Autumn School 2014 for Information Retrieval and Information Foraging

Lecture:

Interactive Retrieval and User Interfaces

Dagstuhl, Sept. 26, 2014
Bio

1986  PhD, Techn. Univ. of Darmstadt
       *Probabilistic Indexing and Retrieval*
1992  Assoc. Professor, Techn. Univ. of Dortmund
2002  Full Professor, Univ. of Duisburg-Essen
2012  Gerard Salton Award of ACM-SIGIR
Contents

1 Models for Interactive Retrieval
2 Information Seeking Behavior
3 Information Searching
4 Strategic Support
5 From Cognitive Models to IR Interfaces
6 Summary
Models for Interactive Retrieval

- A Probability Ranking Principle for Interactive IR
  - Motivation
  - Approach
  - The Model
- Estimating IPRP Parameters via Gaze Tracking
Classical Probability Ranking Principle

defines optimum retrieval for probabilistic models:
ranking documents according to decreasing values of the

probability of relevance

yields

optimum retrieval quality

Restrictions
- Relevance judgments of documents are independent
- Focus on user’s assessment of result list
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- Focus on user’s assessment of result list
The IPRP
Basic Assumptions

[Fuhr 08]

- Focus on a functional level of interaction (usability issues disregarded here)
- System presents list of choices to the user
- Users evaluate choices in linear order
- Only positive decisions/choices are of benefit for a user
Examples of decision lists

- ranked list of documents
- list of summaries
- list of document cluster
- KWIC list
- list of expansion terms
- links to related documents
- ...

Interactive Retrieval and User Interfaces
Models for Interactive Retrieval
A Probability Ranking Principle for Interactive IR
Abstraction: Situations with Lists of Choices
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Basic ideas

- A user moves from situation to situation
- In each situation $s_i$, the user is presented a list of (binary) choices $< c_{i1}, c_{i2}, \ldots, c_{in_i} >$
- The user decides about each of these choices sequentially
- The first positive decision moves the user to a new situation $s_j$
Probabilistic model focusing on single situation
Expected Benefit of a choice

\[ p_{ij} \text{ probability that the user will accept choice } c_{ij} \]
\[ e_{ij} < 0: \text{ effort for evaluating the choice } c_{ij} \]
\[ a_{ij} > 0: \text{ resulting benefit from positive decision} \]

Expected benefit of choice \( c_{ij} \)

\[ E(c_{ij}) = e_{ij} + p_{ij}a_{ij} \]
Example for Expected Benefit

After formulating a query, a user may choose to perform the following actions with the corresponding parameter triple \((e_{ij}, p_{ij}, b_{ij})\)

1. \((-1.0, 0.3, 8)\) add expansion term to the query
2. \((-2.0, 0.4, 10)\) look at the first result list entry
3. \((-10.0, 0.4, 25)\) immediately go to the first document
4. \((-5.0, 0.3, 20)\) look at an aggregated summary of the top ranking documents

In which order should these choices be presented to the user?

1. \((-1.0 + 0.3 \cdot 8) = 1.4\)
2. \((-2.0 + 0.4 \cdot 10) = 2\)
3. \((-10.0 + 0.4 \cdot 25) = 0\)
4. \((-5.0 + 0.3 \cdot 20) = 1\)
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Expected benefit of a choice list

situation $s_i$ with list of choices $r_i = < c_{i1}, c_{i2}, \ldots, c_{in} >$

maximize expected benefit of choice list:

$$E(r_i) = e_{i1} + p_{i1}a_{i1} +$$
$$(1 - p_{i1}) (e_{i2} + p_{i2}a_{i2} +$$
$$(1 - p_{i2}) (e_{i3} + p_{i3}a_{i3} +$$
$$\ldots$$
$$(1 - p_{in-1}) (e_{in} + p_{in}a_{in}) )$$

$$= \sum_{j=1}^{n} \left( \prod_{k=1}^{j-1} (1 - p_{ik}) \right) (e_{ij} + p_{ij}a_{ij})$$
PRP for Interactive IR

\[ a_{il} + \frac{e_{il}}{p_{il}} \geq a_{i,l+1} + \frac{e_{i,l+1}}{p_{i,l+1}} \]

\[ \rightsquigarrow \text{Rank choices by decreasing values of} \]

\[ \varrho(c_{ij}) = a_{il} + \frac{e_{il}}{p_{il}} \]
Parameter estimation

1. Selection probability $p_{ij}$:
   focus of many IR models,
   but models for dynamic info needs required

2. Effort parameter $e_{ij}$:
   most research needed

3. Benefit $a_{ij}$: saved effort
Interactive Retrieval and User Interfaces
Models for Interactive Retrieval
Estimating IPRP Parameters via Gaze Tracking

User Interface
Estimating the iPRP parameters

- **Effort**: time spent for a choice
- **Acceptance probability** = transition probabilities
- **Benefit**: Saved time

Complex tasks

- Query: 4.9 sec
- Basket: 1.7 sec
- Result: 2.3 sec
- Detail: 15.3 sec

Transition probabilities:
- 100% to Query
- 3% to Result
- 15% to Basket
- 2% to Detail
- 85% to Result
- 1% to Basket
- 24% to Detail
- 74% to Result
- 9% to Basket
- 87% to Basket
- 3% to Query
- 15% to Basket
- 85% to Result
- 1% to Basket
- 24% to Detail
- 74% to Result
- 9% to Basket
- 87% to Basket
- 3% to Query
Estimating the iPRP parameters

- Effort: time spent for a choice
- Acceptance probability = transition probabilities
- Benefit: Saved time
Expected time for reaching the basket

- effort in states $t_q$, $t_r$, $t_d$
- $p_{XY}$: transition probability from state $X$ to state $Y$
- expected times $T_q$, $T_r$ and $T_d$ for reaching the basket state

\[
\begin{align*}
T_q &= t_q + p_{qr} T_r \\
T_r &= t_r + p_{rq} T_q + p_{rr} T_r + p_{rd} T_d \\
T_d &= t_d + p_{dq} T_q + p_{dr} T_r
\end{align*}
\]

\[
\begin{align*}
T_q &= 122.7\, s \\
T_r &= 117.8\, s \\
T_d &= 104.9\, s
\end{align*}
\]
Refining the Model
Guidance based on the IPRP

Expected time (s)

Rank

r1 r2 r3 r4 r5 r6 r7 r8 r9 r10

Tq

Tri
Information Seeking Behavior and Information Searching
Ellis’ Behavioral Model of Information Seeking Strategies
Support for seeking behavior according to Ellis/Meho/Tibbo
Models of information searching

- **Classic IR**
  - content-oriented search in unstructured documents
  - vague information needs, uncertain representations
  - system-oriented view, assume static information need

