Information Retrieval Methods

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Spring 2007, part 11

Retrieval strategies

User interfaces and visualisation

Translation from Finnish: Greger Lindén

In this part

- Retrieval strategies
  - querying, browsing, navigation, scanning
  - filtering and routing
- User interfaces and visualisation

Retrieval process

1. The user has an information need
2. The user forms a query
3. The user sends the query to a system
4. The system returns an answer set
5. The user eyes and evaluates the results
6. If the user is satisfied, s/he stops
7. If the user is not satisfied, s/he modifies the query and returns to step 3

Retrieval process

- Background hypothesis:
  - the information need of the information seeker does not change during the retrieval process
  - the process is successful if, by modifying the query iteratively, the end result is a set of all relevant documents and no non-relevant ones

Retrieval process

- In practice the user learns new things during the process
  - the user eyes the titles of the result list, search terms in context, result documents and navigates following hyperlinks
- “the berry picking model”
  - the user’s information need changes during the process
  - the information need is satisfied during the retrieval process by eyeing or reading information fragments
- in addition to querying, other retrieval strategies are scanning, browsing and navigation

Querying, browsing, navigation and eyeing

- querying
  - documents are described explicitly with query words
  - the result is ad hoc document clusters
- browsing
  - the user starts from some possibly interesting topic/idea/document and browses documents to find relevant ones
  - if no relevant documents are found, the user will move to somewhere else
  - the starting point can be found by querying
  - assumption: documents on the same topic are organised together

Querying, browsing, navigation and eyeing

- navigating
  - the user follows hyperlinks towards a known goal (e.g. the phone number of N.N. at the Department of Computer Science)
  - the route is assumed to be known, or it is easily found out while navigating
- scanning
  - the user scans the titles of the answer list, documents, hyperlinks, meta data, etc.
- selection
  - auxiliary operation: e.g. when scanning, the seeker selects a hyperlink to follow

Content-based information filtering and routing

- filtering
  - the goal is to select for a person or an organisation from a document flow (e.g. today’s news, emails) interesting documents or remove unwanted ones
- routing
  - a document from a document flow is routed to a person who is interested in the document or to whose field of activities it belongs (e.g. questions by customers are routed to different experts)

Content-based information filtering and routing

- filtering and routing are based on filters (profiles)
- the document collection in a retrieval system is usually quite static, but queries vary
- in filtering and routing, the document collection changes continuously, but the filters are used for a long time and change only rarely (filters are like static queries)

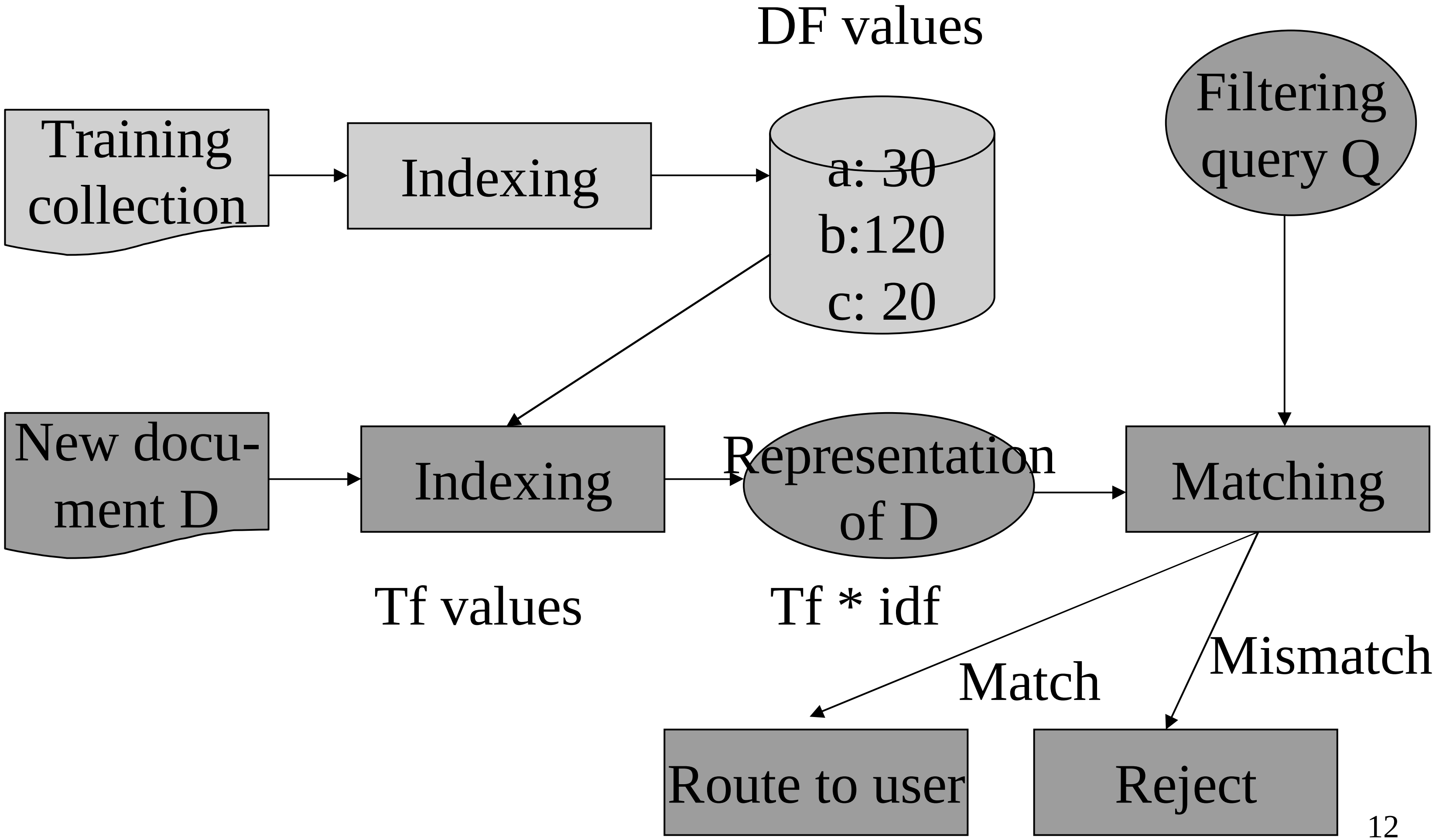
Content-based information filtering and routing

