User Interfaces and Visualization

Lecture 17

Overview

- Interface design principles
- Models of interaction
- Evaluating interactive systems
- Support at different search stages
  - Starting points
  - Query formulation
  - Giving context
  - Using relevance judgments

Information Interfaces

- Users' information needs are imprecise
- Users don't have a clear idea of how to achieve their goals
- The human-computer interface should help users understand and express what they want
  - formulating queries
  - selecting information sources
  - understanding results
  - keeping track of their search process

Design Principles

- Offer informative feedback
- Support an internal locus of control
- Permit easy reversal of actions
- Reduce working memory load
- Provide alternative interfaces for novice and expert users

(Shneiderman 97)

Offer Informative Feedback

- Search system should give feedback on…
  - relationship between query and results
  - relationships among retrieved documents
  - between documents and collection metadata
- User should be able to adjust the level of feedback

Internal Locus of Control

- Users want to know that *they are in control*
- System should respond to user actions
- Users should be *initiators* rather than *responders*
- AVOID
  - surprising system actions
  - tedious inescapable situations
  - inability to produce action
- Example: *modal* vs. *non-modal* interfaces

Easy Reversal of Actions

- Any action should be reversible
- Ability to “undo” relieves user anxiety
- Encourages user exploration
- Consider the unit of undo
  - single action, data entry, or block of actions
- For example, “Back” button in a web browser
  - But once you go forward again, the stack is lost
  - Sometimes the user can get lost in hyperspace

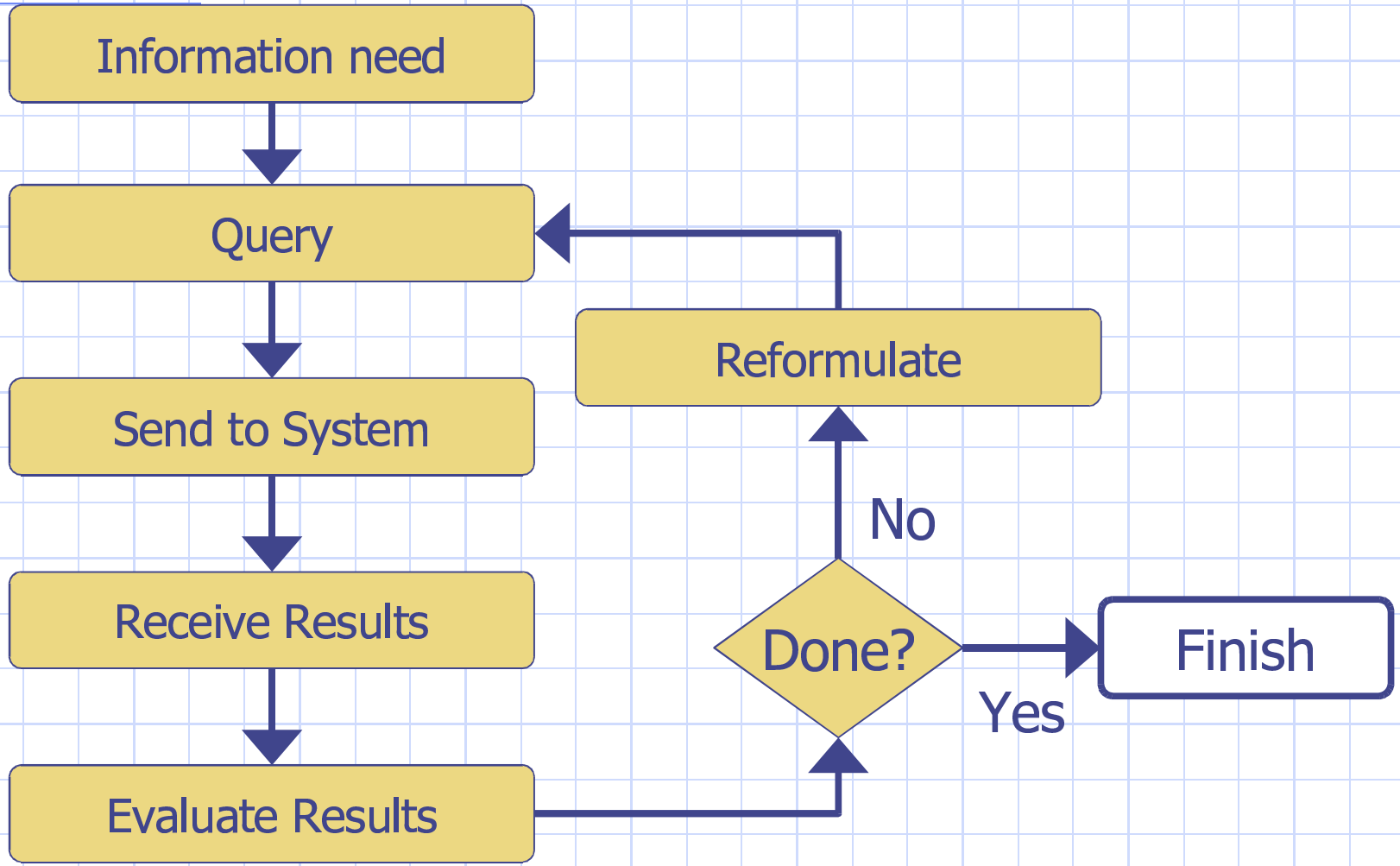
Reduce Working Memory Load

- Don’t overload the user’s short-term memory
  - people can remember “seven +/- two chunks“ of information
- Help with keeping track of search choices
  - let users switch between search strategies
  - retain context and information across sessions
- Provide browsable contextual information
  - suggestions of related search terms/metadata
  - search starting points with topic descriptions

Alternative Interfaces for Experts and Novices

- Tradeoff between simplicity vs. power
  - MacOS Finder vs. Unix shell
  - Simple: easier to learn, but less flexible
  - Powerful: allow experts to do more, faster
- Scaffolding
  - For novices: simple, easy-to-learn interface with basic functionality
  - Experts can go inside the scaffolding and have more control, features, options