- **Interactive information retrieval**
  - focus on user interaction with information system
  - dynamic information need

- **2 views on interactive IR:**
  1. Information Seeking Behavior
  2. Information Searching
Interactive Retrieval and User Interfaces
Information Seeking
Information Seeking Behavior and Information Searching

Models of information searching

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Interactive Retrieval and User Interfaces

Information Seeking

Information Seeking Behavior and Information Searching

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- **2 views on interactive IR:**
  1. Information Seeking Behavior
  2. Information Searching
broader view than content-oriented search

model user’s actions, motivations and strategies for satisfying an information need

questions of interest:
- what triggers an information need?
- what are users doing for solving this problem?
broader view than content-oriented search

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questions of interest:
  - what triggers an information need?
  - what are users doing for solving this problem?
focus on user’s interaction with information sources
regard classic IR systems as well as other sources (e.g. personal communication)
Ellis’ Behavioral Model of Information Seeking Strategies

[Ellis 89]

- general model of search behavior
- based on empirical studies in social sciences and engineering companies
- general categories or properties of search behavior: Starting, Chaining, Browsing, Differentiating, Monitoring, Extracting, Verifying, Ending
Categories of search behavior according to Ellis (1)

Starting

- get overview of literature/locate key authors in a field, e.g. by
  - selection of information source (e.g. personal collection, digital library, Web search engine)
  - review articles
  - personal contacts
Categories of search behavior according to Ellis (2)

Chaining

- follow different forms of referential connections between sources (in both directions)
  - citations
  - Web links
  - same author/research team
  - same conference/journal issue
  - same category
- factors considered:
  - topical relevance
  - popularity of author
  - timeliness
  - citation frequency
  - cost and time for document acquisition
- leads to finding new sources or even to reformulation of information need
Browsing

- starts from information sources and retrieved documents
- semi-goal-oriented search by browsing in promising areas
- scanning of tables of contents, references, lists of people and organizations
- browsing is used when relevant information is available in a comprehensive way
Categories of search behavior according to Ellis (3)

Differentiating

- judging of sources according to type, quality, importance, usefulness
- leads to information filtering
- e.g. comment vs. report, specification vs. manual
Monitoring

- maintain awareness of developments and technologies in a field
- by following particular sources
  - formal channels: scientific journals, conferences, alert profiles
  - informal channels: personal contacts, actual practice (field research, experimental work)
Categories of search behavior according to Ellis (5)

**Extracting**
- working through sources to locate material of interest
- material: documents, new sources, passages
- cognitive capture of information by the user
- user’s background knowledge important
Categories of search behavior according to Ellis (6)

Verifying
check information wrt. correctness and reliability

Ending
end of search, linking of new information with previous knowledge
Categories of search behavior according to Ellis (6)

Verifying
check information wrt. correctness and reliability

Ending
end of search, linking of new information with previous knowledge
Process model

- no strict sequential process
- starting, browsing, chaining and monitoring are search procedures
- differentiating is a filtering step
Extension by Meho/Tibbo

- Repeated Ellis' study, new analysis (especially wrt. new technologies)
- confirmation of Ellis' model
- but: extension by new categories
Additional categories

Accessing
- Access to full texts (instead of surrogates)
- Acquisition of contents via different channels and with different costs

Networking
- Personal communication with various persons
- Discussion and evaluation of retrieved information via internet/intranet fora

Information Managing
- Filing, storing and organizing retrieved and used information
Additional categories

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Phases in search behavior

Starting, Chaining, Browsing, Monitoring, Differentiating, Extracting, Networking

Searching

Direct Sources | Indirect Sources

New Information Needs

Processing

Yes

No

Accessing

Decision-Making

Ending
Support for seeking behavior according to Ellis/Meho/Tibbo

Starting  Resource selection
identifying popular authors
entering search terms

Browsing  Sort result list by different criteria
highlighting, also user-defined

Chaining  links in results pages
comparison of result pages

Monitoring  storing and periodical execution of queries

Extracting  searching in the result page

Inform. Mgmt.  Collate/organize result items
Annotate items (Interpret)
Starting: Resource Selection

- ACM DL: The digital library of the ACM - Association for Computing Machinery
- DBLP: The DBLP Computer Science Bibliography
- LEABIB: Bibliography of the group for efficient algorithms at the University of Munich
- Mendeley: The digital library of Mendeley
- PubMed: A large and well-known resource for the life sciences including medicine and biology
- Wiley: The digital library of the publisher Wiley
Starting: Search term completion
Starting: Search term completion
Starting: Search term completion
Starting: Related Terms

Web | Images | Video | Local | Shopping | more

information retrieval

Explore concepts: information retrieval + Natural Language Processing queries
algorithm
Springer

1 - 10 of about 58,600,000 for information retrieval (About this page)
Starting: Identify important authors 'extract authors' in ezdl

Search query

- Advanced
  - Text: e.g. "information retrieval" OR search
  - Title: interactive retrieval
  - Author: e.g. "seth nickel" OR "suzanna smith"
  - Year: e.g. 1970-1972

Clear Search

Results: 415

Sort by: Relevance
Filter: Enter filter terms

Group by: Nothing

1. 09101 Abstracts Collection Dagstuhl 2010 Interactive Information Search: 09101 Workshop Report Interactive Information Search
   Belkin et al.
   2009 (Mendeley)

2. On the role of user-centred evaluation in the advancement of interactive information retrieval
   Petrelli.
Starting: Identify important authors
'extract authors' in ezdl
Browsing: Sort/group results by different criteria
Browsing: Meaningful Surrogates

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).


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


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
Browsing: Meaningful Surrogates

The compact weak topology on a Banach space.
Manuel González, Joaquin M. Gutiérrez — Extracta Mathematicae
Throughout [this paper], E and F will denote Banach spaces. The bounded weak topology on a Banach space E, noted bw(E) or simply bw, is defined as the finest topology that agrees with the weak topology on bounded sets. It is proved in [3] that bw(E) is a locally convex topology if and only if E is r…

A note on the topology associated with a locally convex space.
Radenović, Stojan — Publications de l’Institut Mathématique. Nouvelle Série
If R is a property in the class of locally convex spaces, which is invariant under passage to an arbitrary inductive limit and the finest locally convex topology, then for every locally convex space (E,τ) there exists a locally convex topology Rt with the property R. For example, R is one of the pro…

Hausdorff topology and uniform convergence topology in spaces of continuous functions

Journals

Commentationes Mathematicae Universitatis Caroliniae
Czechoslovak Mathematical Journal
Annales de l’Institut Fourier
Compositio Mathematica
Algebraic & Geometric Topology

