XML retrieval & IIR

IN4325 – Information Retrieval

Assignment 5: How to find a topic

Google scholar | mobile search

Scholar | Articles and patents | anytime | include citations | Create email alert

A large scale study of wireless **search** behavior: Google **mobile search**
M Kamvar… - Proceedings of the SIGCHI conference on Human …, 2006 - dl.acm.org
Abstract We present a large scale study of **search** patterns on Google's **mobile search** interface. Our goal is to understand the current state of wireless **search** by analyzing over 1 Million hits to Google's **mobile search** sites. Our study also includes the examination of ...
Cited by 143 - Related articles - TU Delft SFX linking - BL Direct - All 22 versions

FaThumb: a facet-based interface for **mobile search**
AK Karlson, GG Robertson, DC Robbins… - Proceedings of the …, 2006 - dl.acm.org
Abstract In this paper we describe a novel approach for searching large data sets from a **mobile** phone. Existing interfaces for **mobile search** require keyword text entry and are not suited for browsing. Our alternative uses a hybrid model to de-emphasize tedious keyword ...
Cited by 74 - Related articles - TU Delft SFX linking - BL Direct - All 24 versions

Deciphering trends in **mobile search**
M Kamvar… - Computer, 2007 - ieeexplore.ieee.org
Abstract Understanding the needs of **mobile search** will help improve the user experience and increase the service's usage. An analysis of **search** data from a large US carrier showed that cell-phone subscribers are typing longer queries in less time and clicking on more ...
Cited by 52 - Related articles - BL Direct - All 26 versions

Computers and iphones and **mobile** phones, oh my!: a logs-based comparison of **search** u different devices
M Kamvar, M Kellar, R Patel… - Proceedings of the 18th …, 2009 - dl.acm.org
Abstract We present a logs-based comparison of **search** patterns across three platforms: computers, iPhones and conventional **mobile** phones. Our goal is to understand how **mobile search** users differ from computer-based **search** users, and we focus heavily on the ...
Cited by 62 - Related articles - TU Delft SFX linking - All 21 versions

Who, what, where & when: a new approach to **mobile search**
K Church… - Proceedings of the 13th international conference …, 2008 - dl.acm.org
Abstract **Mobile** devices and the **mobile** Internet represent an extremely challenging **search** environment. Limited screenspace, restricted text-input and interactivity, and impatient users all conspire to exacerbate the shortcomings of modern Web **search**. Recently researchers ...
Cited by 28 - Related articles - TU Delft SFX linking - All 3 versions

Mobile search for a black hole in an anonymous ring
S Dobrev, P Flocchini, G Prencipe… - Distributed Computing, 2001 - Springer
We address the problem of **mobile** agents searching a ring network for a highly harmful item, a black hole, a stationary process destroying visiting agents upon their arrival. No observable trace of such a destruction will be evident. The location of the black hole is not ...
Cited by 45 - Related articles - All 6 versions

Mobile search for a black hole in an anonymous ring
S Dobrev, P Flocchini, G Prencipe… - Algorithmica, 2007 - Springer
Abstract In this paper we address the problem of **mobile** agents searching for a highly harmful item (called a black hole) in a ring network. The black hole is a stationary process that destroys visiting agents upon their arrival without leaving any observable trace of ...
Cited by 37 - Related articles - BL Direct - All 21 versions

[PDF] A study of **mobile search** queries in Japan
R Baeza-Yates, G Dupret… - Proceedings of the International …, 2007 - ra.ethz.ch
ABSTRACT In this paper we study the characteristics of **search** queries on **mobile** phones in Japan, comparing them with previous results of generic **search** queries in Japan and **mobile search** queries in the USA. We confirm some results while find some interesting ...
Cited by 26 - Related articles - View as HTML - All 9 versions

A large scale study of European **mobile search** behaviour
K Church, B Smyth, K Bradley… - … **mobile** devices and services, 2008 - dl.acm.org
Abstract Recent evidence suggests that **mobile search** is becoming an increasingly important way for **mobile** users to gain access to online information, especially as off-portal content continues to grow rapidly. In this paper we study the characteristics of **mobile** ...
Cited by 31 - Related articles - TU Delft SFX linking - All 7 versions

Query suggestions for **mobile search**: understanding usage patterns
M Kamvar… - Proceedings of the twenty-sixth annual SIGCHI …, 2008 - dl.acm.org
Abstract Entering **search** terms on **mobile** phones is a time consuming and cumbersome task. In this paper, we explore the usage patterns of query entry interfaces that display suggestions. Our primary goal is to build a usage model of query suggestions in order to ...
Cited by 23 - Related articles - TU Delft SFX linking - All 18 versions

MOBILE SEARCH SUBSTRING QUERY COMPLETION
J Ramer, A Soroca… - US Patent App. 11/382,226, 2006 - Google Patents
In embodiments of the present invention improved capabilities are described for **mobile search** substring query entry completion, wherein complete **search** terms are presented to a user in response to a **search** query that is not a fully formed query.
Cited by 32 - Related articles - All 2 versions

[PDF] SocialSearchBrowser: a novel **mobile search** and information discovery tool
K Church, J Neumann, M Cherubini… - Proceedings of IUI, 2010 - karenchurch.com
ABSTRACT The **mobile** Internet offers anytime, anywhere access to a wealth of information to billions of users across the globe. However, the **mobile** Internet represents a challenging information access platform due to the inherent limitations of **mobile** environments, ...
Cited by 22 - Related articles - View as HTML - All 6 versions

Evaluating interfaces for intelligent **mobile search**
K Church, B Smyth… - … accessibility (W4A): Building the **mobile** …, 2006 - dl.acm.org
Abstract Recent developments in the **mobile** phone market have led to a significant increase in the number of users accessing the **Mobile** Internet. Handsets have been improved to support a diverse range of content types (text, graphics, audio, video etc.), infrastructure ...
Cited by 22 - Related articles - TU Delft SFX linking - All 12 versions

Assignment 5: How to find a topic

- Too wide: Mobile search
- Too narrow: Comparison of the typing speed of male Blackberry users in their fifties in the Netherlands and Southern Germany
- About right: Comparison of the search behaviors of mobile phone users in Europe and South America
- Start with a broad keyword (‘mobile search’) on Google Scholar, browse through the first pages and try to cluster the papers into different sub-topics
  - Pick one of the sub-topics as your topic

Today

- A catch-up lecture: important aspects of IR we so far had no time to cover
- XML retrieval
- A look at the challenges of interactive IR

XML retrieval

Sources:

- **Introduction to Information Retrieval** by Manning et al. (Chapter 10)
- **XML Retrieval** by Mounia Lalmas, 2009

IR systems vs. databases

	RDB search	Unstructured retrieval
objects	records	unstructured documents
model	Relational model	VSM, LM, etc.
main data structure	table	inverted index
queries	SQL	free text quries

What about semi-structured documents? ➔ structured retrieval

IR systems vs. databases

	RDB search	Unstructured retrieval	Structured retrieval
objects	records	unstructured documents	trees with text at leaves
model	Relational model	VSM, LM, etc.	?
main data structure	table	inverted index	?
queries	SQL	free text quries	?

Examples: digital libraries, patent databases, blogs, tagged texts, etc.

Ignoring the document structure means ignoring its semantics.