- filters can be based on meta data of documents (e.g. the sender of emails), but also on the contents of documents
- exact matching: the filters are applied as Boolean queries on each incoming document

Content-based information filtering and routing

- Partial matching: the relevance of each document to the filter → accept/reject or the best receiver is selected
  - Problem: the collection does not actually exist → how can we compute df values for term weights
  - Solution: the df values of terms can be learnt from similar training materials (collections)

Content-based information filtering and routing



User interfaces and visualisation

- Overview of the document collection(s)
- Interfaces for specifying queries
- Visualisation of search results and their context

- This part based on
  - Chapter 10 “User Interfaces and Visualization” (by Marti A. Hearst) in Baeza-Yates&Ribeiro-Neto’s book Modern Information Retrieval
  - Chapter also available on the web (link from our course page)

Overview of the document collection(s)

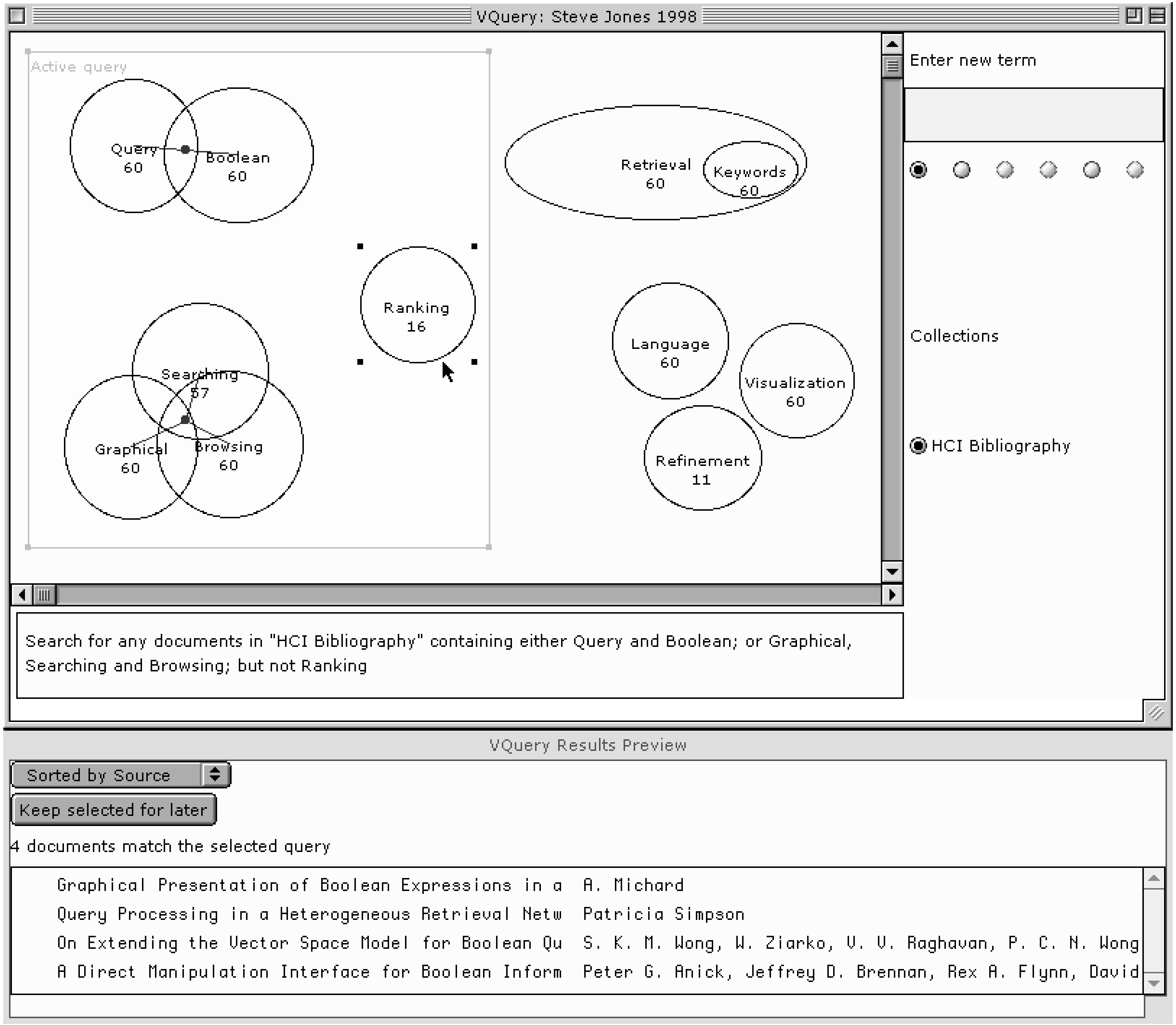
- we can generate overfiews by clustering
  - with labels for clusters
  - e.g. scatter/gather method (see part 6)
- graphical visualizations
  - e.g. WEBSOM (websom.hut.fi)
- manually (semi-automatically) generated hierarchies
  - e.g. Yahoo!, medical concept hierarchies (MeSH)

Interfaces for specifying queries

- forming Boolean queries can be difficult for many users
    - e.g. AND and OR do not correspond to their counterparts in standard language
    - “dogs and cats”, “tee or coffee”
- quorum search may help
    - automatic reformulation of the query from strict to loose
- also interfaces to define flexible forms of faceted queries can be offered
    - (osteoporosis OR ‘bone loss’)
    - (drugs OR pharmaceuticals)
    - (prevention OR cure)