Years

2011
2010
2009
2008
2007

More... ➤
Browsing: Highlighting in the Result List

peer to peer information retrieval

Ungefähr 5.530.000 Ergebnisse (0,21 Sekunden)

Wissenschaftliche Artikel zu peer to peer information retrieval
Peer-to-peer information retrieval using self-organizing... - Tang - Zitiert durch: 541
... mining for the biologist: from information retrieval to... - Jensen - Zitiert durch: 331
... indexing for efficient peer-to-peer information retrieval - Tang - Zitiert durch: 179

[PDF] An Architecture for Peer-to-Peer Information Retrieval
infoscience.epfl.ch/.../P2P-IR_Architecture.pdf - Diese Seite übersetzen
Dateiformat: PDF/Adobe Acrobat - Schnellansicht
von K Aberer - 2004 - Zitiert durch: 35 - Ähnliche Artikel
An Architecture for Peer-to-Peer Information Retrieval. Karl Aberer, Fabius Klemm, Martin Rajman, Jie Wu. School of Computer and Communication Sciences...

Workshop on Information Retrieval in Peer-to-Peer Networks (P2PIR...}
Isinwww.epfl.ch/p2pir2006/ - Diese Seite übersetzen
Workshop on Information Retrieval in Peer-to-Peer Networks. collocated with the. ACM Fifteenth Conference on Information and Knowledge Management (CIKM...
Chaining: Clickable Entries in Result Pages

A behavioural approach to information retrieval system design

Citation-Key:
Ellis:89

Title:
A behavioural approach to information retrieval system design

Author(s):
D. Ellis

Journal:
Journal of Documentation

Volume:
45

Number:
3

Page(s):
171--212

Year:
1989

Classification(s):
H.3.3, H.1.2

Subject descriptor(s):
search process, human factors, query formulation

Keywords:
cognitive models
User term feedback in interactive text-based image retrieval

Full Text:  

Authors:  
Chen Zhang  Michigan State University, East Lansing, MI  
Joyce Y. Chai  Michigan State University, East Lansing, MI  
Rong Jin  Michigan State University, East Lansing, MI

Published in:  
Proceeding  
SIGIR '05  Proceedings of the 28th annual international ACM SIGIR conference on Research and development in information retrieval  
doi>10.1145/1076034.1076046
Chaining: backward/forward chaining of references

Note: OCR errors may be found in this Reference List extracted from the full text article. ACM has opted to expose the complete List rather than only correct and linked references.


2. N. J. Bellin, P. G. Marchetti, Determining the functionality features of an intelligent interface to an information retrieval system, Proceedings of the 13th annual international ACM SIGIR conference on Research and development in information retrieval, p.151-177, September 05-07, 1990, Brussels, Belgium. [doi>10.1145/96749.98901]


Chaining: backward/forward chaining of references

7 Citations


Mouna Torjmen, Karen Pinel-Sauvagnat, Michand Boughanem, Using textual and structural context for searching Multimedia Elements, International Journal of Business Intelligence and Data Mining, v.5 n.4, p.323-352, October 2010


Dilip Kumar Limbu, Andy Connor, Russel Pears, Stephen McDonell, Contextual relevance feedback in web information retrieval, Proceedings of the 1st international conference on Information interaction in context, October 18-20, 2006, Copenhagen, Denmark

Mouna Torjmen, Karen Pinel-Sauvagnat, Michand Boughanem, Towards a structure-based multimedia retrieval model, Proceeding of the 1st ACM international conference on Multimedia information retrieval, October 30-31, 2008, Vancouver, British Columbia, Canada

Joyce Y. Chai, Chen Zhang, Rong Jin, An empirical investigation of user term feedback in text-based targeted image search, ACM Transactions on Information Systems (TOIS), v.25 n.1, p.3-es, February 2007

Forward Chaining in Web Searches

DAFFODIL: Strategic Support Evaluated
www.is.informatik.uni-duisburg.de/bib/docs/Klas_04ta.html
DAFFODIL: Strategic Support Evaluated, UDEFakultäten IngenieurwissenschaftenAbteilung InKoInformationssystemeDAFFODIL: Strategic Support Evaluated ...

DiLAS: a Digital Library Annotation Service
www.is.informatik.uni-duisburg.de/bib/docs/Agosti_etal_05.html
UDEFakultätenIngenieurwissenschaftenAbteilung InKoInformationssystemeDiLAS ...

Teaching
www.is.informatik.uni-duisburg.de/.../index.htm... - Diese Seite übersetzen
UDEFakultätenIngenieurwissenschaftenAbteilung InKoInformationssysteme ...

Comparing different architectures for query routing in peer-to ...
www.is.informatik.uni-duisburg.de/bib/.../Nottelmann_Fuhr_06.html
Zitationschlüssel: Nottelmann/Fuhr:06; Titel: Comparing different architectures ...
Differentiating: comparison of result pages
Sheffield July 29

27th Annual International ACM SIGIR Conference Workshop on Peer-to-Peer Information Retrieval

SIGIR is the major international forum for the presentation of new research results and the demonstration of new systems and techniques in the broad field of information retrieval.

This SIGIR workshop on Peer-to-Peer Information Retrieval focus on new methods of resource representation, resource selection, and data fusion in peer-to-peer networks. The workshop particularly encourages papers that address heterogeneous peer-to-peer networks, as well as papers about methods that cope with partial and uncertain information. However, more broadly, papers are solicited on any topic related to information retrieval in peer-to-peer networks.
is messy. Molecules have to bind and unbind, and chemical and signal elements have to mix and diffuse.”

Nature bypasses this messiness in part by resorting to statistical methods. For example, Wang and his colleagues combined recordings of in vivo neural activity, with a computer simulation of neuron function in the visual cortex of a cat, to show that neurons fired most reliably when they were stimulated by the almost simultaneous arrival of approximately 30 input signals. With fewer than 20 signals arriving at once, the neuron was significantly less likely to fire, but the simultaneous arrival of more than 40 signals brought no gain in the reliability of the output sig-

The current puzzle is to understand how a brain built from fundamentally unreliable components can reliably perform tasks that digital computers have barely begun to crack.
Interactive Retrieval and User Interfaces

Information Seeking

Support for seeking behavior according to Ellis/Meho/Tibbo

Monitoring

'Saved Searches' at PubMed

![PubMed search screenshot]

- Pulsed infrared light therapy does not increase nitric oxide concentration in the blood of patients with type 1 and type 2 diabetes mellitus.
- The effect of monochromatic infrared energy on transcutaneous oxygen measurements and protective sensation: results of a controlled, double-blind, randomized clinical study.
- Light therapy and advanced wound care for a neuropathic plantar ulcer on a Charcot foot.
- Anodyne therapy for recalcitrant diabetic foot ulcers: a report of four cases.
Interactive Retrieval and User Interfaces