Classical Model of Info Seeking



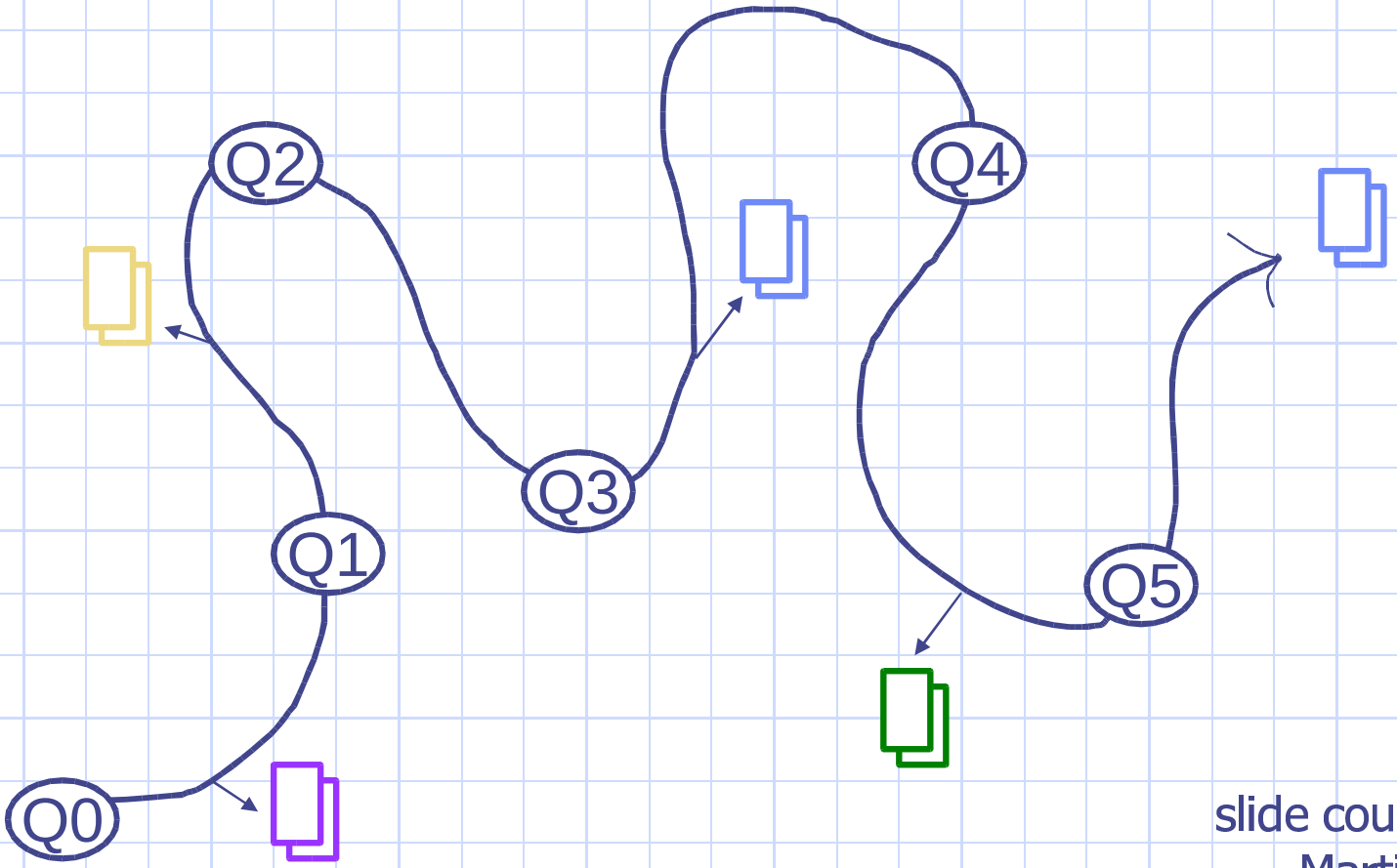
“Berry-Picking” Model

- Users learn as they search
  - causes need to change
  - causes queries to shift around, not refine
  - one goal leads to another
- Information needs not satisfied by a single set of documents
  - really by bits and pieces found along the way

Information-seeking Activities

- Scanning
  - high-level skimming
  - for selecting something to view or as input to query
- Querying
  - produces new, ad-hoc, unorganized collections
- Navigating
  - following a chain of links/views towards a goal
  - a sequence of scan and select operations
- Browsing
  - casual, undirected exploration

A sketch of a searcher… "moving through many actions towards a general goal of satisfactory completion of research related to an information need." (after Bates 89)



slide courtesy of Marti Hearst

Evaluating Interactive Systems

- Precision and recall measure search results
- Not appropriate for interactive systems
  - interactive users require a few relevant documents
  - usually don't care about high recall
- Metrics include
  - time to learn the system
  - time required to achieve goals on benchmark tasks
  - error rates (user, not system)
  - retention of use of the interface over time

Wednesday - Start Here

1. Starting Points

- How do users begin a search?
  - not with long, detailed information needs
  - usually a short query, followed by scanning the results and modifying the query
  - "testing the water"
    - get familiar with collection, query language, etc
- System should guide the user to the right starting point.

Lists of Collections

- Traditional bibliographic systems began with choosing from a list of collections
  - e.g. VICTOR (TTY interface)
  - user must learn which are the right collections
- On the web, a "portal" might offer a list of search engines
- Need *overview* information

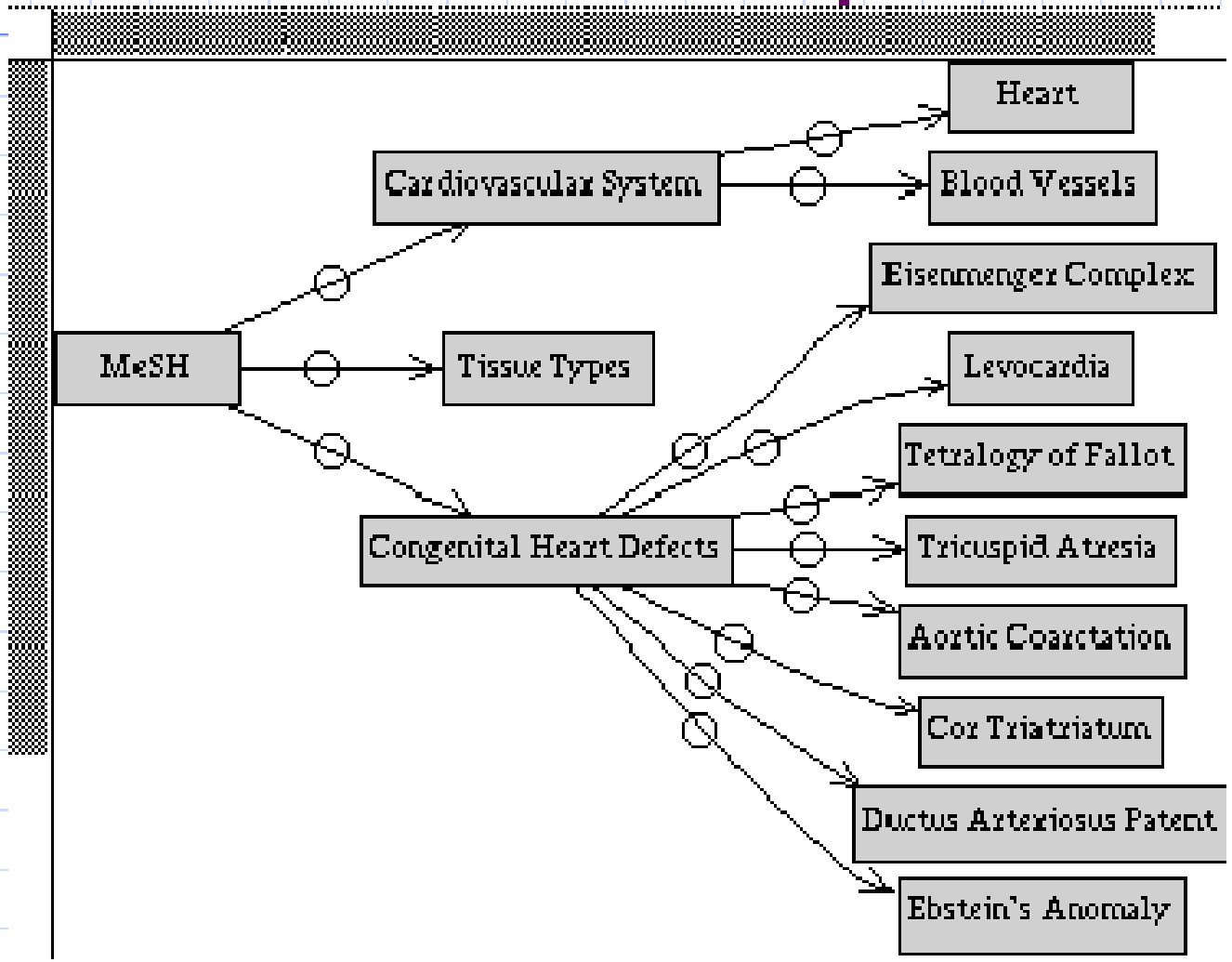
Directory Overviews

- Also called *category* overviews
- Provide a hierarchical structure for the collection
- Very popular on the web
- Possible to get lost browsing a directory