Interfaces for specifying queries: graphical solutions

- Venn diagrams (Hearst: figure 10.10)
- the user can assign any number of query terms to ovals
  - if two or more ovals are placed such that they overlap with another, and if the user selects the area of their intersection → an AND operation is implied among the terms
  - if the user selects outside the area of intersection but within the ovals, an OR is implied among the corresponding terms
  - a NOT operation is associated with any term whose oval appears in the active area of the display but which remains unselected
- an active area indicates the current query: all groups of ovals within the active area are considered to in the query
  - ovals containing query terms can be moved out of the active area for later use



● HCI Bibliography

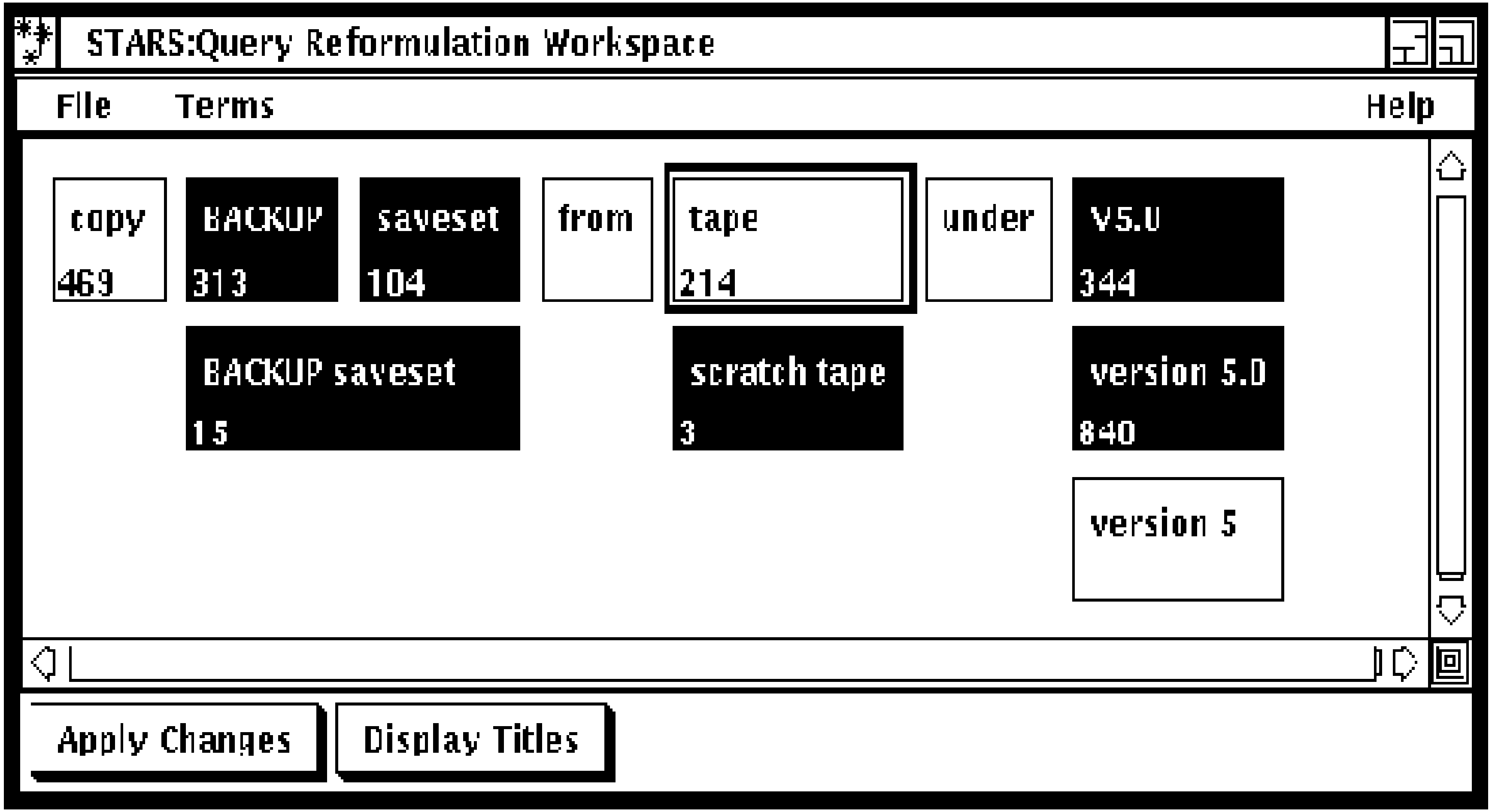
Search for any documents in "HCI Bibliography" containing either Query and Boolean; or Graphical, Searching and Browsing; but not Ranking