Information Seeking

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'Saved Searches' at PubMed
Monitoring 'Saved Searches' at PubMed
Interactive Retrieval and User Interfaces
Information Seeking
Support for seeking behavior according to Ellis/Meho/Tibbo

Monitoring on the Web
Google Alerts and Watchthatpage.com

Google Alerts

Suchanfrage: 

Ergebnistyp: Alles

Sprache: Deutsch

Region: Beliebige Region

Häufigkeit: Einmal täglich

Anzahl: Nur die relevantesten Ergebnisse

Senden an: norbert.fuhr46@gmail.com

Alert erstellen
Alerts verwalten
Interactive Retrieval and User Interfaces

Information Seeking

Support for seeking behavior according to Ellis/Meho/Tibbo

Monitoring on the Web

Google Alerts and Watchthatpage.com

Your profile
This information will be kept strictly CONFIDENTIAL and will NOT be shared with any other party or mailing list as confirmed in our terms and conditions

User name (email address) *some@company.com
User alias dude
Password *password
Repeat password *password

Your pages

Delete selected, Collapse all, Expand all, Move selected

- Competitors
- Computers
  - jakarta.apache.org/
  - java.sun.com
  - www.jboss.org/

Your pages for channel Computer

Add new channel, Edit name, Delete channel, What is a channel?

WatchThatPage: 3 pages changed

Differences in page http://java.sun.com

Let There Be Light
Learn how professors and programmers at the University of California, Berkeley, designed and built a visionary student information system. (May 28)
Interactive Retrieval and User Interfaces
Information Seeking
Support for seeking behavior according to Ellis/Meho/Tibbo

Information Management: Personal Library in Daffodil
Information Searching

- Basic Functions of IR Systems
- Simple models of the search process
- Anomalous State of Knowledge
- Types of searches
- Ingwersen’s Cognitive Model
Basic Functions of IR Systems
Select - Organize - Project

- **Select**: Selecting possibly relevant items
- **Organize**: How the set of result items is structured and organized logically
- **Project**: Construction of the surrogates to be presented in the results page
Select (S) functions

**Ranking method:** e.g. precision- or recall-oriented

**Ranking principle:** e.g. relevance or diversity ranking

**Querying:** simple (set of words) to complex (field, data types) queries, a-priori or by given items (query by example)
Select (S) functions

**Formal filter conditions**: Filtering by formal criteria

![Filter conditions](image.png)
Organize (O) functions

**Sorting**: Sorting of items by one (1D) more criteria (2D, …)

- Sorting of items by one (1D) more criteria (2D, …)

**Grouping**: Grouping by simple (e.g. grouping by document type) or complex criteria

- Grouping by simple (e.g. grouping by document type) or complex criteria
Interactive Retrieval and User Interfaces
Information Searching
Basic Functions of IR Systems

Organize (O) functions

**Clustering:** Content focused grouping by similarity, unknown meaning of clusters

**Linking:** Showing e.g Web links, co-author relationships, ... (see Chaining in Ellis' model)
Project (P) functions

Selecting: Selection of specific fields for surrogates

Summarizing: Summaries of single answer documents

Introduction to Information Retrieval by Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze (Jul 7, 2008)

<table>
<thead>
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<th>Formats</th>
<th>Rent</th>
<th>Buy</th>
<th>New</th>
<th>Used</th>
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Advantages of query biased summaries in information retrieval...
Project (P) functions

**Aggregating:** Generates single entry representing several items

**EXCELLENT CAMERA**
This is an EXCELLENT CAMERA. This is the

★★★★★ Love this camera!
The best feature: Great quality photos! I just

★★★★☆ Easy to use great pics
I have owned earlier models of this camera, so

**Extracting:** Extracting and generating new data (e.g. common terms or frequent authors)
Most IR systems only support flexible selection (but ranking is fixed)

Flexibility wrt. organizing and projecting missing (would be helpful for advanced searchers)

Search is an iterative process
Classical search process model

1. Information Need
2. Query
3. Send to System
4. Receive Results
5. Evaluate Results
6. Reformulate
   - No: Repeat with step 4
   - Yes: Continue
   - Stop

Done?
Empirical studies

- Information search consists of a sequence of connected, but different searches.
- Search result may trigger new searches.
- Only task context remains the same.
- Main goal of a search is accumulated learning and collection of new information while searching.
Berry-picking Model

[Bates 90]
- continuous change of information need and queries during search
- information need cannot be satisfied by a single result set
- instead: sequence of selections and collection of pieces of information during search
Support for Berrypicking

- Filing of single results
- Adding terms/items to the query
- Query history (where have I been before?)
Anomalous State of Knowledge (ASK)(1)

[Belkin 80]

Classic IR systems: "best match" principle

- System returns those documents that fit best to the representation of the information need (e.g. query statement)
- Only feasible, if user can give precise specification of her information need (like e.g. in DBMS)
Anomalous State of Knowledge (ASK) (2)

ASK-Hypothesis

- information need results from user’s anomalous state of knowledge (ASK)
- user is unable to precisely specify information need for removing the ASK
- instead: describe ASK
- requires capture of cognitive and situation-specific aspects for resolving this anomaly
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Interactive Retrieval and User Interfaces
Information Searching
Anomalous State of Knowledge

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interactive retrieval and user interfaces
information searching
anomalous state of knowledge

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[Broder 2002, Rose & Levinson 2004]

**Navigational**: to reach a particular site

**Informational**: to acquire information assumed to be present on one or more web pages

**Transactional**: to perform some web-mediated activity

**Resource**: to get access to an online resource
Taxonomies of Web Search II

[Russell et al 2009]

**Navigate:** query(ies) leading to a site at which the main task can be performed.

**Find-Simple:** searching for an evident piece of information that does not require multiple sources of information.

**Find-Complex:** searching for information that requires searches on very closely related topics to integrate information across resources.

**Locate/Acquire:** the searcher is looking to download something, purchase an item, obtain a good or service.

**Explore/Learn:** searches that are intended to discover something or learn about a topic area.

**Play:** activity where the searches are intended to find games, fun content or items for amusement.

**Meta:** search tasks that are to test some capability.
develop type-specific retrieval methods

- Ranking:
  - Navigational: find home page
  - Informational: find page containing requested info
  - Transactional: find page w/ transaction form
  - ...