(Semi-)structured retrieval

- Idea: run queries which combine textual and structural criteria

- Examples
  - Give me full-length **articles** on fast fourier transforms
  - Give me patents whose **claims** mention RSA public key encryption and that **cite** US patent 4,405,829
  - Give me articles about sightseeing tours of the **Vatican** and **Coliseum** (entity-tagged text)

- Goal: adapt ranked retrieval methods to structured documents
  - Hypothesis: improved precision over unstructured retrieval (semantics taken into account)

XML

- XML: Extensible Markup Language
- Most widely used standard for structured text
- Data-centric vs. text-centric
  - Most XML applications are data-centric (mostly non-text data, encoding of relational data)
  - In IR: a small amount of XML, text data and inverted index-based methods

XML retrieval vs. field-based retrieval

Recall: BM25F

```
<page>
        <title>Anarchism</title>
        <id>12</id>
        <comment>
                /* External links */ partial reversion - we don't
                link to forums per [[WP:EL]]
        </comment>
        <text xml:space="preserve">
                '''Anarchism''' is a [[political philosophy]] encompassing
                theories and attitudes which support the elimination of all …
        </text>
</page>
```

XML retrieval vs. field-based retrieval

Recall: BM25F

- Map the structured collection into unstructured space with modified term frequencies: combine original term frequencies in the different fields in a weighted manner

```
<page>
        <title>Anarchism</title>
        <text xml:space="preserve">
                '''Anarchism''' is a [[political
                philosophy]] encompassing
                theories and attitudes which
                support the elimination of all …
        </text>
</page>
```

```
<page>
        Anarchism Anarchism Anarchism Anarchism
        '''Anarchism''' is a [[political philosophy]] encompassing
        theories and attitudes which support the elimination
        of all …
        '''Anarchism''' is a [[political philosophy]] encompassing
        theories and attitudes which support the elimination
        of all …
</page>
```

$$w(title)=4,\ w(body)=2$$

XML retrieval vs. field-based retrieval

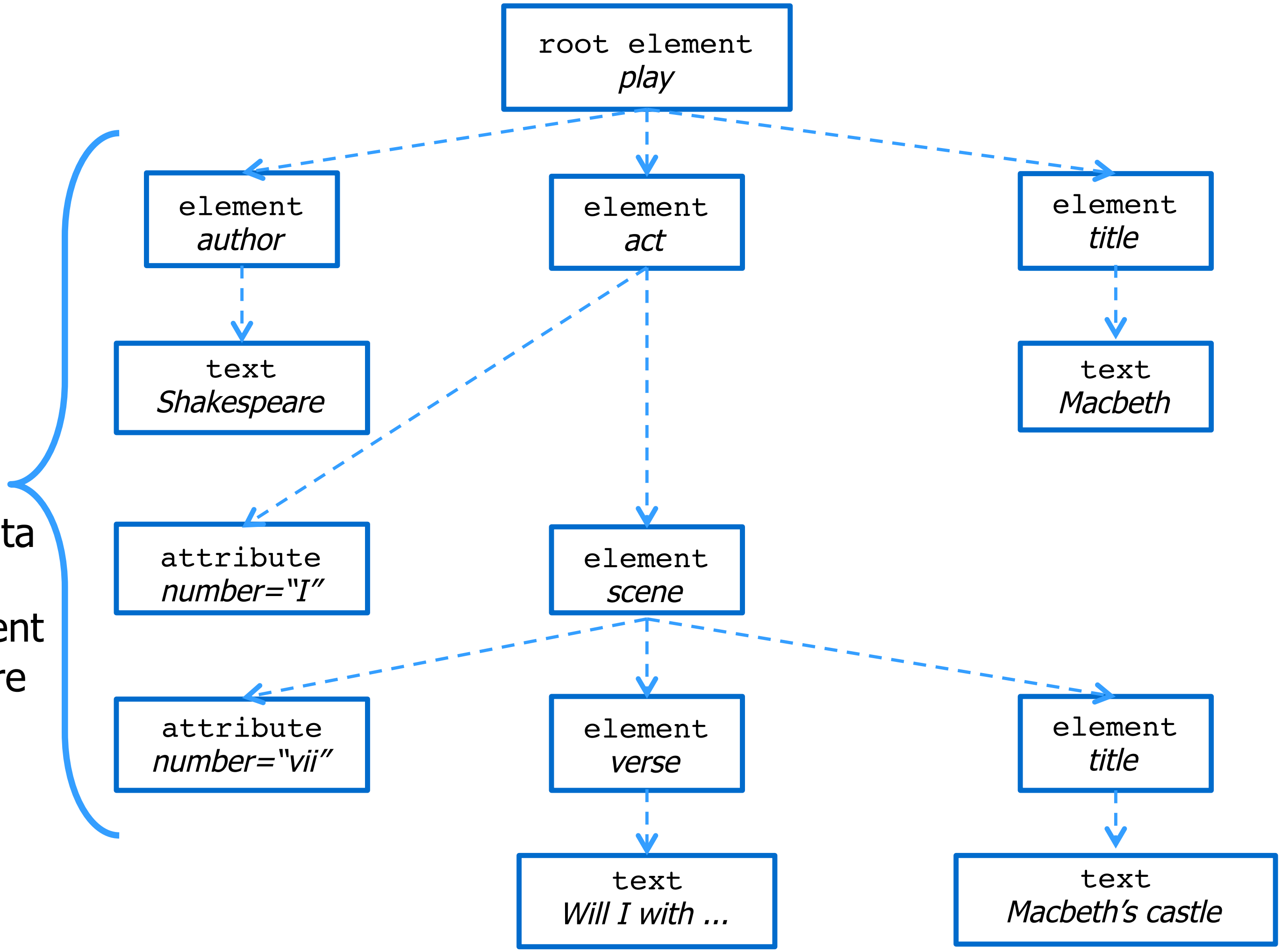
- Field-based retrieval: flat data model per document, no nested attributes

title	id	comment	text

- XML retrieval: nested elements

```
<play>
        <author>Shakespeare</author>
        <title>Macbeth</title>
        <act number="I">
                <scene number="vii">
                        <title>Macbeth's castle</title>
                        <verse>Will I with wine and wassail …. </verse>
                </scene>
        </act>
</play>
```

Simplified XML DOM



internal nodes: metadata & document structure

ordered, labeled tree

node: XML element

leaf nodes contain text

Querying XML

- Content constraints
  - Word constraints
    - “I want a document on XML retrieval evaluation”
  - Context constraints
    - “information and retrieval within 4 terms”
  - Weight constraints
    - “0.6 xml 0.2 retrieval”

common IR

- Structural contstraints
  - “I want a section discussing **XML retrieval evaluation** contained in a chapter discussing **evaluation initiatives**”

Structural contstraint types

- Specification of the target result
  - If the structure is known to the user, he can specify which component is the target of his search (e.g. retrieval based on the abstract of papers or just the title of papers)

- Specification of a support condition
  - "I want a section discussing XML retrieval evaluation **from documents with abstracts about evaluation initiatives**"

- Result construction
  - "I want to retrieve the title of a section, **with its first and last paragraph grouped together into one fragment**"

Classification of XML query languages

- Content only (unstructured keyword query)
- Content-and-structure
  - Tag-based languages
  - Path-based languages
  - Clause-based languages

increase of complexity & expressiveness

- Tag-based (e.g. XSEarch)
  - Intuitive, easy to learn, lacks expressiveness
  - Does not include support conditions or result construction

```
section: xml retrieval
```

Classification of XML query languages

- Path-based (e.g. XPath, XIRQL, NEXI)
  - Based on XPath
  - include the document structure in the query
  - Do not allow result construction
  - NEXI example

“retrieve sections on *xml retrieval* in documents about *information retrieval*”

```
//document[about(.,information retrieval)]
     //section[about(.,xml retrieval)]
```

target

support

result

- Clause-based (e.g. XQuery)

```
for $x in /document/section
       where $x/title=“xml retrieval”
       return $x
```

“retrieve sections with the title *xml retrieval*”

XPath

- XPath: XML Path language
- Defined by the W3C in 1999
- Primary purpose: to access & navigate to components of XML documents
- Contains basic string matching facilities

- Location path (series of navigation steps in XML)
  - `book/publisher/@isbn` where @ indicates an attribute and `publisher` is a direct child node of `book`
  - `book//title` navigates to all title elements that are *directly or indirectly* below the `book` element (`//title` selects all `title` elements)
  - Self-step (`.//book`) and parent step (`../publisher`)

XPath

- **Wildcards** are used to navigate to elements and attributes with any name (`book/*` and `book/publisher/@*`)
- Specified **predicates** must be satisfied for the elements to be selected (`//book[@year=2000]/title`)
  - Pre- or post-filtering of result nodes based on attributes
- **Existential** predicates check whether a path expression returns a non-empty result (`//publisher[city]`)
- **Positional** predicates are used to navigate according to the position of an element in the document tree (`//publisher/country[1]/city`)

XPath

- Instead of ancestor/descendant movements, more **complex navigation** steps are also possible
  - E.g. navigation to all elements that follow the current element
- For content-oriented XML retrieval, the boolean function `contains()` is important (string matching)
- Result of XPath is not a ranked list, but a set of elements
- XPath has inspired other XML query languages of which some allow for the ranking of documents