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
```

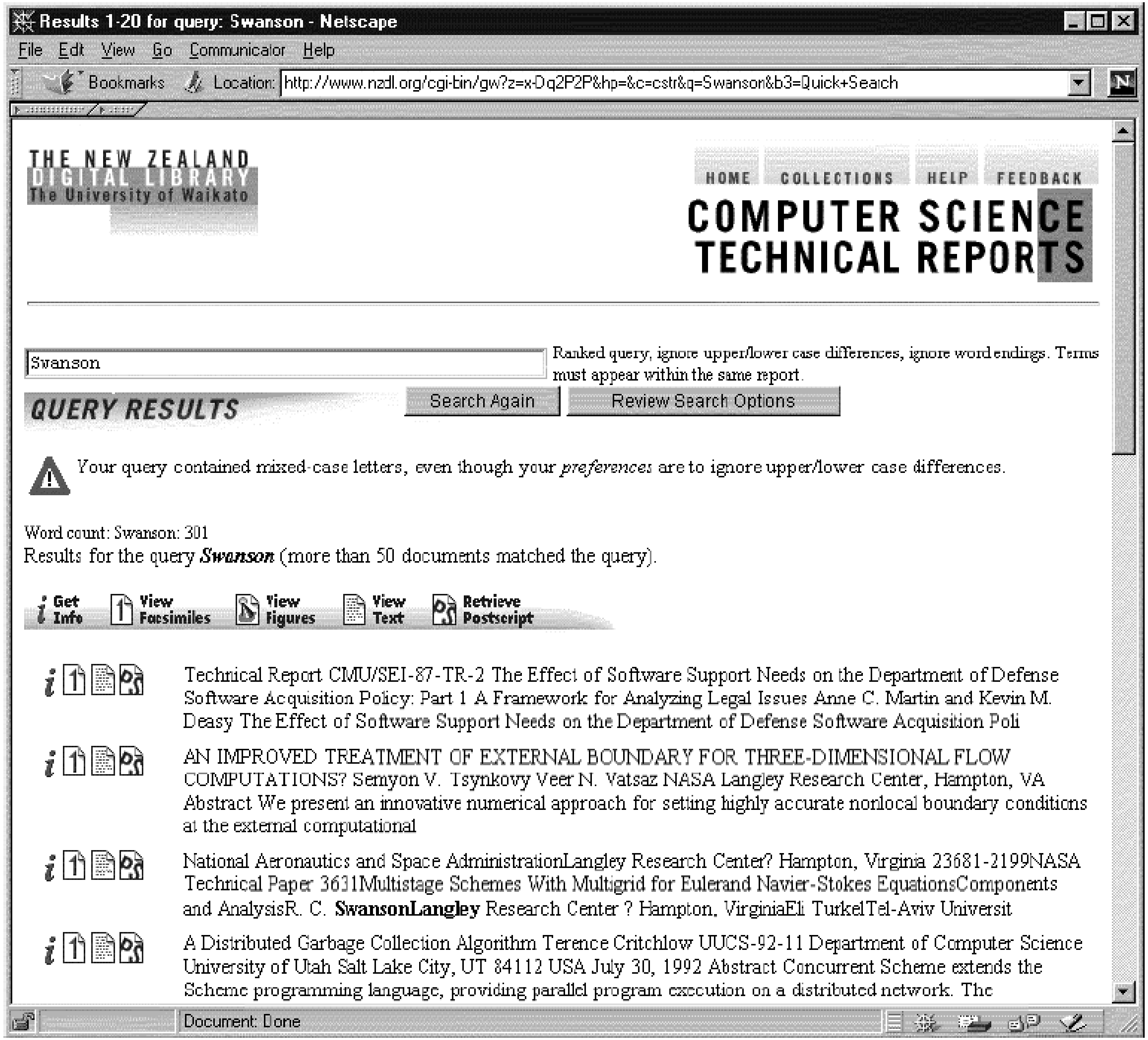
Interfaces for specifying queries: graphical solutions

- block-oriented diagrams (restricted and parallel concepts) (Hearst: figure 10.12)
- the user types a natural language query which is automatically converted to a representation in which each query term is represented within a block
- the block are arranged into rows and columns
  - two or more blocks are in the same row → AND
  - two or more blocks are in the same column → OR
- the user can experiment with different combinations of terms by activating and deactivating blocks


STARS:Query Reformulation Workspace
File
Terms
Help
copy
469
BACKUP
313
saveset
104
from
tape
214
under
V5.0
344
BACKUP saveset
15
scratch tape
3
version 5.0
840
version 5
Apply Changes
Display Titles

Visualization of search results and their context

- a typical way: document surrogates
  - document titles, a fragment from the beginning, a link to an abstract, the class code, similarity value… (Hearst: figure 10.14)


Results 1-20 for query: Swanson - Netscape
File Edit View Go Communicator Help
Bookmarks Location: http://www.nzdl.org/cgi-bin/gw?z=x-Dq2P2P&hp=&c=cstr&q=Swanson&b3=Quick+Search
THE NEW ZEALAND DIGITAL LIBRARY The University of Waikato
HOME COLLECTIONS HELP FEEDBACK
COMPUTER SCIENCE TECHNICAL REPORTS
QUERY RESULTS
Search Again
Review Search Options
Get Info
View Facsimiles
View Figures
View Text
Retrieve Postscript
Document: Done

Swanson

Ranked query, ignore upper/lower case differences, ignore word endings. Terms must appear within the same report.

⚠ Your query contained mixed-case letters, even though your *preferences* are to ignore upper/lower case differences.

Word count: Swanson: 301