D.4 OPERATING SYSTEMS (C)

- D.4.0 General
- D.4.2 Storage Management
  - Allocation/deallocation strategies
  - Distributed memories
  - Garbage collection (NEW)
  - Main memory
  - Secondary storage
  - Segmentation**
  - Storage hierarchies
  - Swapping**
  - Virtual memory

MeSHBrowse example



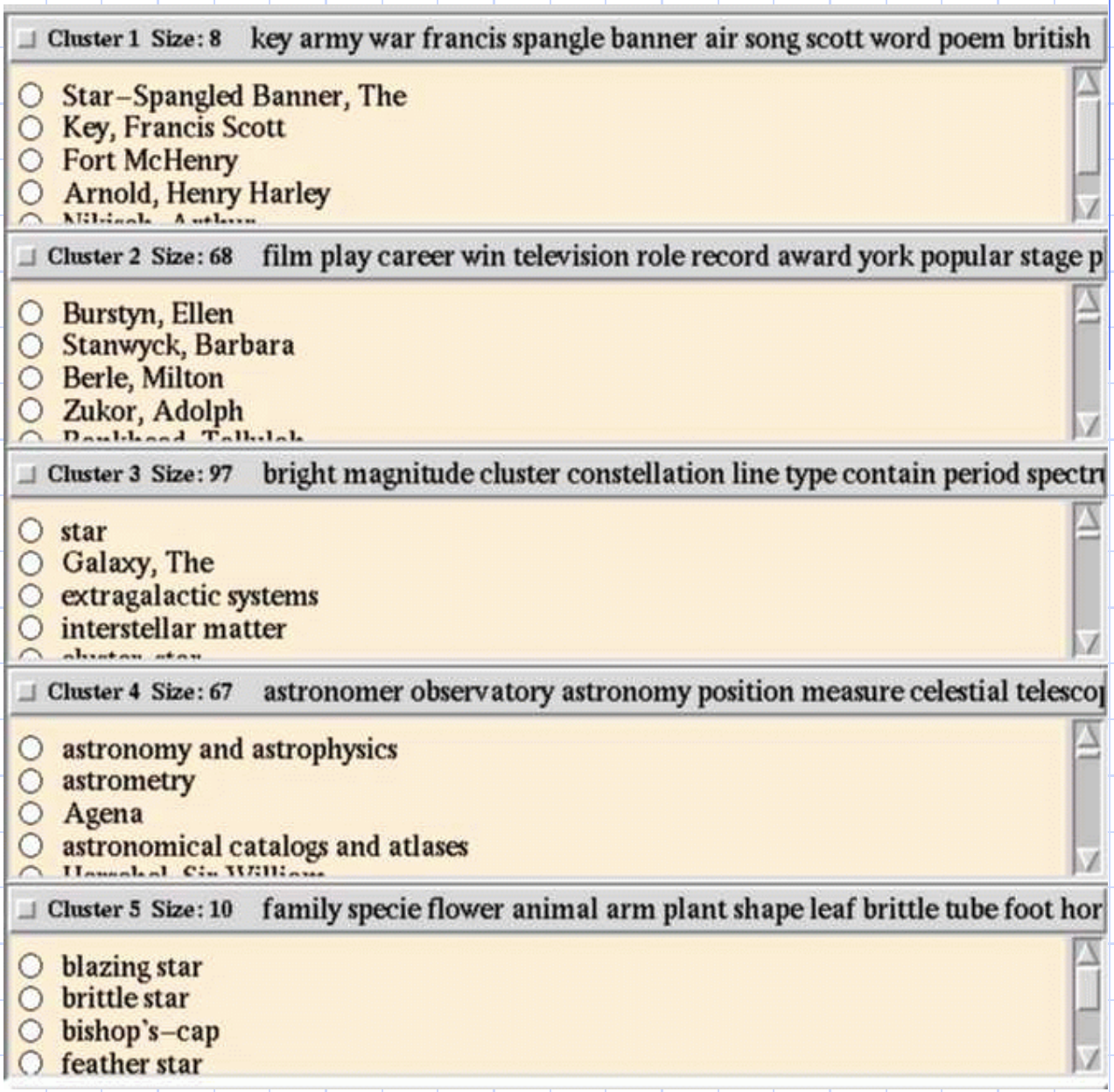
Automatically Creating Collection Overviews

- Idea: extract most common themes occurring in the collection
- Clustering
  - organize documents by similarity to one another
  - centroids of cluster = themes in collection
  - an *unsupervised* learning method

Scatter/Gather

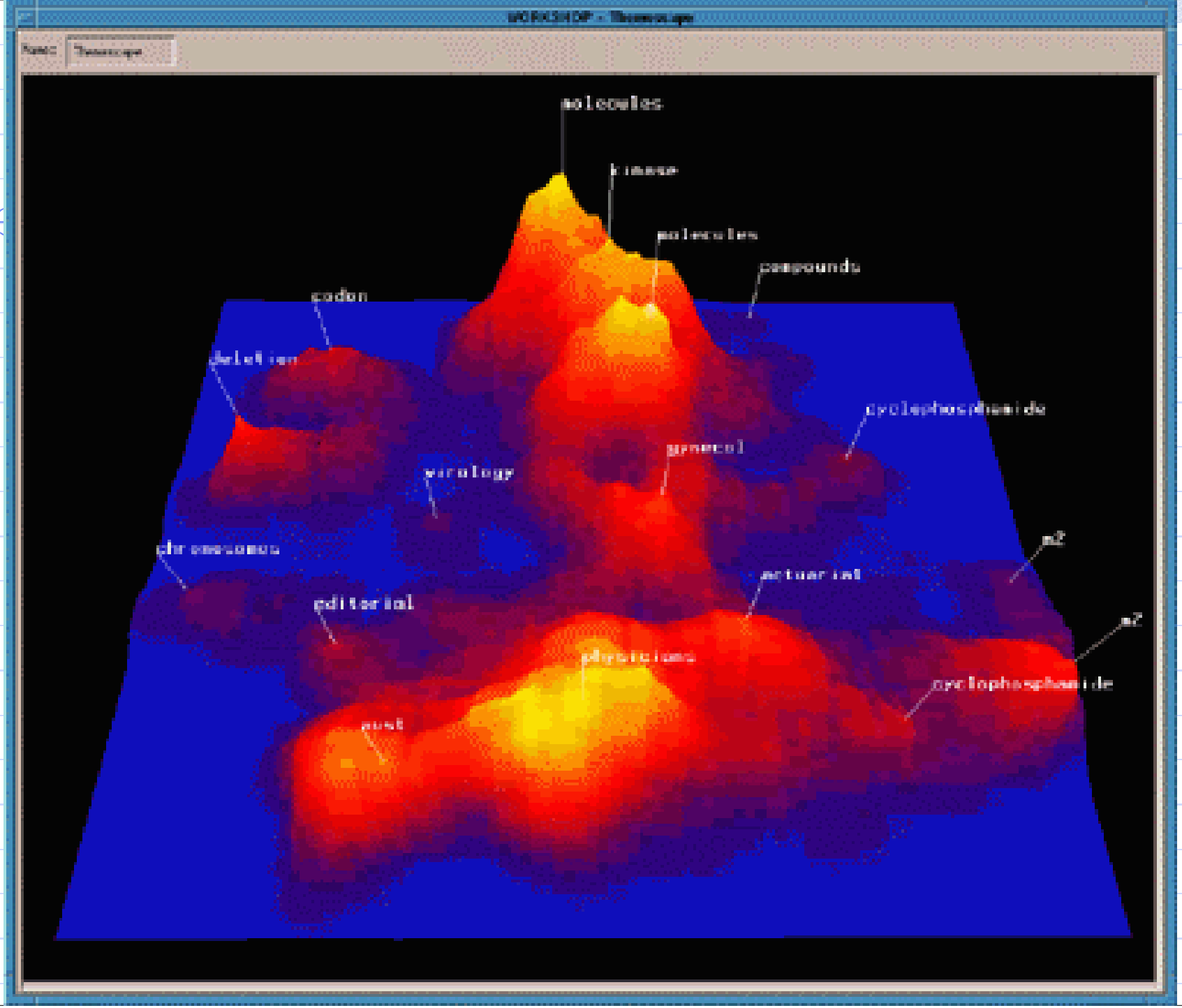
- A browsing paradigm
  - Clusters documents into topical groups
  - Each cluster has a textual summary
    - topical terms + sample titles of documents
- Using Scatter/Gather
  - Cluster the entire collection
  - User selects a few clusters
  - Documents in selected clusters are then re-clustered
- Can also be used with search results

