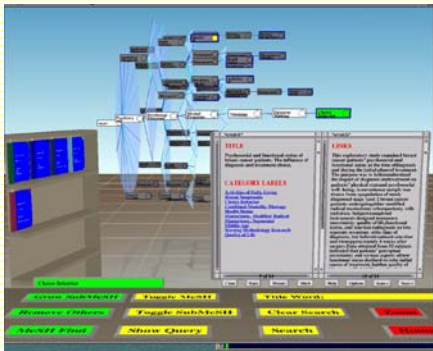
## Starting Points

- A tale of three sites:
  - Google  
<http://www.google.com/>
  - dmoz open directory project  
<http://www.dmoz.org/>
  - University of Maryland Libraries  
<http://www.lib.umd.edu/>

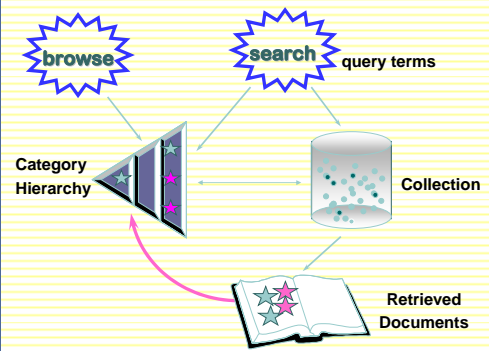
## Cat-a-Cone

- Key Ideas:
  - Separate documents from category labels
  - Show both simultaneously
  - Link the two for iterative feedback
  - Integrate searching and browsing
- Distinguish between:
  - Searching for documents
  - Searching for categories

## Cat-a-Cone Interface



## Cat-a-Cone Architecture



## ConeTree for Category Labels

- One can explore the category hierarchy
  - By searching on label names
  - By browsing the labels
  - By growing/shrinking subtrees
  - By spinning subtrees
- Affordances
  - Learn meaning via ancestors, siblings
  - Disambiguate meanings
  - View many categories simultaneously

## Virtual Book for Result Sets

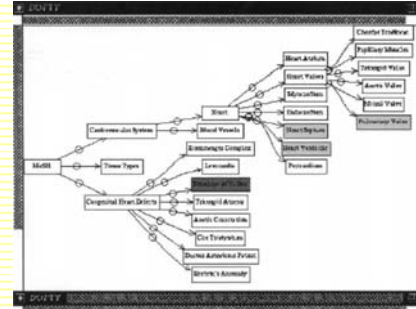
- Categories in retrieved documents linked to categories in tree
- Flipping through "book pages" causes some subtrees to expand and contract
  - Most subtrees remain unchanged
- Books can be stored for later reuse

## Browsing Hierarchies

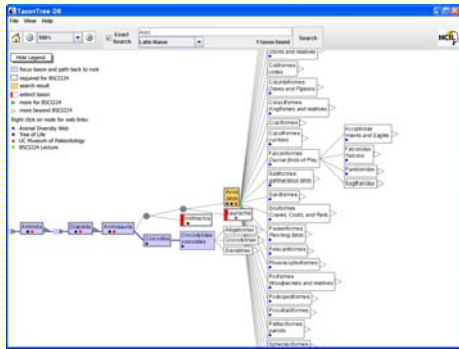
- How do you browse large hierarchies?
- MeSH Category Hierarchy = Medical Subject Headings
  - ~18,000 labels
  - ~8 labels/article on average, manually assigned
  - Top level categories:
 

anatomy	diagnosis	related disc
animals	psych	technology
disease	biology	humanities
drugs	physics	