NEXI

- NEXI: Narrowed Extended XPath I (developed at INEX)
- A simple query language for content-oriented XML retrieval
- Small but enhanced subset of XPath

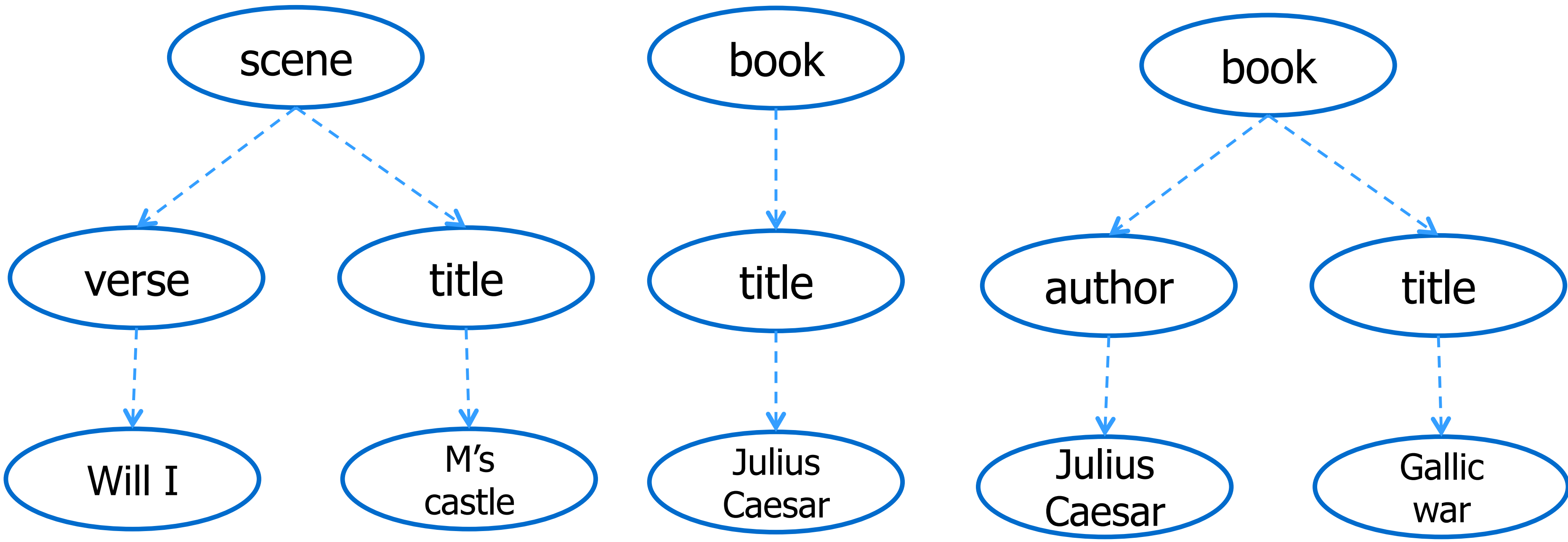
- New function `about()` replaces `contains()`
  - An element is about a topic, standard IR models
- Some XPath elements are removed (positional predicates)

```
//article[about(.//bdy,"information retrieval")]
       //section[about(.,xml) and about(.,retrieval)]
```

- Task of an XML retrieval system is to interpret NEXI queries
  - Structural constraints are processed by the query processing engine

Tree representation of documents and queries

attributes discarded,
element nodes remain



query-by-example

Challenges in XML retrieval

- Instead of returning `<play>` elements, parts of documents (`<scene>`, `<verse>`, etc.) should be returned
  - Depending on the query, different element types should be returned
  - Especially difficult for content-only queries (e.g. 'Macbeth' vs. 'Macbeth castle')

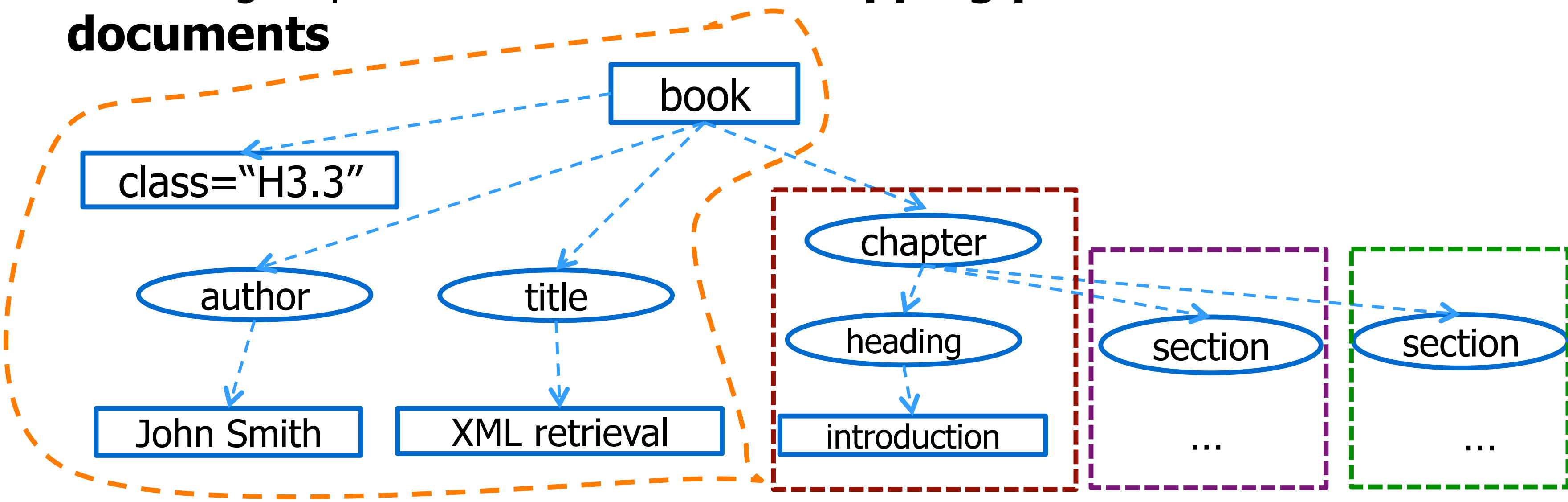
Structured document retrieval principle: A system should always retrieve the most specific part of a document answering the query.

Challenges in XML retrieval

Indexing units

- In unstructured retrieval: a document (a news article, an email, a Web page, …) is a unit
- In structured retrieval different strategies can be employed

- Idea 1: group nodes into **non-overlapping pseudo-documents**



Challenges in XML retrieval

Indexing units

- Idea 1: group nodes into **non-overlapping pseudo-documents**
  - Disadvantage: pseudo-documents may not make sense to the user (incoherent units)

- Idea 2: **top-down indexing**
  - index the largest elements (`<book>`, `<play>`,…)
  - Postprocess search results to find the best matching subelement
  - Problem: for many queries the relevance of a whole book/play is often not a good predictor of the relevance of small subelements within it (the play Macbeth vs. a book analysing the play)

Challenges in XML retrieval

Indexing units

- Idea 3: **bottom-up indexing**
  - Search all leaves, select the most relevant ones and then extend them to larger units in postprocessing
  - Issue: the relevance of a leaf element is often not a good predictor of the relevance of elements it is contained in
- Idea 4: **index all elements**
  - Many XML elements are not meaningful search results which can only be interpreted with surrounding context information
  - Search results will become highly redundant (query 'Macbeth's castle' will return `<play>, <act>, <scene>` and `<title>` elements)
  - Returning redundant nested elements is not user friendly

Challenges in XML retrieval

Indexing units

- Idea 4: **index all elements**
  - Search results will be highly redundant (query 'Macbeth's castle' will return `<play>, <act>, <scene>` and `<title>` elements)
- Restricting redundant results
  - Discard all small element
  - Discard all element types that users do not look at (query log based)
  - Discard all element types that assessors generally do not judge to be relevant (qrels necessary)
  - Only keep element types that a system designer or librarian has deemed to be useful search results
- Collapse several nested elements in the result list and use term highlighting (keeps the context)