Results for the query ***Swanson*** (more than 50 documents matched the query).

Technical Report CMU/SEI-87-TR-2 The Effect of Software Support Needs on the Department of Defense Software Acquisition Policy: Part 1 A Framework for Analyzing Legal Issues Anne C. Martin and Kevin M. Deasy The Effect of Software Support Needs on the Department of Defense Software Acquisition Poli

AN IMPROVED TREATMENT OF EXTERNAL BOUNDARY FOR THREE-DIMENSIONAL FLOW COMPUTATIONS? Semyon V. Tsynkovy Veer N. Vatsaz NASA Langley Research Center, Hampton, VA Abstract We present an innovative numerical approach for setting highly accurate nonlocal boundary conditions at the external computational

National Aeronautics and Space AdministrationLangley Research Center? Hampton, Virginia 23681-2199NASA Technical Paper 3631Multistage Schemes With Multigrid for Eulerand Navier-Stokes EquationsComponents and AnalysisR. C. **SwansonLangley** Research Center ? Hampton, VirginiaEli TurkelTel-Aviv Universit

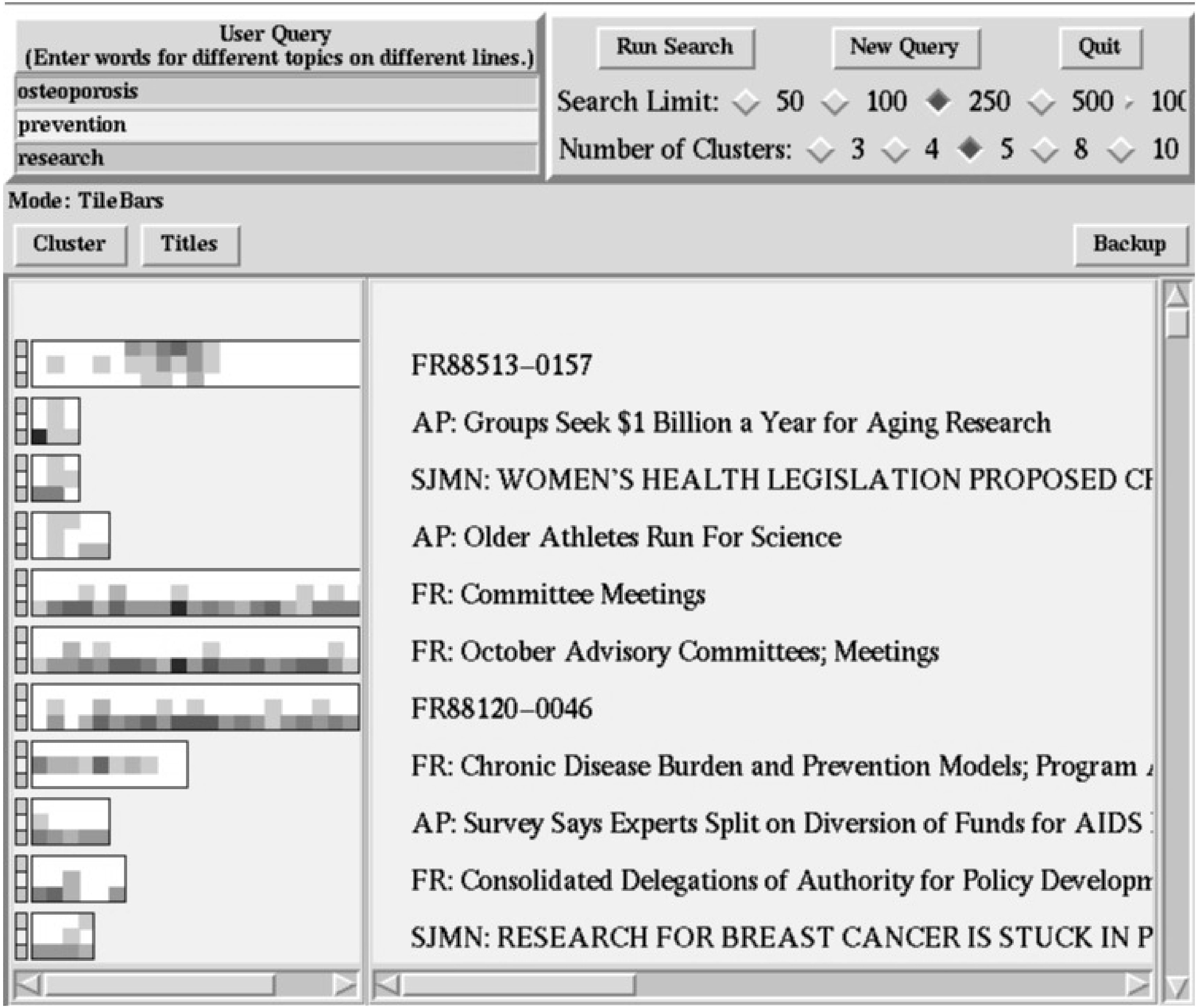
A Distributed Garbage Collection Algorithm Terence Critchlow UUCS-92-11 Department of Computer Science University of Utah Salt Lake City, UT 84112 USA July 30, 1992 Abstract Concurrent Scheme extends the Scheme programming language, providing parallel program execution on a distributed network. The

Visualization of search results and their context

- highlighting of query terms
  - the user can more easily perceive the answer set, if the occurrences of the search words are somehow highlighted in the documents
- KWIC (keyword-in-context)
  - sentences where the query terms occur: summarize the ways the terms are used within a document
  - decisions:
    - How many sentences?
    - Which sentences? E.g. sentences near the beginning with the largest subset of query terms.