## MeshBrowse



## TaxonTree



## HiBrowse

Class	Mnemonic	Replace	Broader	Class	Mnemonic	Replace	Broader	Class	Mnemonic	Replace	Broader
1264	physical disease			1264	therapy AND child			8811	child (in genera		
313	abdominal disease		2448	therapy (in gen			1	brain damaged ch			
189	abnormal body bu		11	acupuncture			15	handicapped child			
38	breast disease		1976	biological ther			3696	infant			
2289	cardiovascular d		724	cancer therap			1855	preschool child			
248	connective tissu		2	computer assis			2371	school child			
248	connective tissu		481	conservative t							
2395	digestive system		171	disease contro							
774	ear nose throat		156	counseling							
1395	endocrine diseas		58	detoxification							
848	eye disease		171	disease contro							
764	head and neck di		847	drug therapy							
3648	hematologic dise		8282	drug therapy							
376	mouth disease		53	adjunct ther							
1628	musculoskeletal		88	antibiotic pe							
3236	neurologic disea		388	antibiotic t							
17	pelvic disease		19	anticoagulat							
3252	respiratory tract		68	anticonvuls							
1589	skin disease		15	antihyperten							
48	soft tissue dise		46	antimicrobia							
56	thorax disease		72	bone marrow							
1527	urogenital tract		15	chelation th							
			1	chemical spm							
			14	chemoprophyl							
			629	chemotherapy							
			5	diuretic ther							

## HiBrowse

Class	Mnemonic	Replace	Broader
1264	degenerative disease		
1264	degenerative disease		
748	depression		
181	chronic fatigue synd		
41	hypertension		
274	hypertension		
71	parkinson disease		
77	parkinson disease		
43	senile dementia		
14	senile dementia		
5	suppurative otitis		
8	suppurative otitis		
79	wilson disease		

## HiBrowse

Class	Mnemonic	Replace	Broader
1264	degenerative disease		
4	depression		
7	depression		
1	computer assisted therapy		
26	conservative treatment		
8	counseling		
87	drug therapy		
2	disease control		
2	emergency treatment		
45	intensive care		
2	leprosy		
2	longevity		
41	nutritional immunotherapy		
4	palliative therapy		
46	physical therapy		
28	physical therapy		
31	radiation therapy		
15	rehabilitation		
9	substitution therapy		
6	supplementation		

## Query Formulation

- The role of the interface in query formulation
  - Can the interface help the user better express his or her query?
  - Does the user actually mean the query that's entered?
- Interaction Styles
  - Command language
  - Form-based interfaces
  - Menu-based interfaces
  - Direct Manipulation
  - Natural Language

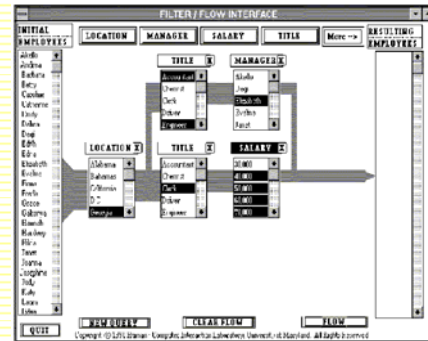
## WESTLAW® Query Examples

- What is the statute of limitations in cases involving the federal tort claims act?
  - LIMITI /3 STATUTE ACTION /S FEDERAL /2 TORT /3 CLAIM
- What factors are important in determining what constitutes a vessel for purposes of determining liability of a vessel owner for injuries to a seaman under the "Jones Act" (46 USC 688)?
  - (741 +3 824) FACTOR ELEMENT STATUS FACT /P VESSEL SHIP BOAT /P (46 +3 688) JONES ACT /P INJURI /S SEAMAN CREWMAN WORKER
- Are there any cases which discuss negligent maintenance or failure to maintain aids to navigation such as lights, buoys, or channel markers?
  - NOT NEGLECT! FAIL! NEGLIG! /5 MAINT! REPAIR! /P NAVIGATI! /5 AID EQUIP! LIGHT BUOY "CHANNEL MARKER"
- What cases have discussed the concept of excusable delay in the application of statutes of limitations or the doctrine of laches involving actions in admiralty or under the "Jones Act" or the "Death on the High Seas Act"?
  - EXCUSI /3 DELAY /P (LIMITI /3 STATUTE ACTION) LACHES /P "JONES ACT" "DEATH ON THE HIGH SEAS ACT" (46 +3 761)

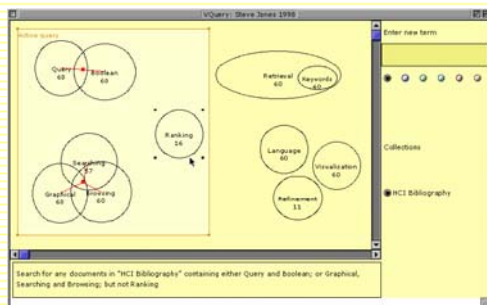
## Google

- Search box as an example of a command language
- Advanced search as an example of a form-based interface
- What is the relationship between the two?