Scatter/ Gather



Collection Visualization

- Scatter/Gather is a textual representation
- Visualization techniques can show the clusters in the collection graphically
  - ThemeScape: “mountains” of documents
  - Kohonen maps
- Provide a high-level visual summary of the collection


molecules
kinase
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virology
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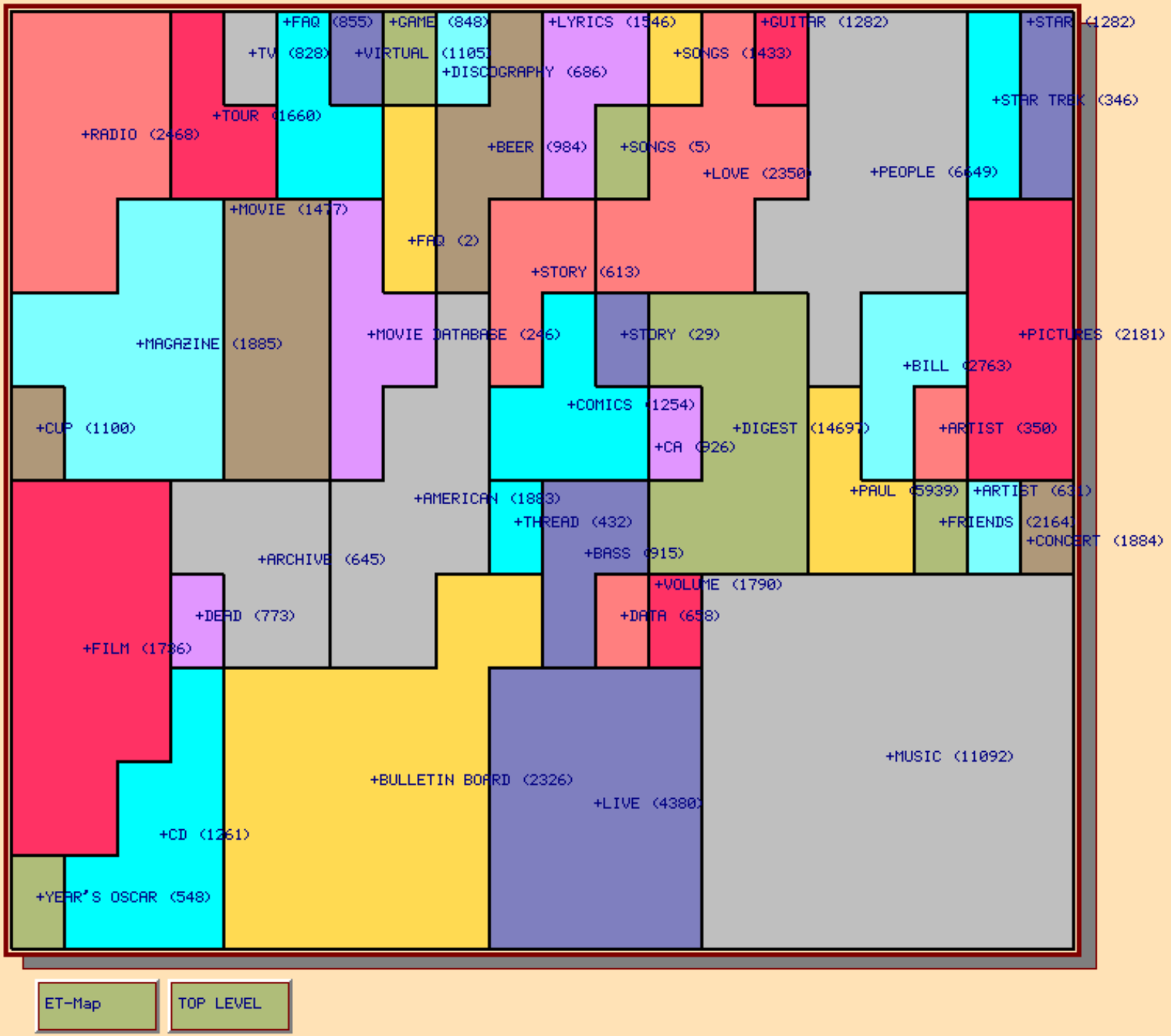
+FAQ (855)
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+GUITAR (1282)
+STAR (1282)
+TV (828)
+VIRTUAL (1105)
+DISCOGRAPHY (686)
+SONGS (1433)
+STAR TREK (346)
+TOUR (1660)
+RADIO (2468)
+BEER (984)
+SONGS (5)
+LOVE (2350)
+PEOPLE (6649)
+MOVIE (1477)
+FAQ (2)
+STORY (613)
+MAGAZINE (1885)
+MOVIE DATABASE (246)
+STORY (29)
+PICTURES (2181)
+BILL (2763)
+COMICS (1254)
+CUP (1100)
+DIGEST (14697)
+ARTIST (350)
+CA (926)
+AMERICAN (1883)
+PAUL (5939)
+ARTIST (631)
+THREAD (432)
+FRIENDS (2164)
+CONCERT (1884)
+ARCHIVE (645)
+BASS (915)
+VOLUME (1790)
+DEAD (773)
+DATA (658)
+FILM (1736)
+MUSIC (11092)
+BULLETIN BOARD (2326)
+LIVE (4380)
+CD (1261)
+YEAR'S OSCAR (548)
ET-Map
TOP LEVEL