    - Which order? Usually in order of occurrence, independent of how many query terms they contain.
  - the retrieval system must have a copy of the original document (web search engines may not have)

Visualization of search results and their context

- TileBars
  - the user enters a query in faceted format
  - the system displays a graphical bar next to the title of each retrieved document, showing the degree of match for each facet
    - the user can see in which documents all the facets are present
    - (Hearst: figure 10.15, better picture in the PDF version)



User Query
(Enter words for different topics on different lines.)

osteoporosis

prevention

research

Search Limit: ◇ 50 ◇ 100 ◆ 250 ◇ 500 ◇ 10(

Number of Clusters: ◇ 3 ◇ 4 ◆ 5 ◇ 8 ◇ 10

Mode: TileBars

FR88513–0157

AP: Groups Seek $1 Billion a Year for Aging Research

SJMN: WOMEN'S HEALTH LEGISLATION PROPOSED CI

AP: Older Athletes Run For Science

FR: Committee Meetings

FR: October Advisory Committees; Meetings

FR88120–0046

FR: Chronic Disease Burden and Prevention Models; Program /

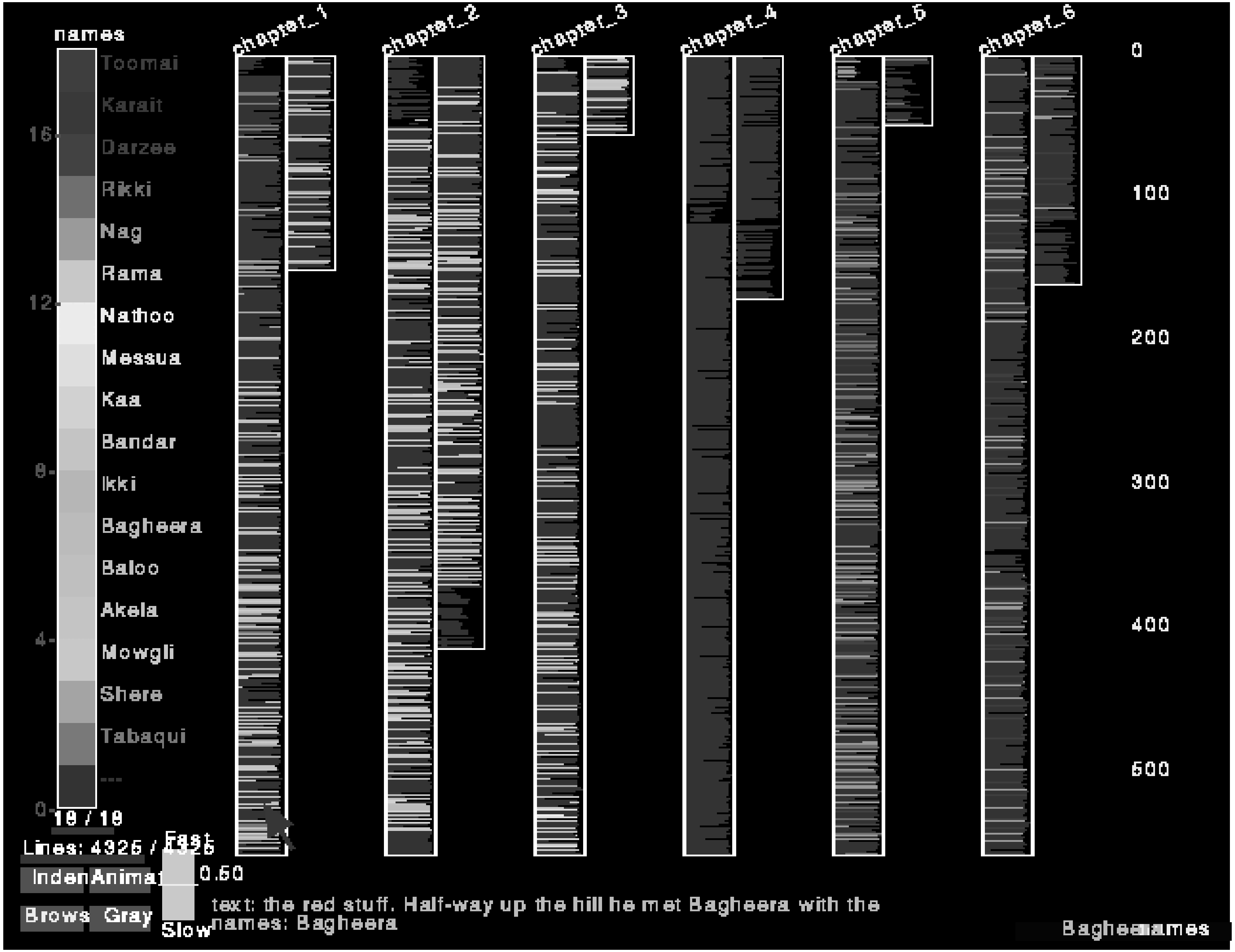
AP: Survey Says Experts Split on Diversion of Funds for AIDS

FR: Consolidated Delegations of Authority for Policy Developn

SJMN: RESEARCH FOR BREAST CANCER IS STUCK IN P

Visualization of search results and their context

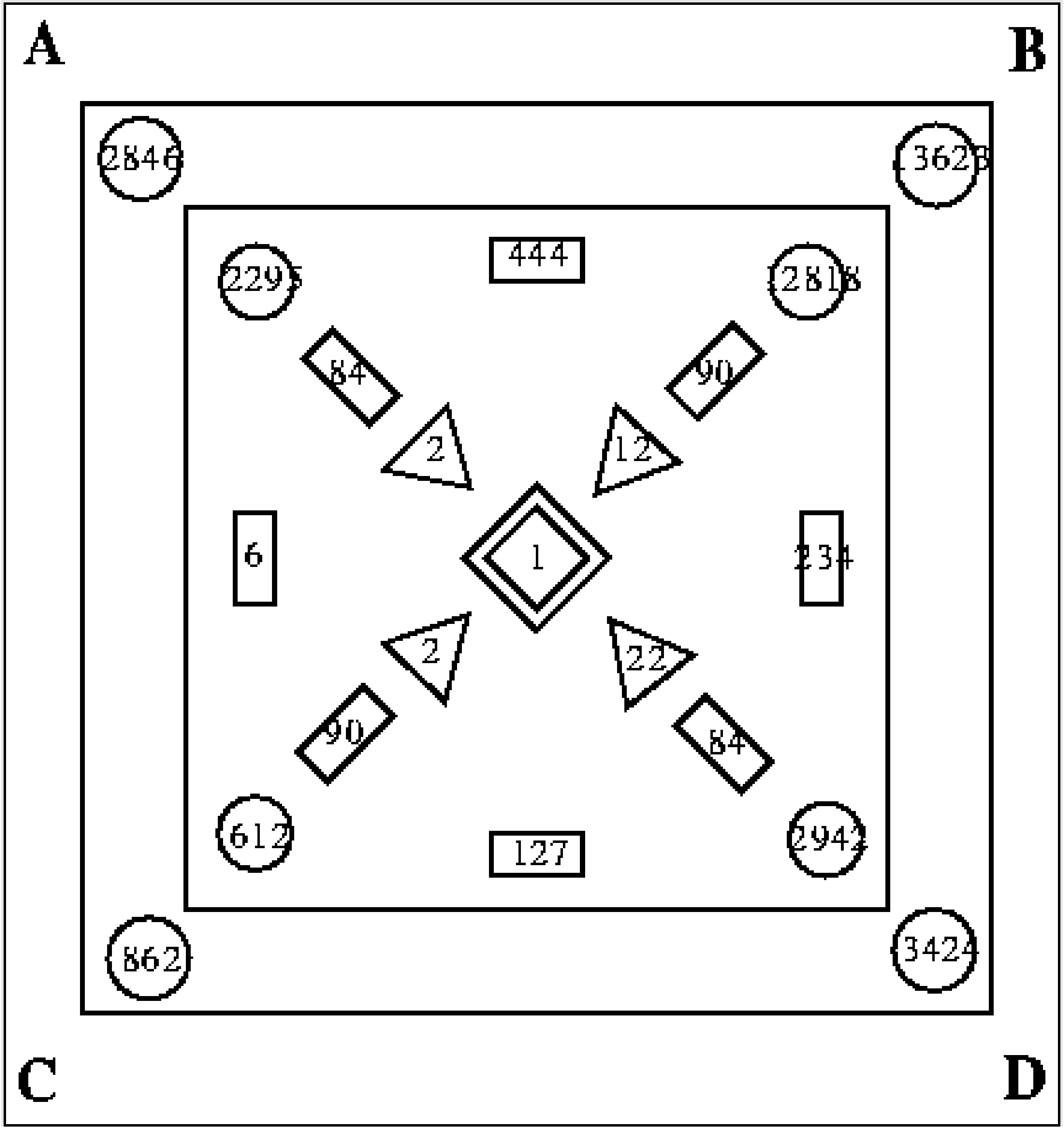
- SeeSoft
  - visualising occurrences of search terms
  - each column denotes one section (in a book)
  - each colour denotes the occurrence of some person (name) in the text
  - (Hearst: figure 10.16)



text: the red stuff. Half-way up the hill he met Bagheera with the
names: Bagheera

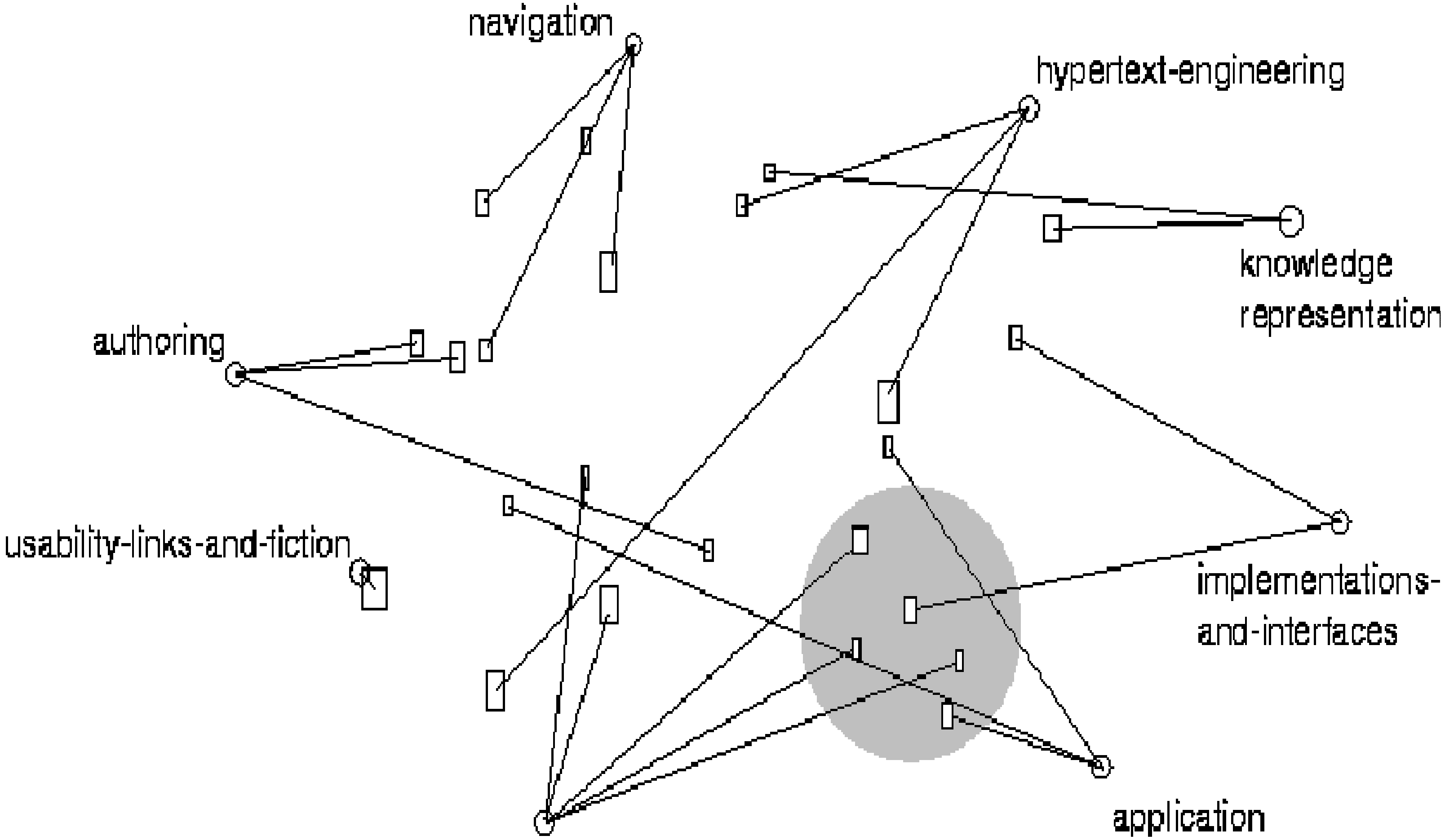
Visualization of search results and their context

- InfoCrystal