## Menu-Based Interfaces



## Direct Manipulation



## Presenting Results

- I performed a search and got back a whole bunch of results... now what?
- Simplest interface: one-dimensional lists:
  - Content: title, source, date, summary, ratings, ...
  - Order: retrieval status value, date, alphabetic, ...
  - Size: scrolling, specified number, score threshold

## Putting Results in Context

- Interfaces should
  - Give hints about the roles terms play within the result set and within the collection
  - Give hints about the relationship between different terms
  - Show explicitly why documents are retrieved in response to the query
  - Compactly summarize the result set
- This can be viewed as a problem in information visualization

## Information Visualization

- What is it?
- Information visualization for document retrieval:
  - Enhance a person's ability to read, understand, and gain knowledge from a document or documents
  - Understand the contents of a document or collection of documents without reading them
- We're focusing on search results

## More Specific Tasks

- Which documents contain text on the relevant topic?
- Which documents are of interest to me?
- Are there other documents that might be close enough to be worthwhile?
- What are the main themes of a document?
- How are certain words or themes distributed through a document?

## Fundamental Problem

- Scale – there's simply too much data to fit on one screen
  - Too many instances
  - Too many variables
  - Too many points of user focus
  - ...
- Basic concepts
  - Overview + detail
  - Focus + context

## Overview + Detail

- Providing an overview of the information is extremely valuable
  - Helps present overall patterns
  - Assists user with navigation and search
  - Orients activities
- Users also want to examine details: individual instances and variables
- How do we get the best of both worlds?

## Case 1: Detail-only



Case 2: Zoom and Replace



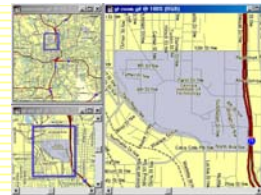
Case 3: Overview + Detail



Case 4: Multiple Overviews



Case 5: Tiled Browser



Case 6: Bifocal Magnification



Case 7: Fish-eye view

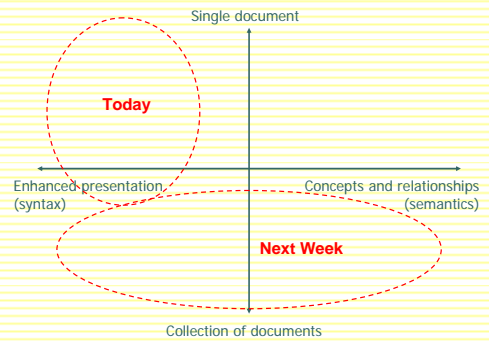




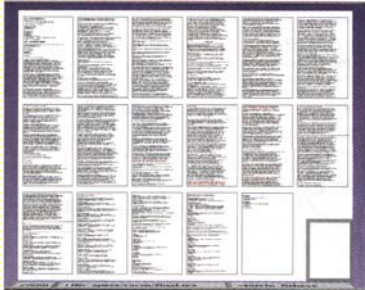
## Focus + Context

- Same basic idea as overview and detail, with one key difference:
  - Typically, the overview and the detail are combined into a single display
  - Shows information in its "natural surrounding"
- General paradigm seems to work well for text...

## Simple Taxonomy



## Too Much Text!



Text is too small to read!

## Presenting Results

- KWIC and extensions
- TileBars
- Next time: clustering
  - Automatically group together "related" documents

## The Oldest Trick

- KWIC = Key Word In Context
- Displaying query terms in the context of the retrieved documents

## Issues to Consider

- What part of the document should the system extract?
  - A contiguous segment of text?
  - Segments extracted from different sections?
- How much context should you show?
- How should you mark the keywords?

## How Much Context?

- How much context for question answering?
- Possibilities
  - Exact answer
  - Answer highlighted in sentence
  - Answer highlighted in paragraph
  - Answer highlighted in document

Jimmy Lin, Dennis Qian, Vineet Sinha, Karun Bakshi, David Hays, Boris Katz, and David R. Karger. (2003) What Makes a Good Answer? The Role of Context in Question Answering. Proceedings of INTERACT 2003.