Kohonen Maps experiment

- Compared Kohonen map view to Yahoo! hierarchy
  - Task: find an interesting document using both views
  - Some started with Yahoo!, some with map
- Most users could find a document on Yahoo! and then on the map
- …but not vice-versa
- Maps appear good for
  - high-level view, zooming/panning
  - jumping around in hierarchy

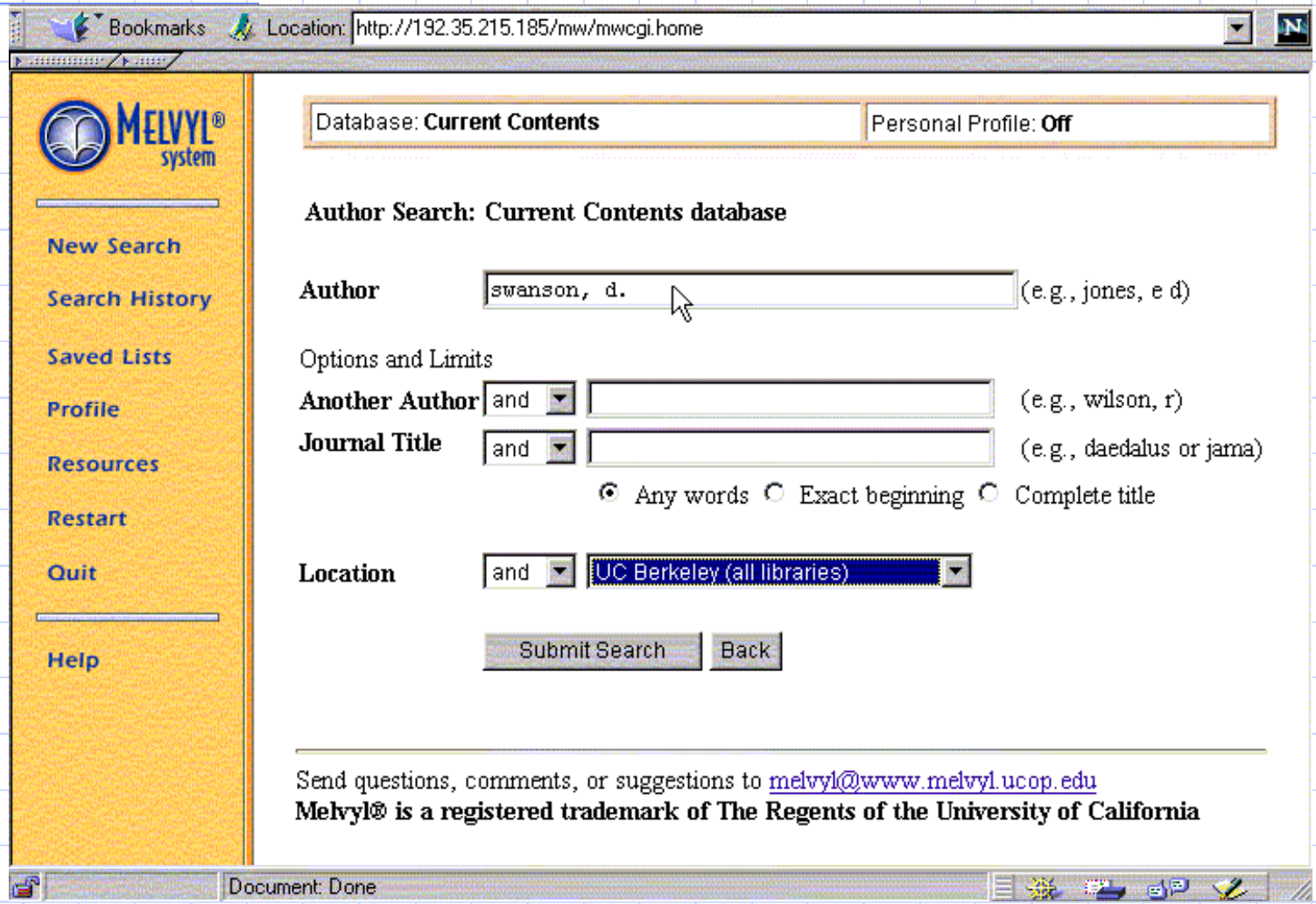
2. Query Specification

- Five visual interaction styles
  - command language
  - form fill-in
  - menu selection
  - direct manipulation
  - natural language
- All have been used in query formulation interfaces
- Command languages and form fill-in are most common on the web

Boolean Queries

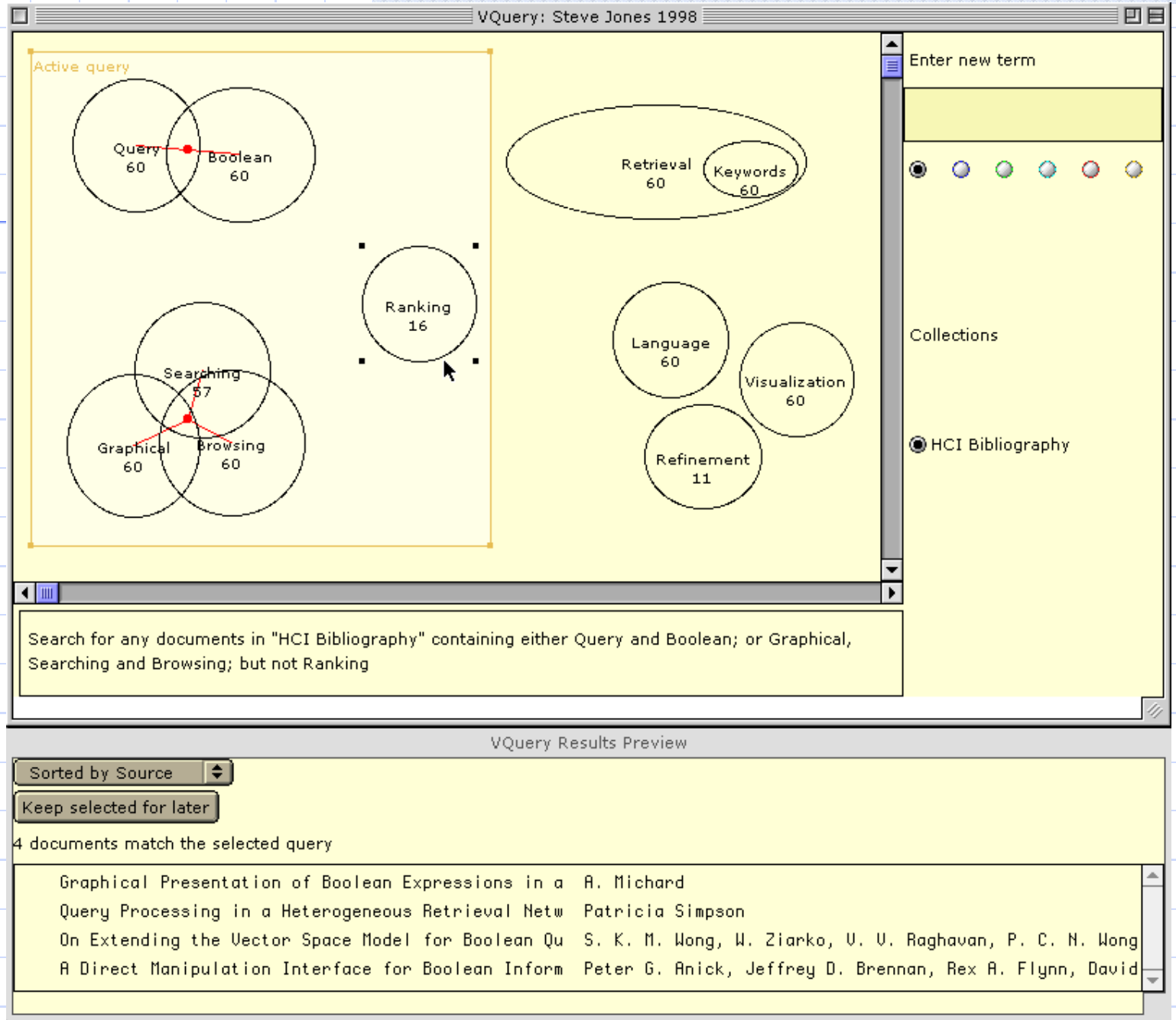
- Until recently, most common query language
- Users find it very difficult to use and exploit
  - "and" implies wider scope
  - "or" implies an exclusive choice
  - connector syntax, metadata
- Solutions on the Web
  - "all the words", "any of the words"
  - + operator (but can mislead: "cats + dogs")
  - Forms allowing two or three clauses