- Task-specific selection + presentation functions: (see below)
Ingwersen’s Cognitive Model

- **Global perspective**
  - comprises all factors influencing a search
    - social context
    - IR system
    - information objects
    - user interface
    - user
  - focuses on *cognitive structures* – manifestations of human cognition, reflexions and ideas
Ingwersen’s Cognitive Model

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Ingwersen’s Cognitive Model

- Information objects
- IT: Engines, Logics, Algorithms
- Interface
- Cognitive Actor(s) (team)

Organizational, Social, Cultural Context

Cognitive transformations and influence
Interactive communications of cognitive structures
Polyrepresentation

[Ingwersen 94]

- representation of information objects in different forms
- representations should correlate with cognitive structures
- example: document can be represented by
  - title (specified by the author)
  - keywords (by indexer)
  - other documents citing the current doc (extern)
  - annotations (extern)
- retrieval system should support several representations (thus, also several cognitive structures)
  → intentional redundancy
- good search result, when several representations point to the same document (Overlap)
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Polyrepresentation: the Amazon case

1. **Introduction to Information Retrieval** by Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze (Hardcover - Jul 7, 2008)
   - **Buy new:** $60.00 **$48.00** 22 Used & new from $46.98
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3. **Introduction to Modern Information Retrieval** by G. G. Chowdhury (Paperback - Dec 1, 2003)
   - **Buy new:** $89.95 7 Used & new from $89.94
Polyrepresentation: the Amazon case
Polyrepresentation: the Amazon case

Editorial Reviews
Product Description

Interested in how an efficient search engine works? Want to know what algorithms are used to rank resulting documents in response to user requests? The authors answer these and other key information retrieval design and implementation questions.

This book is not yet another high level text. Instead, algorithms are thoroughly described, making this book ideally suited for both computer science students and practitioners who work on search-related applications. As stated in the foreword, this book provides a current, broad, and detailed overview of the field and is the only one that does so. Examples are used throughout to illustrate the algorithms.

The authors explain how a query is ranked against a document collection using either a single or a combination of retrieval strategies, and how an assortment of utilities are integrated into the query processing scheme to improve these rankings. Methods for building and compressing text indexes, querying and retrieving documents in multiple languages, and using parallel or distributed processing to expedite the search are likewise described.

This edition is a major expansion of the one published in 1998. Besides updating the entire book with current techniques, it includes new sections on language models, cross-language information retrieval, peer-to-peer processing, XML search, mediators, and duplicate document detection.
Polyrepresentation: the Amazon case
Polyrepresentation: the Amazon case

Customer Reviews

8 Reviews

5 star: (4)
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3 star: (1)
2 star: (0)
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Average Customer Review ★★★★★ (8 customer reviews)

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12 of 12 people found the following review helpful:

★★★★★ Extremely Clear "Fundamentals" Book, February 12, 2002
By Gordon Rios (Palo Alto, CA United States) - See all my reviews

This review is from: Information Retrieval: Algorithms and Heuristics (The Springer International Series in Engineering and Computer Science) (Hardcover)

If you're working in the IR industry, or want to develop software in this field, this book is a great starting point. A clarification: this will not be a book for researchers -- instead think of it as a book for advanced practitioners or engineers needing to work in this area. Inside you'll see complete worked examples of several fundamental computations rather than detailed proofs.

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★★★★★ A Good Guide to The Field, August 31, 2006
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Experimental Results for Polyrepresentation

[Koolen 2014]

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</tr>
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</table>

Experimental Results for INEX Social Book Search

- Amazon Title+ Author
- British Library + Library of Congress Classification
- Amazon Reviews
- Librarything Tags
Polyrepresentation of the cognitive user space

cognitive space can be represented via polyrepresentation

- requests
- problems/goals
- work task
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Global Polyrepresentation Model

Information space

System

S1 → r1
S2 → r2
S3 → r3
Sn → rn

Request model builder Interface

Information Need

Uncertainty State

Problem Space

Current Cognitive State

Work-Task/Interest Domain

Cognitive space

User

Information interaction

Text entity retrieval

Variability
Representations of Problems and Work Tasks
Example: LibreOffice FAQ

- How do I install the latest version of LibreOffice?
- How to convert an odt to pdf?
- How to maintain document compatibility between LibreOffice and other office suites?
- LibreOffice Spell Checker doesn’t work?
- Can’t open .xlsx file with LibreOffice
- No page number in first page
- LibreOffice missing certain Microsoft fonts
Strategic Support

- Information Seeking Behavior & Information Searching
- Levels of search activities
- Degrees of system involvement
- Proactivity in IR Systems
searching consists of sequence of different phases

experienced searchers employ a variety of actions in different phases

des actions should be supported by the system as much as possible

each phase should be supported appropriately by the system

Bates’ model for strategic system support

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- Levels of search activities
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Levels of search activity

1. **Move**: An identifiable thought or *action* that is a part of information searching.

2. **Tactic**: One or a handful of moves made to *further* a search.

3. **Stratagem**: A larger, more complex set of thoughts and/or actions than the tactic, all designed to exploit the file structure of a *particular search domain* thought to contain desired information.

4. **Strategy**: A *plan*, which may contain moves, tactics, and/or stratagems, for an entire information search.
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Interactive Retrieval and User Interfaces
Strategic Support
Levels of search activities

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Types of Tactics

**Term tactics:** modification of words or phrases in the query (spelling, related terms)

**Information structure (file) tactics:** following links like references (in both directions), structural relationships (journal, proceedings, web site), searching within a structure

**Search formulation tactics:** narrowing/broadening the query, more/less terms

**Idea tactics:** open search possibilities /variants

**Monitoring tactics:** monitor search progress, compare it with search goals
Interactive Retrieval and User Interfaces
Strategic Support
Levels of search activities

Information structure (file) tactics
Structural and referential links

User term feedback in interactive text-based image retrieval

Authors: Chen Zhang, Michigan State University, East Lansing, MI
          Joyce Y. Chai, Michigan State University, East Lansing, MI
          Rong Jin, Michigan State University, East Lansing, MI

Published in:
  • Proceeding
    SIGIR '05 Proceedings of the 28th annual international ACM
    SIGIR conference on Research and development in information
    retrieval
doi>10.1145/1076034.1076046
Interactive Retrieval and User Interfaces
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7 Citations


Mouna Torjmen, Karen Pinel-Sauvagnat, Mohand Boughanem, Using textual and structural context for searching Multimedia Elements, International Journal of Business Intelligence and Data Mining, v.5 n.4, p.323-352, October 2010


Dilip Kumar Limbu, Andy Connor, Russel Pears, Stephen MacDonell, Contextual relevance feedback in web information retrieval, Proceedings of the 1st international conference on Information interaction in context, October 18-20, 2006, Copenhagen, Denmark