## Interface Conditions

Who was the first person to reach the south pole?

The image shows three stacked screenshots of a search interface. Each screenshot displays the question 'Who was the first person to reach the south pole?' and the search results for 'Norwegian Roald Amundsen'. The first screenshot highlights the answer 'Norwegian Roald Amundsen' in a grey box, labeled 'Exact Answer'. The second screenshot highlights the sentence 'The first expedition to reach the South Pole was led by Norwegian explorer Roald Amundsen in 1911.' in a grey box, labeled 'Sentence'. The third screenshot highlights the entire paragraph of text, labeled 'Paragraph'.

## User study

- Independent variable: amount of context presented
- Test subjects: 32 MIT undergraduate/graduate computer science students
  - No previous experience with QA systems
- Actual question answering system was canned:
  - Isolate interface issues, assuming 100% accuracy in answering factoid questions
  - Answers taken from WorldBook encyclopedia

## Question Scenarios

- User information needs are not isolated...
  - When researching a topic, multiple, related questions are often posed
  - How does the amount of context affect user behavior?
- Two types of questions:
  - Singleton questions
  - Scenarios with multiple questions

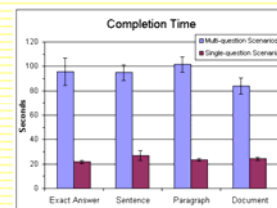
When was the Battle of Shiloh?  
 What state was the Battle of Shiloh in?  
 Who won the Battle of Shiloh?

## Setup

- Materials:
  - 4 singleton questions
  - 2 scenarios with 3 questions
  - 1 scenarios with 4 questions
  - 1 scenarios with 5 questions
- Each question/scenario was paired with an interface condition
- Users asked to answer all questions as quickly as possible

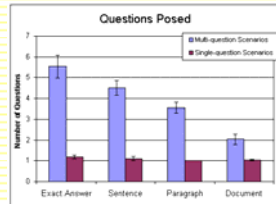
## Results: Completion Time

- Answering scenarios, users were fastest under the document interface condition
  - Differences not statistically significant



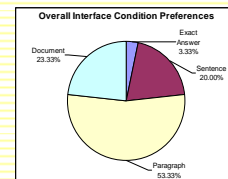
## Results: Questions Posed

- With scenarios, the more the context, the fewer the questions
  - Results were statistically significant
  - When presented with context, users read



## A Story of Goldilocks...

- The entire document: too much!
- The exact answer: too little!  
It occurred on July 4, 1776.  
What does this pronoun refer to?
- The surrounding paragraph: just right...



## Lessons Learned

- Keyword search culture is engrained
- Discourse processing is important  
When was the Battle of Shiloh?  
And where did it occur?
- Users most prefer a paragraph-sized response
- Context serves to
  - "Frame" and "situate" the answer within a larger textual environment
  - Provide answers to related information

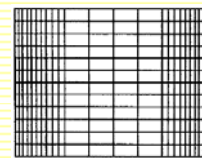
## Other Ways to Show Context

- Distortion-oriented techniques
- TileBars

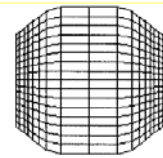
## Everyday Life Example



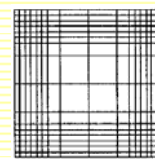
## Ways to Distort Reality



Bifocal Display

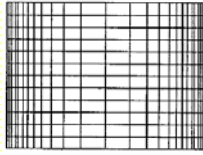


Perspective Wall

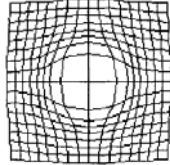




### More Ways...



1D Fisheye



2D Fisheye



### A Real Fisheye

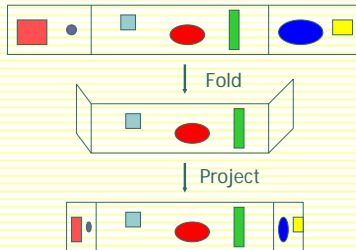
#### On I-285, another Perimeter maul



Traffic snarls along I-285 ventilation during the evening rush hour Thursday after a hole developed in a bridge over the Chattahoochee River and it closed. Officials say recent construction work may have caused the problem. This photo, taken with a fisheye lens, is looking south toward downtown Atlanta.