Melvyl (UC) Boolean Form



Direct Manipulation

- Direct manipulation interfaces feature
  - Continuous representation of objects of interest
  - Physical actions or button presses
  - Rapid, incremental, reversible operations
  - Immediate feedback
- Uses for Boolean query specification
  - Venn diagrams for illustrating sets
  - Block diagrams for organizing query terms


VQuery: Steve Jones 1998
Active query
Query
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Boolean
60
Retrieval
60
Keywords
60
Ranking
16
Searching
57
Graphical
60
Browsing
60
Language
60
Visualization
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Refinement
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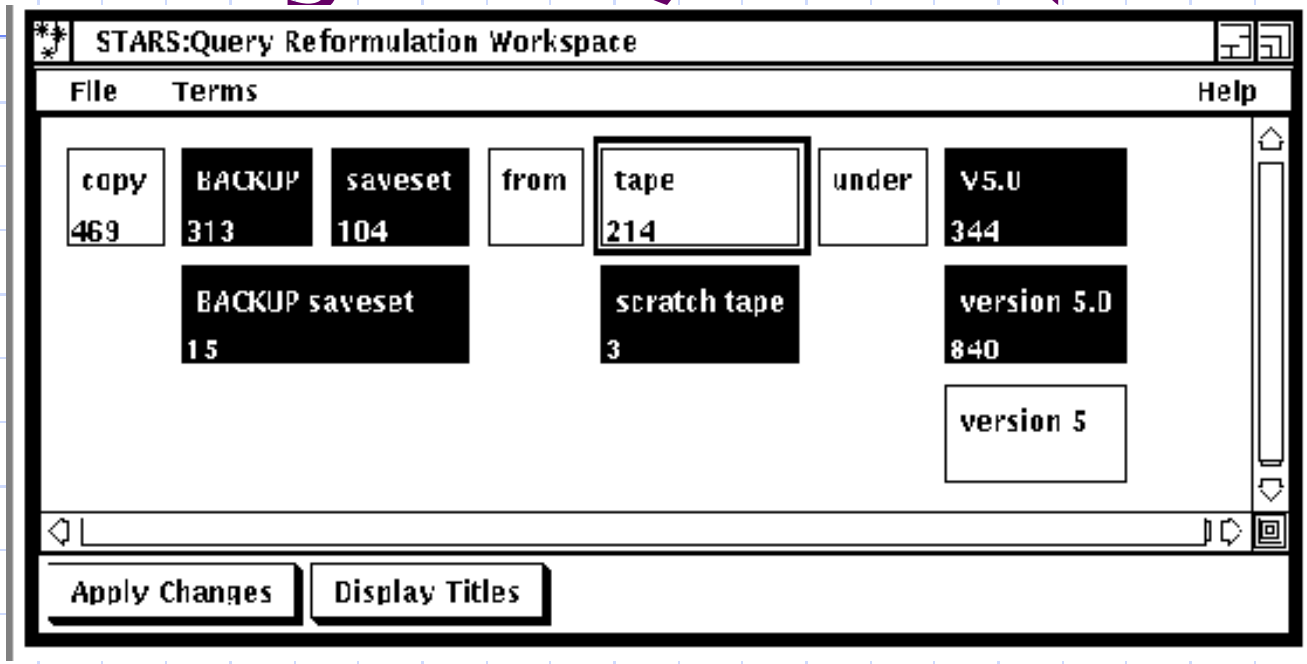
Enter new term
Collections
HCI Bibliography
Search for any documents in "HCI Bibliography" containing either Query and Boolean; or Graphical, Searching and Browsing; but not Ranking
VQuery Results Preview
Sorted by Source
Keep selected for later
4 documents match the selected query
Graphical Presentation of Boolean Expressions in a A. Michard
Query Processing in a Heterogeneous Retrieval Netw Patricia Simpson
On Extending the Vector Space Model for Boolean Qu S. K. M. Wong, W. Ziarko, V. V. Raghavan, P. C. N. Wong
A Direct Manipulation Interface for Boolean Inform Peter G. Anick, Jeffrey D. Brennan, Rex A. Flynn, David

Block-diagram Queries (Anick)