Mouna Torjmen, Karen Pinel-Sauvagnat, Mohand Boughanem, Towards a structure-based multimedia retrieval model, Proceeding of the 1st ACM international conference on Multimedia information retrieval, October 30-31, 2008, Vancouver, British Columbia, Canada

Joyce Y. Chai, Chen Zhang, Rong Jin, An empirical investigation of user term feedback in text-based targeted image search, ACM Transactions on Information Systems (TOIS), v.25 n.1, p.3-33, February 2007

Interactive Retrieval and User Interfaces
Strategic Support
Levels of search activities

Information structure (file) tactics
Structural and referential links


2. N. J. Bellin, P. G. Marchetti, Determining the functionality features of an intelligent interface to an information retrieval system, Proceedings of the 13th annual international ACM SIGIR conference on Research and development in information retrieval, p.151-177, September 05-07, 1990, Brussels, Belgium [doi>10.1145/96749.98901]


Interactive Retrieval and User Interfaces
Strategic Support
Levels of search activities

Information structure (file) tactics
Structural and referential links

The ACM Computing Classification System (*CCS rev.2012*)

CCS for this Article

- Information systems
- Human-centered computing

- Information retrieval
  - Information retrieval query processing
  - Evaluation of retrieval results
  - Interaction paradigms

Human computer interaction (HCI)
Information structure (file) tactics
Online shop example
Example stratagems

**Subject Search**

**Journal Run** Having identified a journal central to one’s topic of interest, one reads or browses through issues or volumes of the journal.

**Citation Search** Using a citation index or database, one starts with a citation and determines what other works have cited it.

**Area Scan** After locating a subject area of interest in a classification scheme, one browses materials in the same general area.

**Footnote Chase** One follows up footnotes or references, moving backward in time to other related materials.
Example stratagems

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ACM Transactions on Information Systems (TOIS)

Archive

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Volume 31 Issue 2, May 2013
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Volume 30 Issue 3, August 2012
Volume 30 Issue 2, May 2012
Interactive Retrieval and User Interfaces
Strategic Support
Levels of search activities

Stratagem
Journal Run

ACM Transactions on Information Systems (TOIS)
Volume 32 Issue 2, April 2014

Table of Contents

Efficient Index-Based Snippet Generation
Hannah Bast, Marjan Celikik
Article No.: 6
doi:10.1145/2590972
Full text: PDF

Ranked result lists with query-dependent snippets have become state of the art in text search. They are typically implemented by searching, at query time, for occurrences of the query words in the top-ranked documents. This document-based approach ...

Modeling Term Associations for Probabilistic Information Retrieval
Jiashu Zhao, Jimmy Xiangji Huang, Zheng Ye
Article No.: 7
doi:10.1145/2590988
Full text: PDF

Traditionally, in many probabilistic retrieval models, query terms are assumed to be independent. Although such models can achieve reasonably good performance, associations can exist among terms from a human being’s point of view. There are some ...

Social-Sensed Image Search
Peng Cui, Shao-Wei Liu, Wen-Wu Zhu, Huan-Ro Luan, Tat-Seng Chua, Shi-Qiang Yang
Article No.: 8
doi:10.1145/2590974
Full text: PDF
Stratagem
Area Scan

Primary Classification:
H. Information Systems
  ➜ H.3 INFORMATION STORAGE AND RETRIEVAL
  ➜ H.3.3 Information Search and Retrieval
  ➜ Subjects: Query formulation

Additional Classification:
H. Information Systems
  ➜ H.3 INFORMATION STORAGE AND RETRIEVAL
  ➜ H.3.3 Information Search and Retrieval
  ➜ Subjects: Search process Relevance feedback
  ➜ H.5 INFORMATION INTERFACES AND PRESENTATION (1.7)
  ➜ H.5.2 User Interfaces (D.2.2, H.1.2, I.3.6)
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Searching for: CCS:H52 (start a new search)

Found 34,232 within The ACM Guide to Computing Literature (Bibliographic citations from major publishers in computing)

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1. A configurable environment for the visualization of data
   *Benoi T. Ozell*
   October 1996  A configurable environment for the visualization of data
   **Publisher:** Ecole Polytechnique
   **Bibliometrics:** Downloads (6 Weeks): n/a, Downloads (12 Months): n/a,
   **Keywords:** data visualization, information extraction

2. A multitouch software architecture
   *Florian Echtler, Gudrun Klinker*
   October 2008  **NordiCHI ’08:** Proceedings of the 5th Nordic conference on Human-Computer Interaction bridges
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Google Stratagems

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Degrees of system involvement

0 – No system involvement  All search activities human generated and executed.

1 — Displays possible activities. System lists search activities when asked. Said activities may or may not also be executable by system (higher levels).

2 — Executes activities on command  System executes specific actions at human command.

3 — Monitors search and recommends  System monitors search process and recommends search activities:
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0 — No system involvement  All search activities human generated and executed.

1 — Displays possible activities.  System lists search activities when asked. Said activities may or may not also be executable by system (higher levels).

2 — Executes activities on command  System executes specific actions at human command.

3 — Monitors search and recommends  System monitors search process and recommends search activities:
   a) Only when searcher asks for suggestions.
   b) Proactive:  Always when it identifies a need.

4 — Executes automatically.  System executes actions automatically and then:
   a) Informs the searcher.
   b) Does not inform the searcher.
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Interactive Retrieval and User Interfaces
Strategic Support
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Interactive Retrieval and User Interfaces

Strategic Support

Degrees of system involvement

Monitors search and recommends

Yahoo!®

summer school

summer school movie
summer school programs
harvard summer school
online summer school
summer school activities
summer...for...school...
summer school in london
ucla summer school
summer school 01106

SUMMER SCHOOL, (2009)
Unrated
After a marathon horror-movie session, a teenage film...
Interactive Retrieval and User Interfaces
Strategic Support
Degrees of system involvement

Executes automatically + informs
Interactive Retrieval and User Interfaces
Strategic Support
Degrees of system involvement
Executes automatically + does not inform
## Combination of search activities and system support

<table>
<thead>
<tr>
<th>Search Activity/ System involvement</th>
<th>Move</th>
<th>Tactics</th>
<th>Stratagem</th>
<th>Strategy</th>
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<tr>
<td>No system involvement</td>
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<td></td>
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</tr>
<tr>
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</tbody>
</table>
Interactive Retrieval and User Interfaces
Strategic Support
Proactivity in IR Systems

Daffodil desktop
Daffodil: Search Continuation

- proposal based on automatic analysis of the current search result
- case-based reasoning
- availability of suggestions indicated as button at the bottom of result list window
Daffodil: Search Continuation

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- case-based reasoning
- availability of suggestions indicated as button at the bottom of result list window
Daffodil: Search Continuation 2