### Perspective Wall

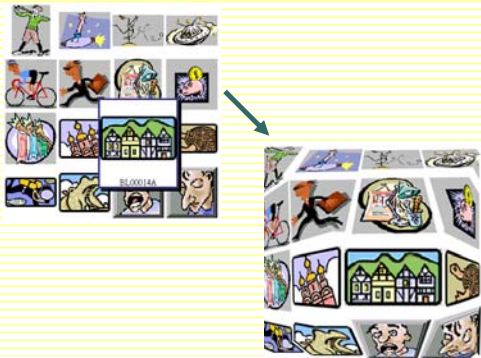


### Perspective Wall

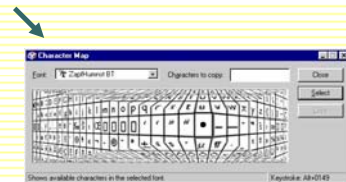
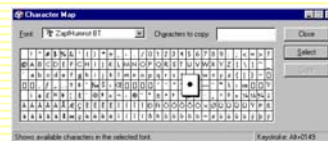
- o 3D implementation of a bifocal display
- o Presenting work charts:
  - x-axis is time
  - y-axis is project



### Other Applications



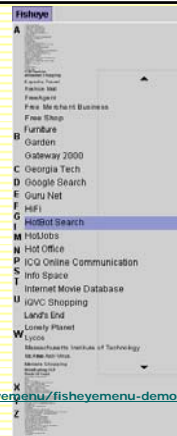
### Even More Applications



## The Document Lens

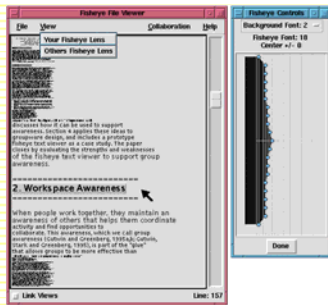


## Fisheye Menu

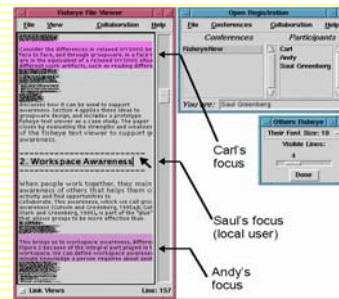


<http://www.cs.umd.edu/hcil/fisheymenu/fisheymenu-demo.shtml>

## Fisheye Views of Documents



## Multiple Focii



## Does it always work?



## TileBars

- o All this zooming is making me dizzy
  - What about a more abstract representation of the document?
- o Show a graphical representation of term distribution and overlap in search results
- o Simultaneously Indicate:
  - Relative document length
  - Query term frequencies
  - Query term distributions
  - Query term overlap

## Technique

Relative length of document

Search term 1  
Search term 2

Blocks indicate "chunks" of text, such as paragraphs

Blocks are darkened according to the frequency of the term in the document

## Example

**Topic:** reliability of DBMS (database systems)  
**Query terms:** DBMS, reliability

DBMS reliability: [Bar chart showing high frequency of both terms]

DBMS reliability: [Bar chart showing high frequency of DBMS, moderate of reliability]

DBMS reliability: [Bar chart showing moderate frequency of both terms]

DBMS reliability: [Bar chart showing low frequency of both terms]

## TileBars Screenshot

Term Set 1	Term Set 2	Term Set 3
network	image	image

Document Titles Contained:

- "HOT Technologies for I..."
- "Information age: the Smithsonians' LAN"
- "Hot T-1 stuff: (customer premises eq..."
- "Codex Fall. (1989)"
- "MAN about town: taking the local out of I..."
- "Ethernet products: you can get there from..."
- "HDIV and..."
- "Backing up... (tape back-up strategies)"
- "CPC '90: gatheri..."
- "DEC imaging workstations to challenge PC..."
- "Paradox 3.0. (Software Review) ( one of s..."
- "Xerox goes wild. (a new version of the..."