  - for each combination of search terms: in how many documents does the combination occur
  - the user does not have to specify Boolean operators in the query
  - allows visualization of all possible relations among N user-specified terms (although beyond 4 terms the interface becomes difficult to understand)
  - (Hearst: figure 10.17)


A
B
2846
13628
444
2295
12818
84
90
2
12
6
1
234
2
22
90
84
612
127
2942
862
3424
C
D

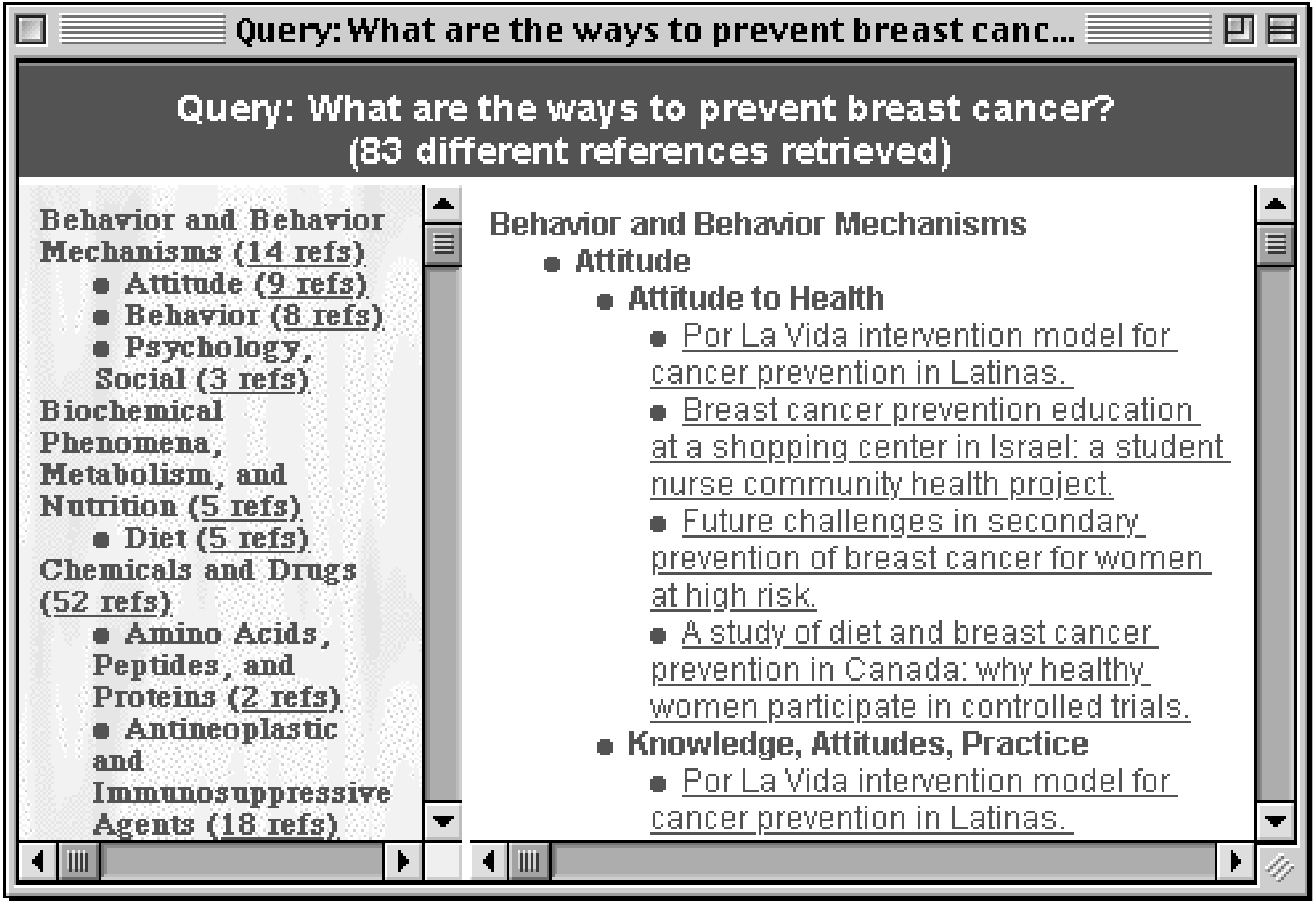
Visualization of search results and their context

- Vibe
  - – query terms are placed in conceptual space
  - – after the search, result documents are positioned in this space
    - a set of document that contain three query terms are shown at a point midway between the representations of the three terms
  - – (Hearst: figure 10.18)


navigation
hypertext-engineering
knowledge representation
authoring
usability-links-and-fiction
implementations-and-interfaces
application

Visualization of search results and their context

- DynaCat
  - the answer set is ordered according to a classification system
  - all classes are not shown, only those that are relevant according to predefined query types
    - example of a type: ”Behaviour and behaviour mechanisms”
    - a query that belongs to the type: ”what are the ways to prevent breast cancer?”
  - (Hearst: figure 10.20)



Query: What are the ways to prevent breast canc...

Query: What are the ways to prevent breast cancer?
(83 different references retrieved)

Behavior and Behavior Mechanisms (14 refs)
- Attitude (9 refs)
- Behavior (8 refs)
- Psychology, Social (3 refs)

Biochemical Phenomena, Metabolism, and Nutrition (5 refs)
- Diet (5 refs)

Chemicals and Drugs (52 refs)
- Amino Acids, Peptides, and Proteins (2 refs)
- Antineoplastic and Immunosuppressive Agents (18 refs)

Behavior and Behavior Mechanisms