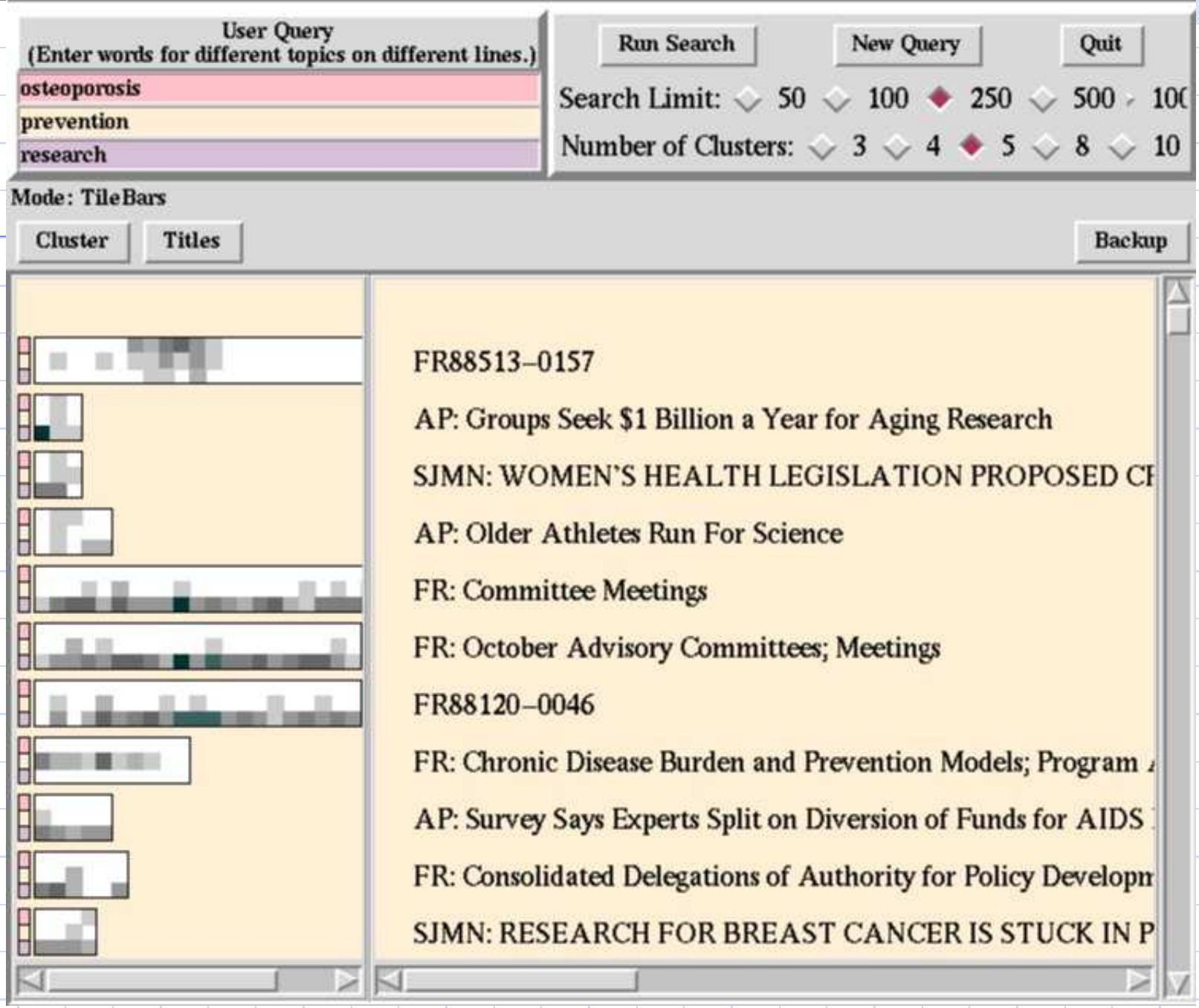
- Blocks in a row are ANDed
- Blocks in a column are Ored
- Each block can be activated or deactivated
- Users can quickly experiment with different query formulations

3. Providing Context

- The context of a document (set) includes
  - relationship to the query terms
  - relationship to other documents within the set
  - relationship to collection as a whole
  - metadata (dates, authors, subjects…)
  - hyperlink structure
- Providing this feedack helps the user understand the behavior of the system in response to their query

Query term context

- Document surrogates
  - title, date, source, document length
  - similarity score or degree of match
- Term highlights in an abstract
- Key Word In Context (KWIC)
- TileBars
  - Number of term hits per document passage
  - Query facets displayed as stacked bars


User Query
(Enter words for different topics on different lines.)
osteoporosis
prevention
research
Run Search
New Query
Quit
Search Limit: 50 100 250 500
Number of Clusters: 3 4 5 8 10
Mode: TileBars
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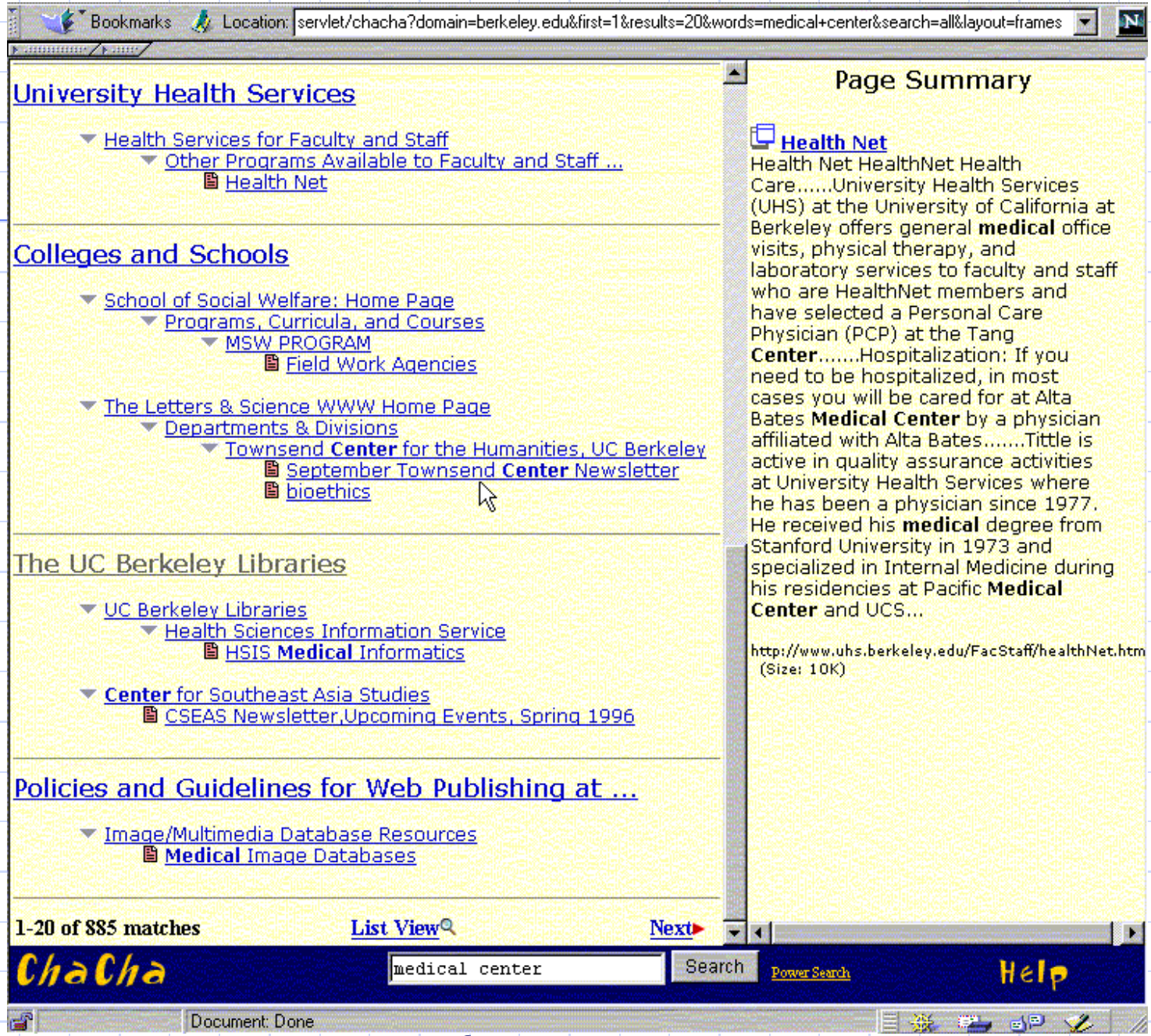
Backup
FR88513-0157
AP: Groups Seek $1 Billion a Year for Aging Research
SJMN: WOMEN'S HEALTH LEGISLATION PROPOSED CH
AP: Older Athletes Run For Science
FR: Committee Meetings
FR: October Advisory Committees; Meetings
FR88120-0046
FR: Chronic Disease Burden and Prevention Models; Program
AP: Survey Says Experts Split on Diversion of Funds for AIDS
FR: Consolidated Delegations of Authority for Policy Developm
SJMN: RESEARCH FOR BREAST CANCER IS STUCK IN P