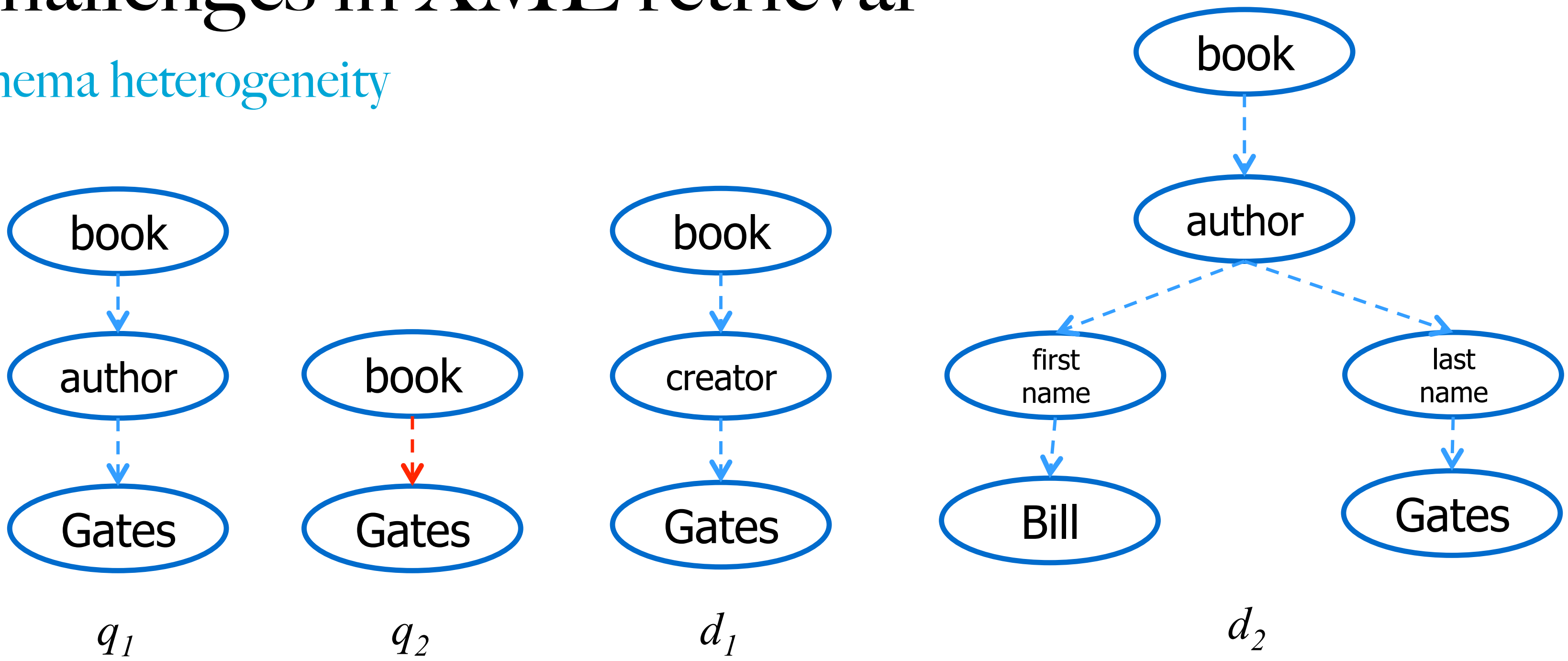
Challenges in XML retrieval

Term statistics

- To compute retrieval statistics (in particular IDF) we need to distinguish different contexts of a term
- Example: *Gates* under the node `<author>` is unrelated to an occurrence under a content node like `<section>` (it will mostly occur in the sense of plural of gate)
- Idea 1: compute IDF for XML-context/term pairs, i.e. compute different IDF weights for the different element types
  - Problem: sparseness, often no reliable estimate possible
- Idea 2: consider only the direct parent node of the term
  - Less problematic, few conflations of context (author vs company name)

Challenges in XML retrieval

Schema heterogeneity



- Different XML schemas often co-occur in a collection (documents come from several sources)
- Varying names for comparable elements (creator vs. author)
- Varying structural organization
- Strict tree matching: q_1 neither retrieves d_1 nor d_2 (although both are relevant) ➔ approximate matching of element names

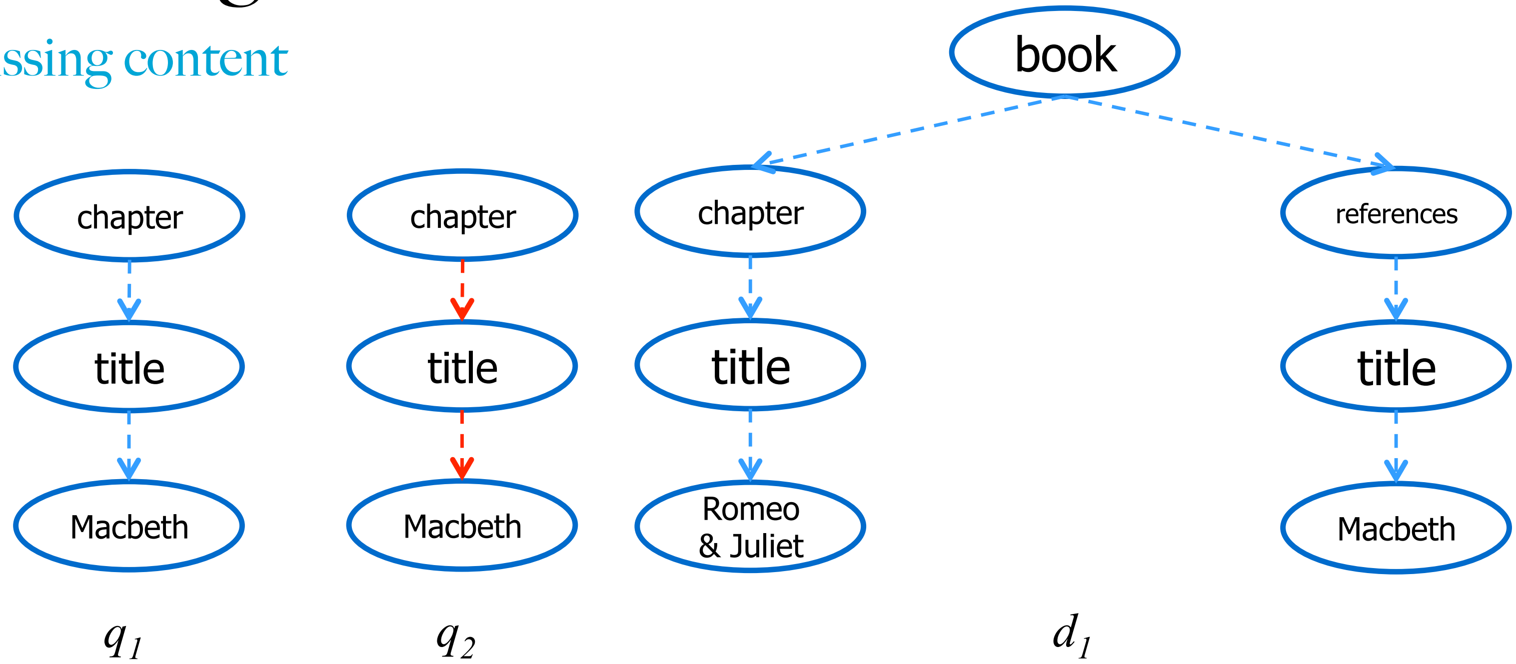
Challenges in XML retrieval

User familiarity

- Users often do not know the element names and the specific structure of the schemas in the corpus
- Interface design in XML retrieval is difficult
  - Exposing the entire schema places a high cognitive load on the user
  - Users are used to search boxes and keyword queries
- Idea: **extended queries**
  - Relaxed interpretation of parent-child relationships in the query (all parent-child relationships are transformed into descendant relationships with any number of intervening nodes)