- Attitude
  - Attitude to Health
    - Por La Vida intervention model for cancer prevention in Latinas.
    - Breast cancer prevention education at a shopping center in Israel: a student nurse community health project.
    - Future challenges in secondary prevention of breast cancer for women at high risk.
    - A study of diet and breast cancer prevention in Canada: why healthy women participate in controlled trials.
  - Knowledge, Attitudes, Practice
    - Por La Vida intervention model for cancer prevention in Latinas.

User interfaces and visualisation

- there are naturally many other subfields in designing user interfaces for retrieval systems
  - relevance feedback: what is automated, what is left in control of the user
  - supporting the retrieval process : e.g. how is the retrieval history stored; using a result as input for the next phase (query)
  - supporting long-term retrieval processes e.g. continuous follow-up of competing enterprises

In this part

- Retrieval strategies
  - – querying, browsing, navigation, scanning
  - – filtering and routing
- User interfaces and visualisation
  - – Overview of the document collection(s)
  - – Interfaces for specifying queries
  - – Visualisation of search results and their context

Presentation of project work (19 February)

- Each project group will give an informal presentation during the last exercise session on Monday February 19th (starting at 12.15 in C221)
- The length of the presentation should be about 15-20 minutes
- The project work does not have to be completed at the time of the presentation
  - the aim is to give an overview of the progress so far (what is your topic, what kind of queries and results you have studied, etc.)
- Remember that the project report deadline is on Friday, March 9th