- suggestions displayed as ranked list
- descriptive title, explanation, success rate
- execute on or more suggestions, with following feedback
- icons indicate the state of suggestions: (executable, used, useful)
**Daffodil: Search Continuation 2**

- suggestions displayed as ranked list
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Evaluation of search suggestions

- 24 test subjects, half of them w/ suggestion component
- each subject worked on 3 tasks
- case base contained 30 different suggestions

Results:
supported users
  - are more content with the search process \( p = 0.067 \)
  - are significantly more satisfied with the result
  - find more relevant documents
  - use significantly more often Daffodil’s advanced search tools
(unsupported users mainly restrict on reformulating queries)
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From Cognitive Models to IR Interfaces

- Session support in the user interface
- Design Patterns for Search Modes
Session Support

- Term completion and query expansion
- Search as you type
- Show results together with the query
- Allow editing of the previous query
- Show search history
- Allow for combination of queries
- Filing of single results
- Storing of sessions
Term completion and query expansion
Interactive Retrieval and User Interfaces
From Cognitive Models to IR Interfaces
Session support in the user interface

Search as you type

[Information Retrieval](https://de.wikipedia.org/wiki/Information_Retrieval) (IR) bzw. Informationsrückgewinnung, gelegentlich ungenau Informationsbeschaffung, ist ein Fachgebiet, ...
Anwendungsbereich - Geschichte - Grundbegriffe - Relevanz und Pertinenz

Information retrieval - Wikipedia, the free encyclopedia
[Information retrieval](https://en.wikipedia.org/wiki/Information_retrieval) is the activity of obtaining information resources relevant to an information need from a collection of information resources. Searches can be ...
Interactive Retrieval and User Interfaces
From Cognitive Models to IR Interfaces
Session support in the user interface

Show results together with the query

The Universal Digital Library
Million Book Collection

Enter any word in the book title. e.g. Operas
Show results together with the query

Click on book title to view more details about it.

Search matched 8 books with 2618 pages
Show results together with the query

**Query**

- title = stemen retrieval in context

As HyREX query: 

```xml
   wsum(1.0,#PCDATA $title:stemen$ "retrieval",1.0,#PCDATA $title:stemen$ "ln",1.0,#PCDATA $title:stemen$ "context")
```

**Results**

100 documents found, 100 documents displayed (with PIRE)

Massimo Melucci (2008).

   A Basis for Information Retrieval in Context. *ACM Transactions on Information Systems* 26(3)

Boicho Kokinov; Daniel C. Richardson; Thomas R. Roth-Berghofer; Laure Vieu (eds.) (2007).


Giuseppe Atardi; Sergio Di Marco; Davide Salvi (1998).

   Categorisation by Context. *Journal of Universal Computer Science* 4(9)

Peter Ingwersen (2000).

Allow editing of the previous query
Allow for combination of queries

Results: 1 to 20 of 283422

   PMID: 21732552 [PubMed - as supplied by publisher]

2. Kim YM, Cho HS, Jung GY, Park JM.
   PMID: 21732330 [PubMed - as supplied by publisher]
**Filing of single results**

- **Quantitative dissection of the simple repression input-output function.**
  Garcia HG, Phillips R.
  Proc Natl Acad Sci U S A. 2011 Jul 5. [Epub ahead of print]
  PMID: 21730194 [PubMed - as supplied by publisher]

- **Functional prokaryotic-eukaryotic chimera from the pentameric ligand-gated ion channel family.**
  Proc Natl Acad Sci U S A. 2011 Jul 5. [Epub ahead of print]
  PMID: 21730130 [PubMed - as supplied by publisher]
Filing of single results

**Clipboard: 7** Remove all items

1. **In vivo post-translational modifications of recombinant mussel adhesive protein in insect cells.**
   Lim S, Kim KR, Choi YS, Kim DK, Hwang D, Cha HJ.
   PMID: 21732552 [PubMed - as supplied by publisher]
   Remove from clipboard

2. **Engineering the pentose phosphate pathway to improve hydrogen yield in recombinant Escherichia coli.**
   Kim YM, Cho HS, Jung GY, Park JM.
   PMID: 21732380 [PubMed - as supplied by publisher]
   Remove from clipboard

3. **Cell surface display of carbonic anhydrase on Escherichia coli using ice nucleation protein for CO(2) sequestration.**
Save sessions for continuing later

<table>
<thead>
<tr>
<th>Time</th>
<th>Database</th>
<th>Type</th>
<th>Term</th>
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</thead>
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<tr>
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<td>PubMed</td>
<td>record</td>
<td><em>In vivo post-translational modifications of recombinant...</em></td>
</tr>
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<td>Yesterday 1:48 PM</td>
<td>PubMed</td>
<td>search</td>
<td><em>(ehec virus) OR (escherichia coli)</em></td>
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<td>Yesterday 1:43 PM</td>
<td>PubMed</td>
<td>search</td>
<td><em>(escherichia coli treatment)</em></td>
</tr>
<tr>
<td>Yesterday 1:42 PM</td>
<td>PubMed</td>
<td>search</td>
<td><em>(escherichia coli symptoms)</em></td>
</tr>
<tr>
<td>Yesterday 1:41 PM</td>
<td>PubMed</td>
<td>search</td>
<td><em>Escheria coli</em></td>
</tr>
<tr>
<td>Yesterday 1:36 PM</td>
<td>PubMed</td>
<td>search</td>
<td><em>ehec virus</em></td>
</tr>
</tbody>
</table>
Design Patterns for Search Modes
Support for Marchionini’s search activities

[Marchionini 1995] [Beckers & Fuhr 12] [Russell-Rose & Tate 13]
Search Activities and Search Modes

- **Lookup**: (i) Locate, (ii) Verify, (iii) Monitor
  - Specified queries
  - No complicated examination of results required
- **Learn**: (i) Compare, (ii) Comprehend, (iii) Explore
  - Gaining knowledge, comprehension, comparisons, …
  - Processing and interpretation necessary
- **Investigate**: (i) Analyze, (ii) Evaluate, (iii) Synthesize
  - Analysing, synthesizing information
  - Searchers needs high knowledge level
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Lookup: Locating - Autocomplete
Lookup: Locating - Partial Matches

"nike leather sandals" did not match any products.