Challenges in XML retrieval

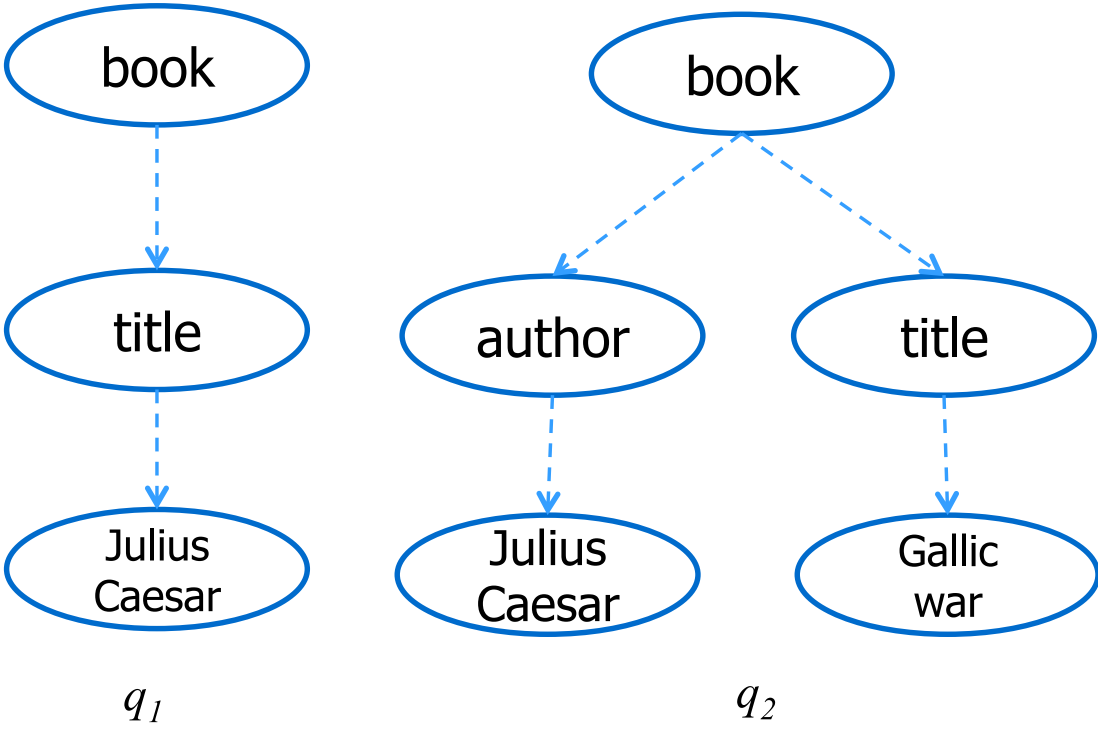
Missing content



- Neither the original nor extended query retrieve d_1
- If the result list is empty/small, further relax the user's structural constraints
  - Elements not matching the structural constraints should be ranked lower, not omitted completely

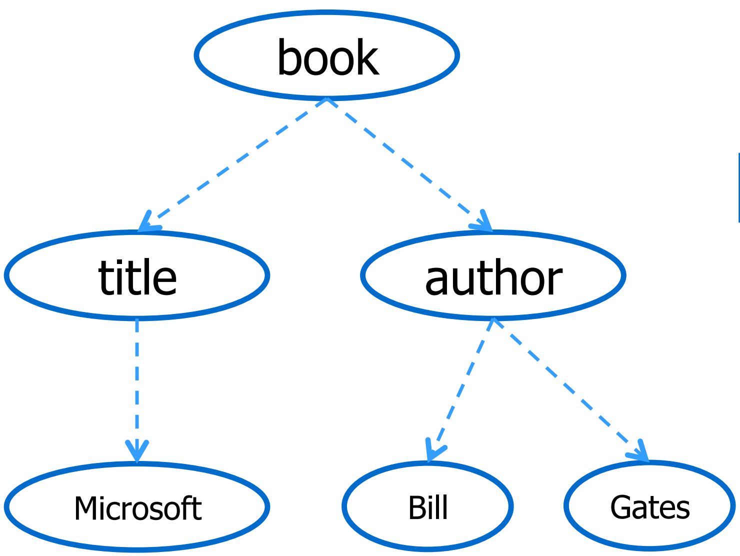
A vector space model for XML retrieval

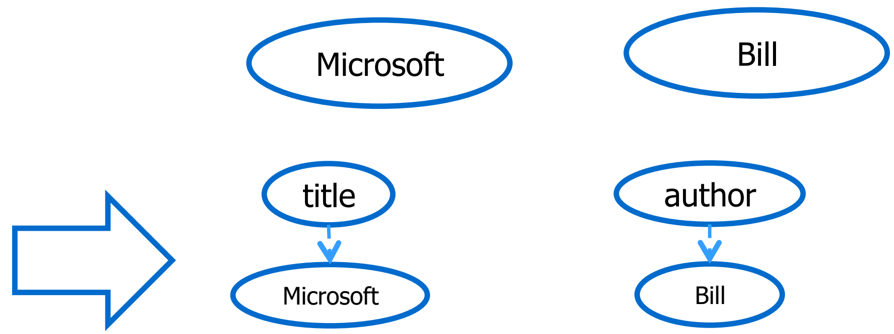
- A book with the title *Julius Caesar* should be a match for q_1 and a lower weighted match for q_2
- In the unstructured VSM, a single dimension exists for term *Caesar*
- In XML retrieval, we need to separate the title word *Caesar* from the author name *Caesar*

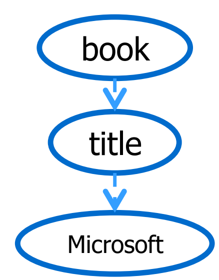


A vector space model for XML retrieval

- Idea: each dimension in the vector space encodes a term together with its position within the XML tree
- Queries and documents are transformed into the space of lexicalized subtrees (makes partial structural matches possible)







...

lexicalized subtrees: each one contains at least 1 vocabulary term

A vector space model for XML retrieval

- Trade-off: space dimensionality and effectiveness of the retrieval engine
- One dimension per term ➔ standard VSM
  - Many documents will be retrieved that do not match the structure of the query
- One dimension for each lexicalized subtree occurring in the corpus ➔ high-dimensional space
- Compromise: index all paths that end in a single vocabulary term

- Structural term:

$$\langle c,t \rangle: \text{ a pair of XML-context } c \text{ and vocabulary term } t$$

A vector space model for XML retrieval

- User queries are treated as extended queries
  - Preference given to documents matching the query structure closely (fewer additional nodes)

- Context resemblance: similarity between document and query path

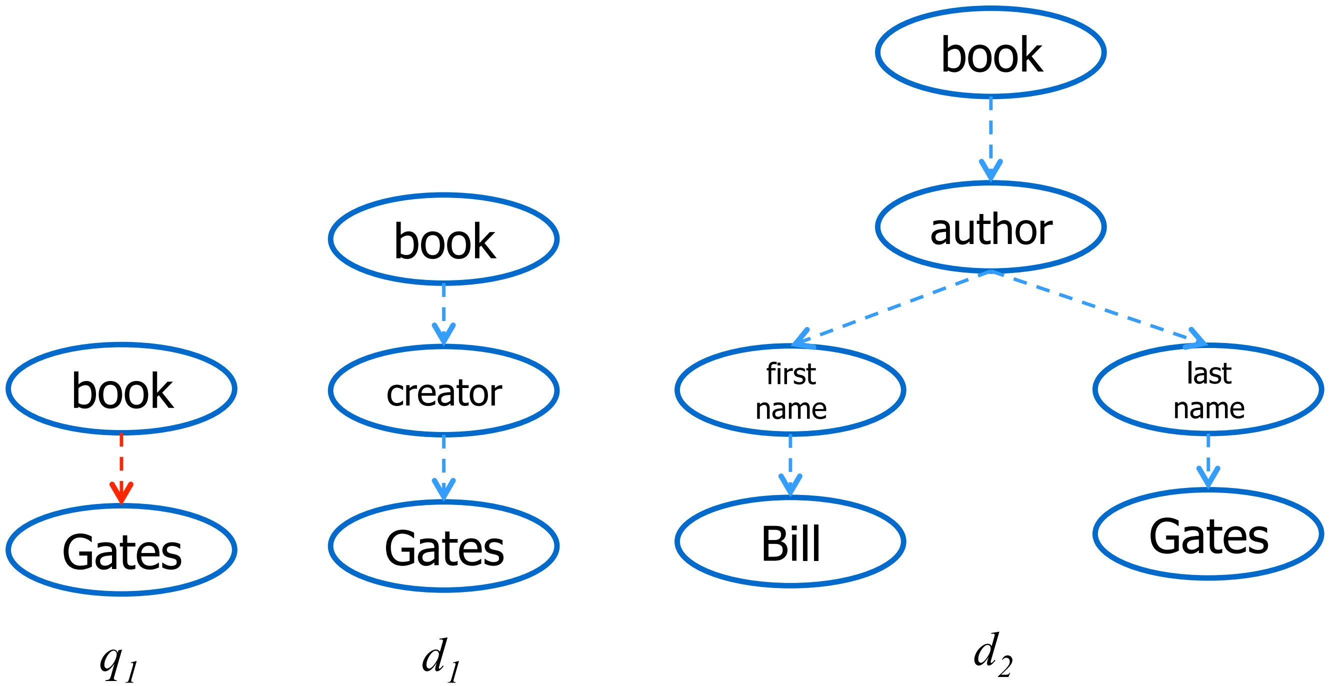
$$CR(c_q, c_d) = \begin{cases} \dfrac{1+|c_q|}{1+|c_d|} & \text{if } c_q \text{ can be transformed into } c_d \\ 0 & \text{otherwise} \end{cases}$$