## TileBars Screenshot

Document Titles Contained:

- "Color transformations. (guide to color-tr..."
- "Oracle makes inroads into imaging market..."
- "Mac-Sun-PC network takes off at Harvard..."
- "Forecast calls for faster weather data vi..."
- "Picture this: DEC adds scanner, imaging t..."
- "Database stands ready as probe nears Yenu..."
- "Challenging for the multimedia lead. (IBM..."
- "Ventura Publisher. (Software Review) (Xer..."
- "Congress shuns FTS 2000, picks MCI. (Fede..."
- "Broadband ISDN waits in the wings. (Integ..."
- "DEC beefs up visualization to catch the e..."
- "Image-processing system targets OS/2 work..."

## TileBars Summary

- Compact, graphical representation of term distribution for full text retrieval results
  - Simultaneously display term frequency, distribution, overlap, and doc length
  - However, does not provide the context in which query terms are used
- Do they help?
  - Users intuitively understand them
  - Lack of context sometimes causes problems in disambiguation

## Scrollbar-Tilebar

Document Titles Contained:

- Elevenets.
- Storage Rooms and Warehouses.
- Libraries.
- Courtyards and Halla.
- Dining Facilities.
- Kitchen and Food Preparation Areas.
- Medical/Dental Care Delivery Areas.
- Inspection/Investigation Vehicles.
- Administrative Areas and Offices.
- Auditoriums.
- Class and Conference Rooms.
- Gymnasiums and Exercise rooms. and
- Restrooms.

Definition: For purpose of this rule, smoking is defined as carrying or inhaling a lighted cigar, cigarette, pipe or other lighted tobacco products.

Legend: red, green, blue, yellow

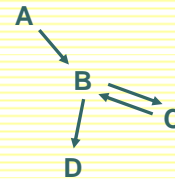
From U. Mass

## Navigation

- The “berry-picking model”: interfaces should make it easy to follow trails with unanticipated results
- Interfaces should support navigation of the information space

## The “Back” Button

- The “back” button isn’t enough!
- Behavior is counterintuitive to many users

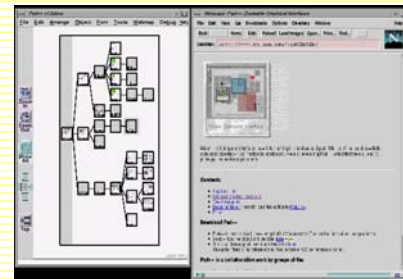


You hit “back” twice from page D. Where do you end up?

## PadPrints

- Tree-based history of recently visited Web pages
  - History map placed to left of browser window
  - Node = title + thumbnail
  - Visually shows navigation history
- Zoomable: ability to grow and shrink sub-trees

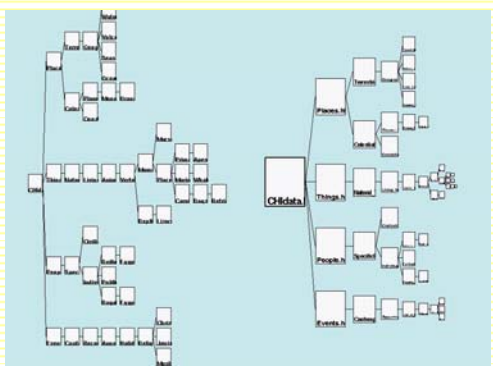
## PadPrints Screenshot



## PadPrints Thumbnails



## Zoomable History



## Does it work?

- Study involved CHI database and National Park Service website
- In tasks requiring return to prior pages, 40% savings in time when using PadPrints
- Users more satisfied with PadPrints

## The Importance of Interfaces

- The user interface is the part of the system that the user interacts with:
  - Interaction is an integral part of the information seeking process
  - Search experience is affected by the quality of the interface
- Interfaces should
  - Help users get started
  - Help users keep track of what they have done
  - Help users make sense of what the system did
  - Suggest next choices
- It is very difficult to design good UIs
- It is very difficult to evaluate search UIs

## The Role of Interfaces