"nike leather sandals" (See all 7,232 results)

1. Reef Men's Reef Leather Slip-On Sandal
   - Buy new: £42.00 - £41.95
   - Eligible for FREE Super Saver Delivery.
   - 4.6 stars (1)

2. Birkenstock Milano Natural Leather, Unisex Sandals
   - Buy new: £50.56 - £83.56
   - Eligible for FREE Super Saver Delivery.
   - Only 1 left in stock - order soon.
   - 4.6 stars (2)

3. Birkenstock Milano Smooth Leather, Unisex Sandals
   - Buy new: £83.35 - £86.20
   - Eligible for FREE Super Saver Delivery.
   - Only 3 left in stock - order soon.
   - 4.6 stars (1)

"nike leather sandals" (See all 867 results)

1. Nike T-Lite 9 Leather Cross Training Shoes
   - Buy new: £29.95 - £49.96

2. Nike T-Lite 9 Leather Cross Training Shoes
   - Buy new: £24.95 - £45.90

3. 2011 Nike Club Inspired Swoosh Buckle Golf Belt NEW OUT
   - Buy new: £44.99 - £29.99

"nike leather sandals" (See all 34 results)
Lookup: Verifying - Instant Results

natural language processing
natural language
natural language interface
natural language processing jobs
natural language processing with python

About 4,930,000 results (0.24 seconds)

Scholarly articles for natural language processing
Natural language processing - Rustin - Cited by 53
Foundations of statistical natural language processing - Manning - Cited by 5753
Natural language processing - Joshi - Cited by 23

Natural language processing - Wikipedia, the free encyclopedia - 2 visits - 18 Mar
Natural language processing (NLP) is a field of computer science and linguistics concerned with the interactions between computers and human (natural) ...
History - NLP using machine learning - Major tasks in NLP - Statistical NLP en.wikipedia.org/wiki/Natural_language_processing - Cached - Similar

NLP - 2 visits - 13 Apr
A very large group of NLP researchers headed by Yorick Wilks. Topics include architectures for NLP, NL Analysis (esp. IE), Dialogue, NLP Resources and Tools ...
nlp.shef.ac.uk/ - Cached - Similar

Natural Language Toolkit - 2 visits - 18 Mar
Open source Python modules, linguistic data and documentation for research and development in natural language processing and text analytics, ...
www.nltk.org/ - Similar
Lookup: Verifying - Detail Overlay
Product Comparison

Here are the products you have to compare:

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Price</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model GTWN4450MWS</td>
<td>$599.00/EA-Eacl</td>
<td>Free Shipping</td>
</tr>
<tr>
<td>Model GTWN4000MWS</td>
<td>$479.00/EA-Eacl</td>
<td>Free Shipping</td>
</tr>
<tr>
<td>Model WM39074W</td>
<td>$1,599.00/EA-Eacl</td>
<td>Free Shipping</td>
</tr>
<tr>
<td>Model ATWN4475XQ</td>
<td>$298.00/EA-Eacl</td>
<td>Free Shipping</td>
</tr>
</tbody>
</table>

Comparing - Parallel Views

Thomson Reuters Corporation (Public, TSE:TRI) [Watch this stock]

38.04
+0.13 (0.34%)

May 30 - Close
TSE data delayed by 15 mins - Disclaimer
Currency in CAD

Compare: [Enter ticker here] Add [S&P TSX] [TRI] [MHP] [more]

Zoom: 1d 5d 1m 3m 6m VT D 1y 5y 10y All

Nov 19, 2010 - May 25, 2011
NYT -3.39% IRI +1.01%
Learn: Exploring: Autosuggest
Learn: Exploring - Faceted Search

DATABASE: Library of Congress Online Catalog

Guided Search Tips

1. **Optional** -- Set Search Limits before following the steps below.
2. **Search**: Enter a word, several words, or a phrase in the box.
3. From the following drop-down menu, select all of these, any of these or as a phrase ("all of these" is the default, and is highly recommended).
4. **As**: Select an Index Name from the drop-down menu (Note: Number Searches are also available).
5. From the following radio buttons, select AND, OR, or NOT (boolean operators) to add more information to the search (see Boolean Searching help page for assistance).
6. Repeat steps 2, 3 and 4 to refine your search further by using the last set of fill-in blanks and...
Interactive Retrieval and User Interfaces

Learn: Exploring - Faceted Search
Learn: Comprehending - Facet Menus
Learn: Comprehending - Facet Menus
Interactive Retrieval and User Interfaces
From Cognitive Models to IR Interfaces
Design Patterns for Search Modes

Investigate: Analyzing - Alternate Views
Investigate: Analyzing - Data Visualization
Summary
Interactive PRP for analysis and design of IIRS

Information seeking behavior vs. searching

Cognitive models:
- search as iterative process
- large variation in search tasks
- search influenced by many factors

Systems:
- strategic support through high-level search functions (especially for typical cognitive actions)
- proactive support

User interface design based on cognitive models
Summary

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M. J. Bates.
The design of browsing and berrypicking techniques for the online search interface.

Marcia J. Bates.
Where should the person stop and the information search interface start?

Thomas Beckers and Norbert Fuhr.
Search system functions for supporting search modes.
In *2nd European Workshop on Human-Computer Interaction and Information Retrieval (EuroHCIR) @ IliX 2012*, August 2012.

N. J. Belkin.
Anomalous states of knowledge as a basis for information retrieval.


N. Fuhr.

Marti A. Hearst.
_Search User Interfaces_.

P. Ingwersen.
_Information Retrieval Interaction_.
URL http://www.db.dk/pi/iri/.

P. Ingwersen.
Polyrepresentation of information needs and semantic entities, elements of a cognitive theory for information retrieval interaction.
References IV

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*The turn: integration of information seeking and retrieval in context.*  
ISBN 140203850X.

Sascha Kriewel and Norbert Fuhr.  
Adaptive search suggestions for digital libraries.  

Sascha Kriewel and Norbert Fuhr.  
An evaluation of an adaptive search suggestion system.  

Lokman I. Meho and Helen R. Tibbo.  
Modeling the information-seeking behavior of social scientists: Ellis’s study revisited.  
ISSN 1532-2882.  
doi: http://dx.doi.org/10.1002/asi.10244.
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ISBN 1-58113-844-X.  
Conference Chair-Feldman, Stuart and Conference Chair-Uretsky, Mike and Program Chair-Najork, Marc and Program Chair-Wills, Craig.

Daniel M. Russell, Diane Tang, Melanie Kellar, and Robin Jeffries.  
Task behaviors during web search: The difficulty of assigning labels.  

Tony Russell-Rose and Tyler Tate.  
*Designing the Search Experience: The Information Architecture of Discovery*.  
André Schaefer, Matthias Jordan, Claus-Peter Klas, and Norbert Fuhr. 
Active support for query formulation in virtual digital libraries: A case study with DAFFODIL.

Vu T. Tran and Norbert Fuhr.
Using eye-tracking with dynamic areas of interest for analyzing interactive information retrieval.

Andrew H. Turpin and William Hersh.
Why batch and user evaluations do not give the same results.