#nodes in the query/document path

A vector space model for XML retrieval

Context resemblance

$$CR(c_{q_1}, c_{d_1}) = 3/4$$
$$CR(c_{q_1}, c_{d_2}) = 3/5$$



A vector space model for XML retrieval

From context resemblance to RSV

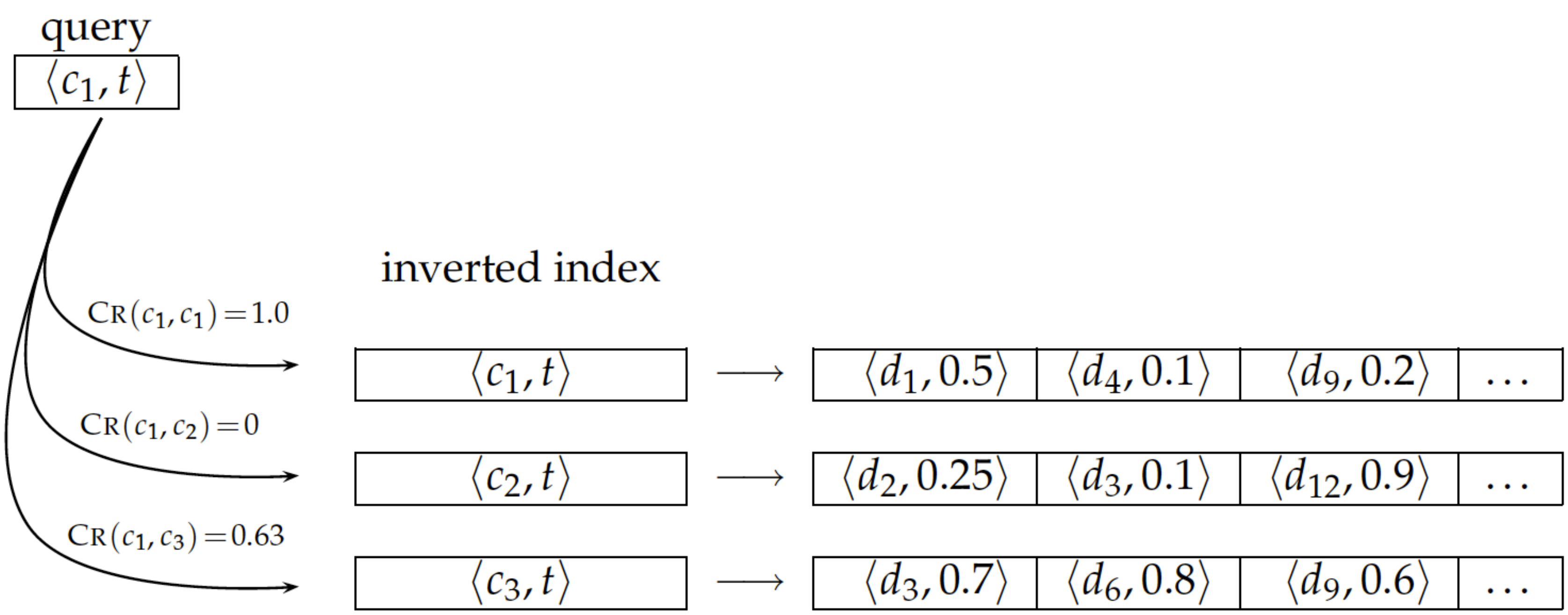
- For a given query, the retrieval score for a document is a variant of the cosine similarity measure

$$\mathrm{SIMNOMerge}(q,d) = \sum_{c_k \in B} \underbrace{\sum_{c_l \in B}}_{B\text{: set of all XML contexts}} CR(c_k,c_l) \sum_{t \in V} \underbrace{w}_{w\text{: weight of term } t}(q,t,c_k) \frac{w(d,t,c_l)}{\boxed{\sqrt{\sum_{c \in B, t \in V} w(d,t,c)^2}}}$$

document length normalization

A vector space model for XML retrieval

Scoring of a query with one structural term (SIMNOMERGE)



- Retrieve all posting lists with vocabulary term t
- Different XML contexts are kept separate for the purposes of weighting

A vector space model for XML retrieval

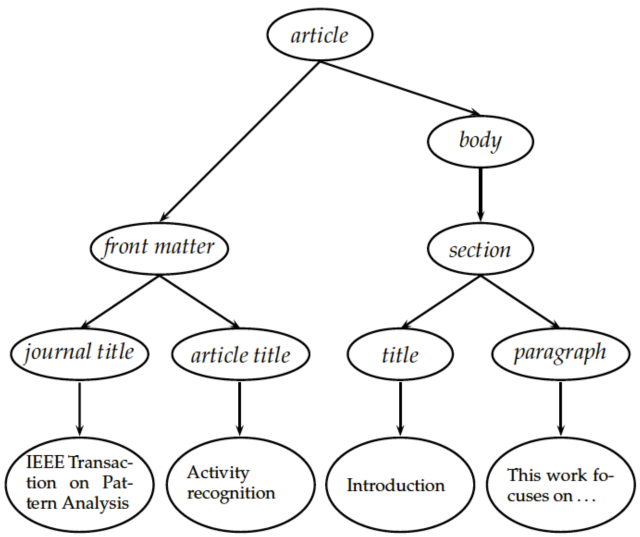
From context resemblance to RSV

- SIMMerge: relaxes the matching conditions of queries and documents
  - Collect the statistics to compute the weights from all contexts with a non-zero resemblance to c
  - Merge all structural terms in the document with a non-zero context resemblance to a given query structural term

- Relaxed conditions alleviate the sparseness problem of the term statistics
  - Increased robustness of the matching function against poorly posed structural queries

Evaluation of XML retrieval

- INEX: Initiative for the Evaluation of XML retrieval
- INEX 2002: 12,000 articles from IEEE journals



Time of article publication	1995-2002
Av. #XML nodes per document	**1,532**
Av. node depth	6.9
COS topics (content only)	30
CAS topics (content & structure)	30

Image source: **Introduction to IR** by Manning et al.