Cha-Cha

- Intranet web search tool
  - uses hyperlinks to organize search results
  - finds shortest paths from the root page to each search hit
  - results shown as paths in a hierarchy
- Shows context of results within collection
  - can see how results are part of the web
  - lists information sources (1st-level pages)
  - "Virtual" table of contents
- Demo: http://cha-cha.berkeley.edu/


Bookmarks
Location: servlet/chacha?domain=berkeley.edu&first=1&results=20&words=medical+center&search=all&layout=frames
University Health Services
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Other Programs Available to Faculty and Staff ...
Health Net
Colleges and Schools
School of Social Welfare: Home Page
Programs, Curricula, and Courses
MSW PROGRAM
Field Work Agencies
The Letters & Science WWW Home Page
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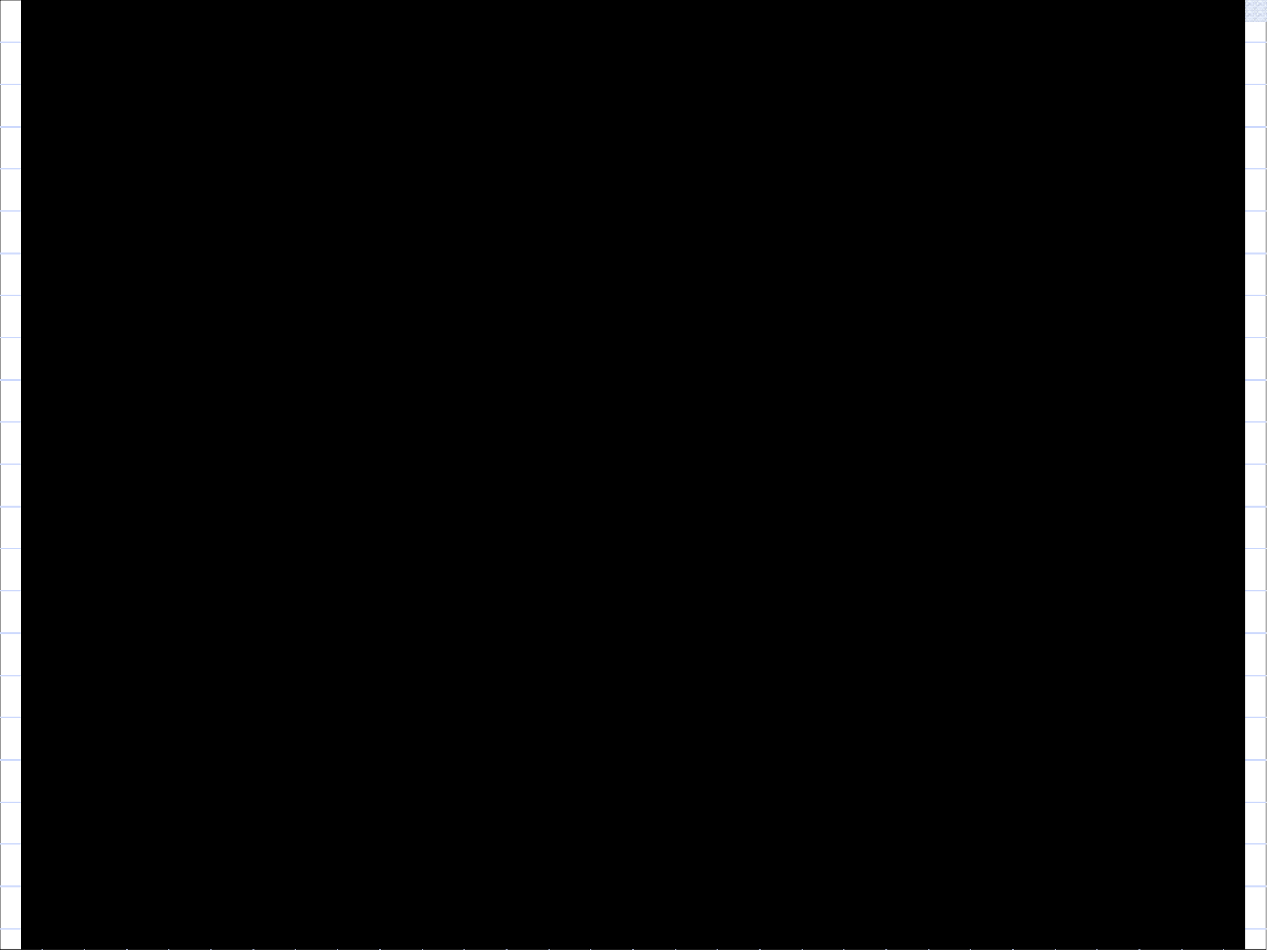
Townsend Center for the Humanities, UC Berkeley
September Townsend Center Newsletter
bioethics
The UC Berkeley Libraries
UC Berkeley Libraries
Health Sciences Information Service
HSIS Medical Informatics
Center for Southeast Asia Studies
CSEAS Newsletter,Upcoming Events, Spring 1996
Policies and Guidelines for Web Publishing at ...
Image/Multimedia Database Resources
Medical Image Databases
1-20 of 885 matches
List View
Next
Page Summary
Health Net
Health Net HealthNet Health Care.....University Health Services (UHS) at the University of California at Berkeley offers general medical office visits, physical therapy, and laboratory services to faculty and staff who are HealthNet members and have selected a Personal Care Physician (PCP) at the Tang Center.....Hospitalization: If you need to be hospitalized, in most cases you will be cared for at Alta Bates Medical Center by a physician affiliated with Alta Bates.....Tittle is active in quality assurance activities at University Health Services where he has been a physician since 1977. He received his medical degree from Stanford University in 1973 and specialized in Internal Medicine during his residencies at Pacific Medical Center and UCS...
http://www.uhs.berkeley.edu/FacStaff/healthNet.htm
(Size: 10K)
ChaCha
medical center
Search
Power Search
Help
Document: Done

4. Relevance Feedback

- Previously, we focused on algorithmic level
- But also need to consider…
  - how do we get feedback from the user?
  - will the user understand the effect on the query?
- Users want to understand and control search
  - Selecting feedback documents and terms
  - Seeing how feedback queries are constructed
  - Know what is being retrieved or rejected, and why

Study of Relevance Feedback

- Koenemann and Belkin, 1996
- Four types of feedback interaction
  - **Control:** No relevance feedback, only manual reformulation
  - **Opaque:** Selecting relevant documents only
  - **Transparent:** Show expansion terms
  - **Penetrable:** stop midway, showing terms for expansion and query reformulation. Subjects select terms for reformulation.
- Subjects more effective with feedback
- Penetrable feedback most effective



Organizing the Search Process

- Berry-picking model says search is not linear
  - users jump between different strategies
  - and try different tactics/operations
- Search "product" is a collection of strategies and their results
- Organizing these threads is hard
  - Bookmarks: location, no context
  - "Back" list: single path from root page
- Should unify search, browsing, navigation, and selection

Summary

- Information systems need good interfaces
  - Tools can be complex to use
  - Underlying models are hard to understand
  - There is too much information to keep track of
- The best interfaces will
  - employ good design principles
  - integrate all information seeking behaviors
  - support long-term search strategies
  - yield happy users