Evaluation of XML retrieval

CAS topic example

```
<inex_topic topic_id="76" query_type="CAS">
<title>
//article[(./fm//yr='2000' OR ./fm//yr='1999') AND about
(.,'"intelligent transportation system"')]//sec[about
(.,'automation +vehicle')]
</title>
<description>
Automated vehicle applications in articles from 1999 or 2000
about intelligent transportation systems.
</description>
<narrative>
To be relevant, the target component must be from an article
on intelligent transportation systems published in 1999 or
2000 and must include a section which discusses automated
vehicle applications, proposed or implemented, in an
intelligent transportation system.
</narrative>
</inex_topic>
```

Evaluation of XML retrieval

- Relevance assessments: more complicated than in unstructured retrieval
- 2 orthogonal dimensions of relevance in INEX 2002: component coverage & topical relevance

- Component coverage: is the retrieved element structurally correct
  - Exact coverage (E): the information sought is the main topic of the component & the component is a meaningful unit of information
  - Too small (S): the information sought is the main topic, but the component is not meaningful
  - Too large (L): the information sought is present but not the main topic
  - No coverage (N): the information sought is not a topic of the component

Evaluation of XML retrieval

- Topical relevance
  - Highly relevant (3), Fairly relevant (2)
  - Marginally relevant (1), Non-relevant (0)

- Retrieved components are judged on both dimensions
  - 2S: fairly relevant component which is too small
  - 3E: highly relevant component with exact coverage

$$Q(\text{rel},\text{cov}) = \begin{cases} 1.00 & \text{if } (\text{rel},\text{cov}) = \text{3E} \\ 0.75 & \text{if } (\text{rel},\text{cov}) \in \{\text{2E},\text{3L}\} \\ 0.50 & \text{if } (\text{rel},\text{cov}) \in \{\text{1E},\text{2L},\text{2S}\} \\ 0.25 & \text{if } (\text{rel},\text{cov}) \in \{\text{1S},\text{1L}\} \\ 0.00 & \text{if } (\text{rel},\text{cov}) = \text{0N} \end{cases}$$

Evaluation of XML retrieval

- Number of relevant components in the retrieved set A of components

$$\#(\text{relevant items retrieved}) = \sum_{c \in A} Q(rel(c), \text{cov}(c))$$

- Standard definitions (precision, recall) can now be applied

- Comparison of SIM(NO)MERGE on CAS topics

	MAP
SIMNOMERGE	0.242
SIMMERGE	0.271

(fewer structural constraints)

Evaluation of XML retrieval

Structured vs. unstructured retrieval

- Comparison of COS and CAS topics in INEX 2003/2004

	Content only (LM)	Full structure	%change
prec@5	0.2000	0.3265	+63.3%
prec@10	0.1820	0.2531	+39.1%
prec@20	0.1700	0.1796	+5.6%
prec@30	0.1527	0.1531	+0.3%

ranks elements that satisfy structural constraints higher than elements that do not

- Structured retrieval performs well for precision-oriented tasks

Interactive information retrieval

Sources:

- **Method for evaluating interactive information retrieval systems with users** by Diane Kelly, 2009
- **Relevance: a review of the literature and a framework for thinking on the notion in information science. Part II** by Tefko Saracevic, 2007
- **Query length in interactive information retrieval** by NJ Belkin et al., 2003

Example research questions in IIR

- How do people re-find information on the Web?
- What Web browser functionalities are currently being used during Web-based information-seeking tasks?
- What are the differences between written and spoken queries in terms of their retrieval characteristics and performance outcomes?
- What is the relationship between query box size and query length? What is the relationship between query length and system performance?

System-centred vs. user-centred

- Up to now: query, query representation, document, document representation, query-document similarity, system, evaluation, Cranfield, pseudo-relevance feedback, ….
- But what about the user?
  - The user’s interactions with the search system?
  - The user’s impression of the system performance?
  - The usability of the system?

Interactive IR: users are studied along with their interactions with systems and information

System-centred vs. user-centred

- Classic IR: does the system retrieve relevant documents?
- Interactive IR: can people use this system to retrieve relevant documents?
- IIR draws inspiration from different fields
  - Tradtional IR
  - Psychology
  - Human-computer interaction

Assumptions of system-centered IR

Precision & recall as measures

- All documents in the system are known
  - Valid for small corpora
- All documents can be judged in advance for their relevance to any given topic
  - Relevance is a static entity
- Users' relevance judgments are a single event purely based on the document's content

Relevance

Saracevic, 2007

"relevance is a tangled affair"

interacting layers

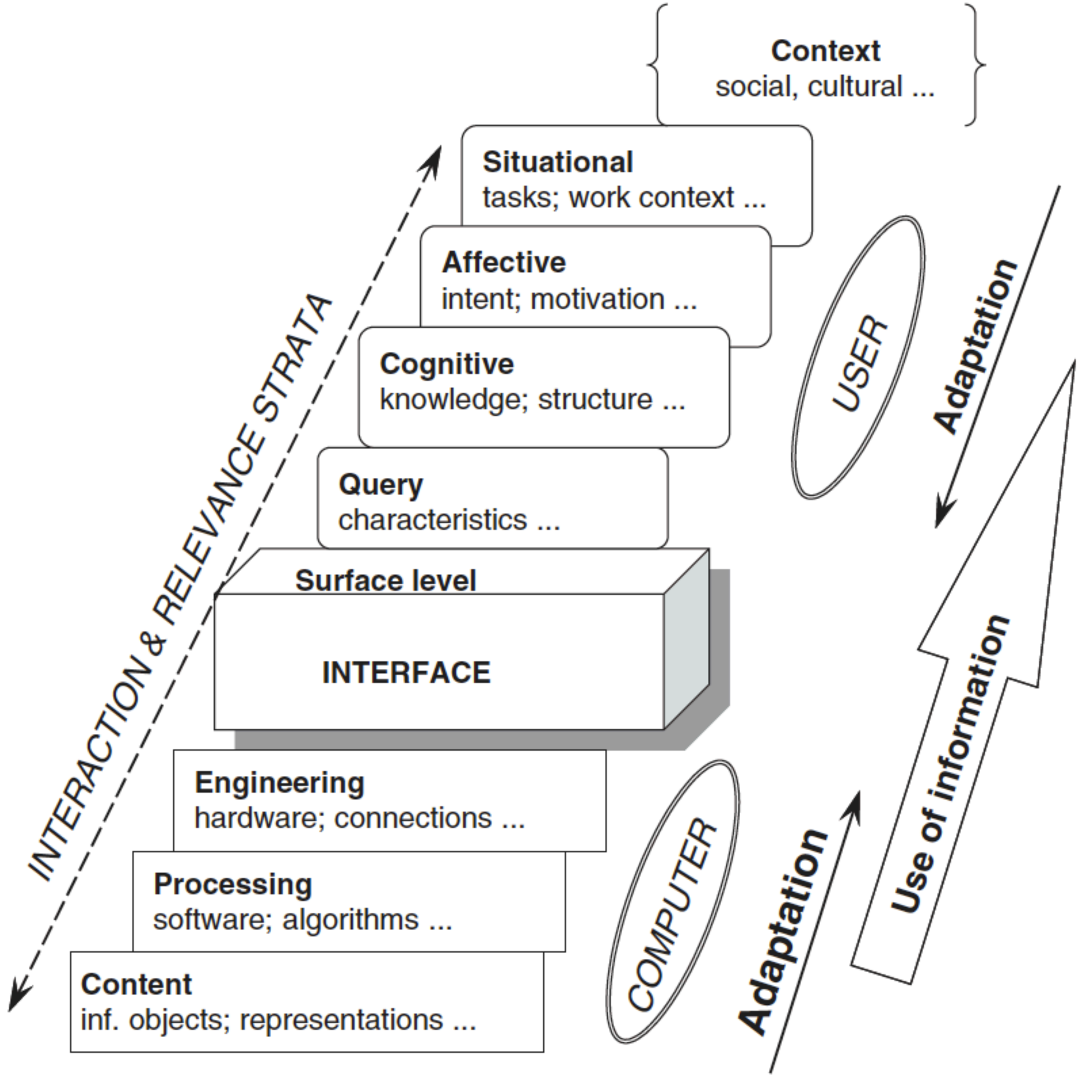


FIG. 1. Stratified model of relevance interactions.

Manifestations of relevance

Saracevic, 2007

- **System relevance**: relation between query and information objects (documents)
- **Topical relevance**: relation between the subject of the topic and the subject of the information objects
- **Cognitive relevance** (pertinence): relation between the cognitive state of the user and the information objects
  - Cognitive correspondence, novelty, information quality, etc.
- **Situational relevance** (utility): relation between the situation and the information objects
  - Appropriateness of information, reduction of uncertainty
- **Affective relevance**: relation between the intent, goals, emotions of the user and information
  - Success, accomplishment

The difficulty of IIR: an example

- First types of IR interactions were associated with relevance feedback
- Many difficulties inherent in IIR studies
  - From the same information need, users formulate different queries
  - Different queries lead to different search results
  - Different search results lead to different opportunities for relevance feedback
  - Different users provide different amounts of relevance feedback
  - Different relevance feedback amounts will yield different revised search results

Inferring cognitive activities

- Causes & consequences of these interactions in the user can only be observed indirectly
  - Actions are surrogates of cognitive activities
- A user saving a document might do so because it adds/changes his understanding of the information need
- A user might reformulate a query because of a better understanding of the information need or because of frustration about the 'wrong' results shown

Factors influencing user-system interactions

- Individual users have different cognitive compositions and behavioral dispositions
- Users vary in
  - How much they know about the topic
  - How motivated they are to search
  - (How much they know about searching)
  - How much they know about the particular search task
  - Their perceptions and expectations of an IIR study

- Difficult to create an experimental situation that all people will experience in the same manner
  - Makes it difficult to establish causality

The continuum of IIR research

TREC-style studies (systems, assessors, no real users, indexing)

system focus

"users" create qrels

filtering

lack of interaction and searching

log analysis (queries, descriptive studies, live tests)

archetypical IIR study

TREC-interactive studies (goal: better search support)

experimental information behavior

information seeking behavior with IR systems

information seeking behavior in context

human focus

The continuum of IIR research

- Experimental information behavior
  - Researcher controlls aspects of the search process that are typically not controlled (e.g. what results are retrieved in response to the query; in what order are the results retrieved)
  - Goal: isolate and study *individual* aspects of the search process
  - Outcome generally refers to search behavior instad of the system effectiveness

- Information seeking behavior with IR systems
  - No experimental systems, natural search behaviors of the users (usually not driven by system concerns)
  - E.g. re-finding strategies on the Web, search tactics, how do users assess relevance for their own search tasks

The continuum of IIR research

- Information seeking behavior in context
  - Focus on humans, their information needs and search behaviors
  - In what contexts does an information need arise?
    - E.g. diary study of TV watching users (what information needs arise?)
  - Without consideration for the IR system used
  - Researchers as observers, qualitative studies (e.g. interviews)

Cognitive viewpoint in IR

- Cranfield & TREC make simplifying assumptions about the users, their needs and behaviors
- Cognitive viewpoint embraces the complexity inherent in IR when users are involved (focus on cognitive activities)
- IIR models
  1. Stratified model of interactive IR (Saracevic 1997)
  2. Episodic model of IR (Belkin 1996)
  3. Interactive feedback and search process model (Spink 1997)
  4. Global model of polypresentation (Ingwersen 1996)

Laboratory vs. naturalistic studies

- Laboratory studies
  - Good in the terms of control the researcher has over the study situation
  - Criticism: too artificial, not representing real-life, limited generalizability
- Naturalistic studies
  - Examine IIR in the settings it occurs
  - Log-based studies fall into this category
  - Researcher has litle control over the setting, which makes cross-user comparisons difficult
  - Studies often have a longitudinal character

Wizard of Oz studies

- Researcher simulates the design he wants to study
- Instead of spending a lot of resources actually building the system, the users are made to believe to deal with the system, while the researcher orchestrates the system's replies
- A typical proof-of-concept approach

Query length in interactive IR

Belkin et al., 2003

- Facts
  - In standard IR, increased query length leads to increased system effectiveness (compare topic title vs. topic description runs)
  - In interactive IR systems (mostly Web search engines), the query length is rather short and between 1-3 terms
  - Approaches that increase the query length without user intervention (pseudo-relevance feedback) tend to perform well

- But I: no direct evidence that automatically-enhanced queries perform better in interactive IR

- But II: no evidence that longer queries obtained through searcher encouragement will lead to better performance in IIR

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Query length in interactive IR

Research questions and hypothesis

- RQ1: What can make searchers' query length in interactive IR longer, and will searchers find such techniques acceptable and usable?
  - H1: A search interface which asks searchers to describe their information problems at length will lead to longer queries than a standard search interface (keywords, search box).
- RQ2: Does query length affect any measures of performance or effectiveness in the search task?
  - H2: A system which encourages long queries will lead to better performance in the search task than one which does not.
  - H2: Query length will be positively correlated with performance in the search task

Query length in interactive IR

Study

- Baseline query elicitation mode (NQE): scrollable query entry box of five 40-character lines labeled "Query terms"
  - In the tutorial, subjects were told to enter they queries as lists of keywords
- Experimental query elicitation mode (QE): identical box labeled "Information problem description (the more you say, the better the results are likely to be)"
  - In the tutorial, subjects were told that they could enter their queries as multiple full sentences or questions
- 32 subjects each searching with 8 given topics (4 each in NEQ and QE mode); saved documents indicated relevance

Query length in interactive IR

Results

- QE and query length
  - QE mode: average query length: 6.45
  - NQE mode: average query length: 4.24
- Usability of QE (questionnaire, number of search iterations)
  - No significant difference in experienced difficulty between both modes
  - In QE mode the number of iterations per search (2.09) was significantly lower than in NQE mode (2.64)
- Topic familiarity: subjects that are more familiar with a topic enter longer queries than those subjects that are less familiar (questionnaire based)

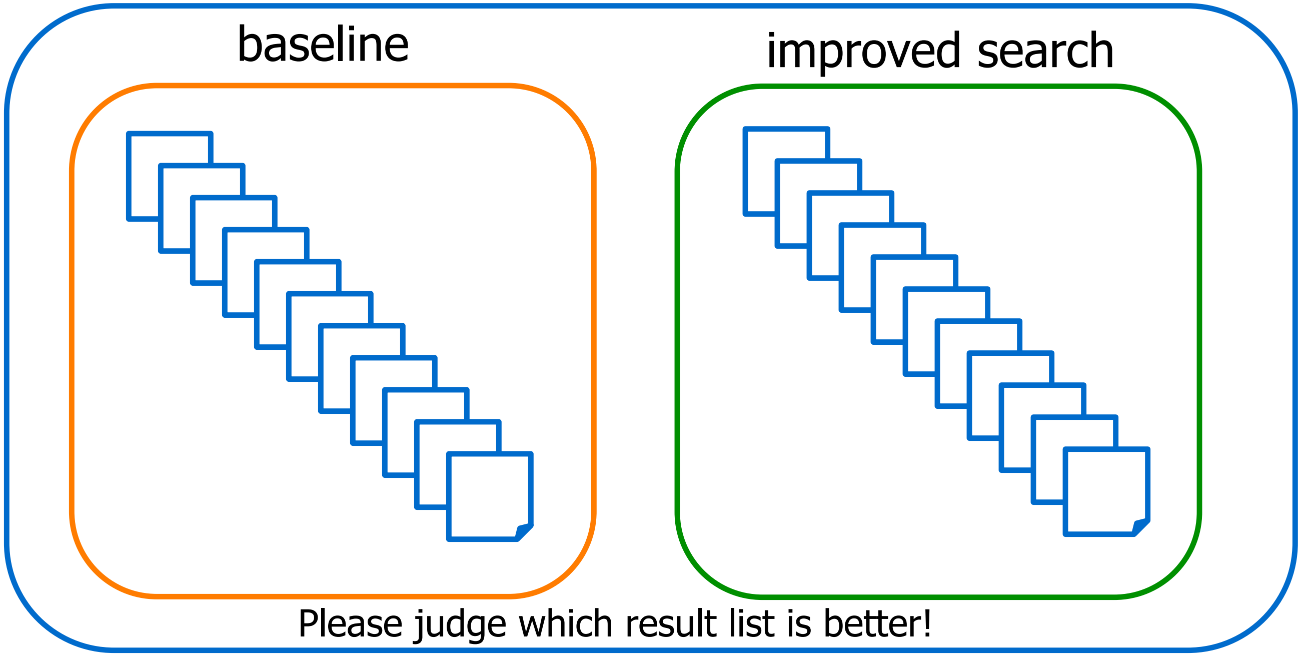
Query length in interactive IR

Results

- QE and performance
  - No significant difference in retrieval performance between QE and NQE
- Satisfaction of the users was higher in the QE setting (questionnaire, not stat. significant)
- Query length and performance: overall
  - No stat. significant difference found between query length and system effectiveness

An example IIR interface evaluation setup

Mistakes are easy to make



User study with 10 of your colleagues

All findings: invalid

Designing a good study is a big challenge in IIR research!

Summary

- XML retrieval
  - In a structured collection, XML retrieval can improve the precision-oriented retrieval effectiveness
- Interactive information retrieval
  - Focuses on the user
  - A number of cognitive models exist
  - IIR studies need to be designed with great care