Introduction to Entity Search

Web Science 2010/2011

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Topics

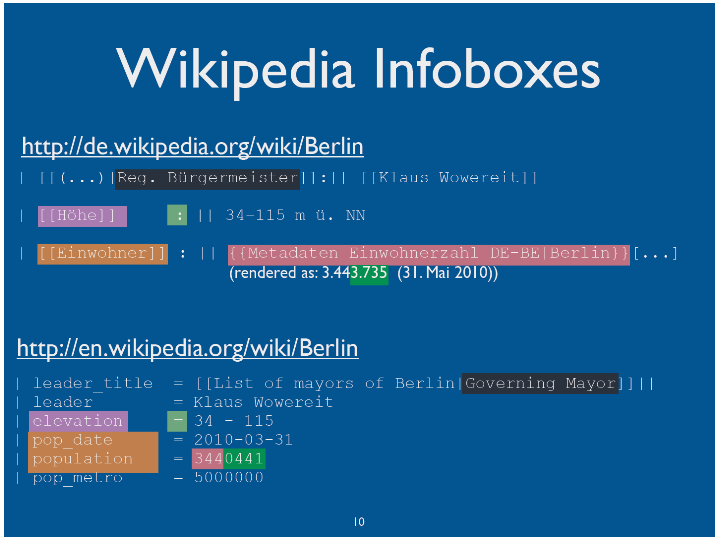
- 1. Information Integration
- 2. Web Information Retrieval
- **3. Entity Search**
- 4. Web Usage
- 5. Collaborative Web
- 6. Web Archiving
- 7. Medical Social Web

Outline

- From documents to entities
- Different Entity Search tasks
  - Entity Identification
    - Okkam
  - Expert Finding
    - In a company
  - Entity Ranking
    - In Wikipedia
    - On the Web
- Selected Papers

Entity Search

- Lecture 1: Entities



Wikipedia Infoboxes

http://de.wikipedia.org/wiki/Berlin

```
| [[(...)|Reg. Bürgermeister]]:|| [[Klaus Wowereit]]

| [[Höhe]]      : || 34-115 m ü. NN

| [[Einwohner]] : || {{Metadaten Einwohnerzahl DE-BE|Berlin}}[...]
```

(rendered as: 3.443.735 (31. Mai 2010))

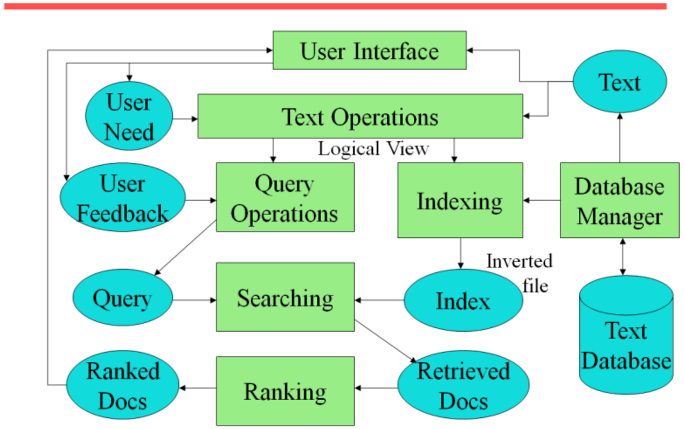
http://en.wikipedia.org/wiki/Berlin

```
| leader_title  = [[List of mayors of Berlin|Governing Mayor]]||
| leader        = Klaus Wowereit
| elevation     = 34 - 115
| pop_date      = 2010-03-31
| population    = 3440441
| pop_metro     = 5000000
```

10

- Lecture 2: Search

IR System Architecture



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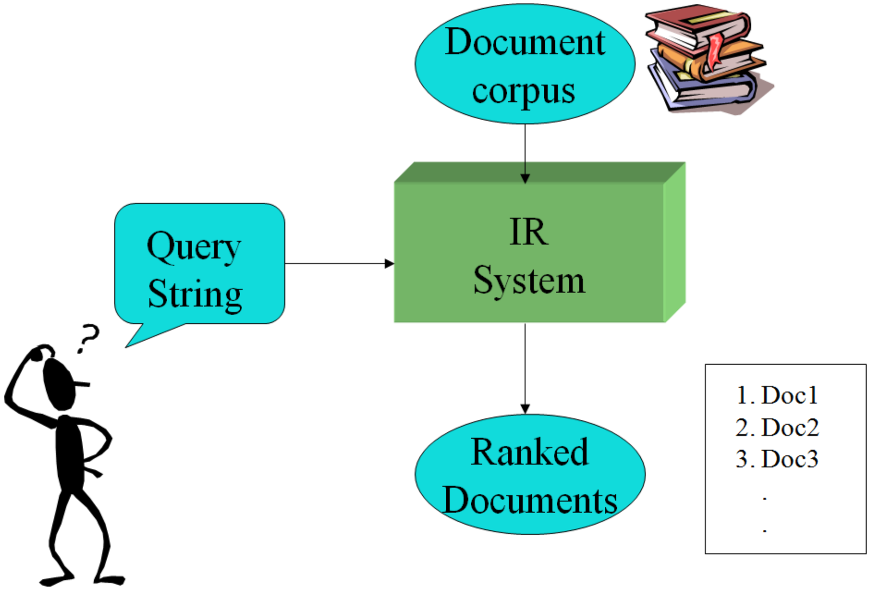
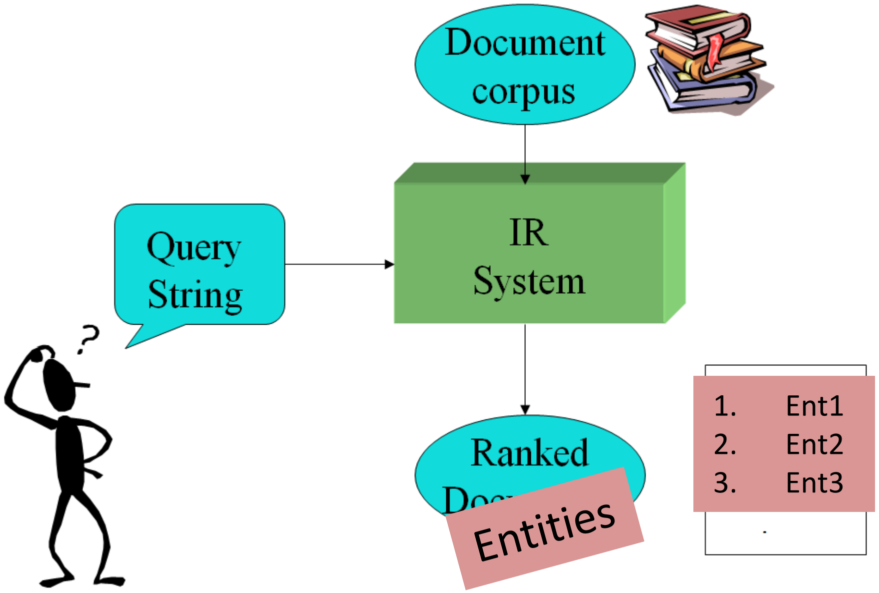
From Documents to Entities

- Document Search

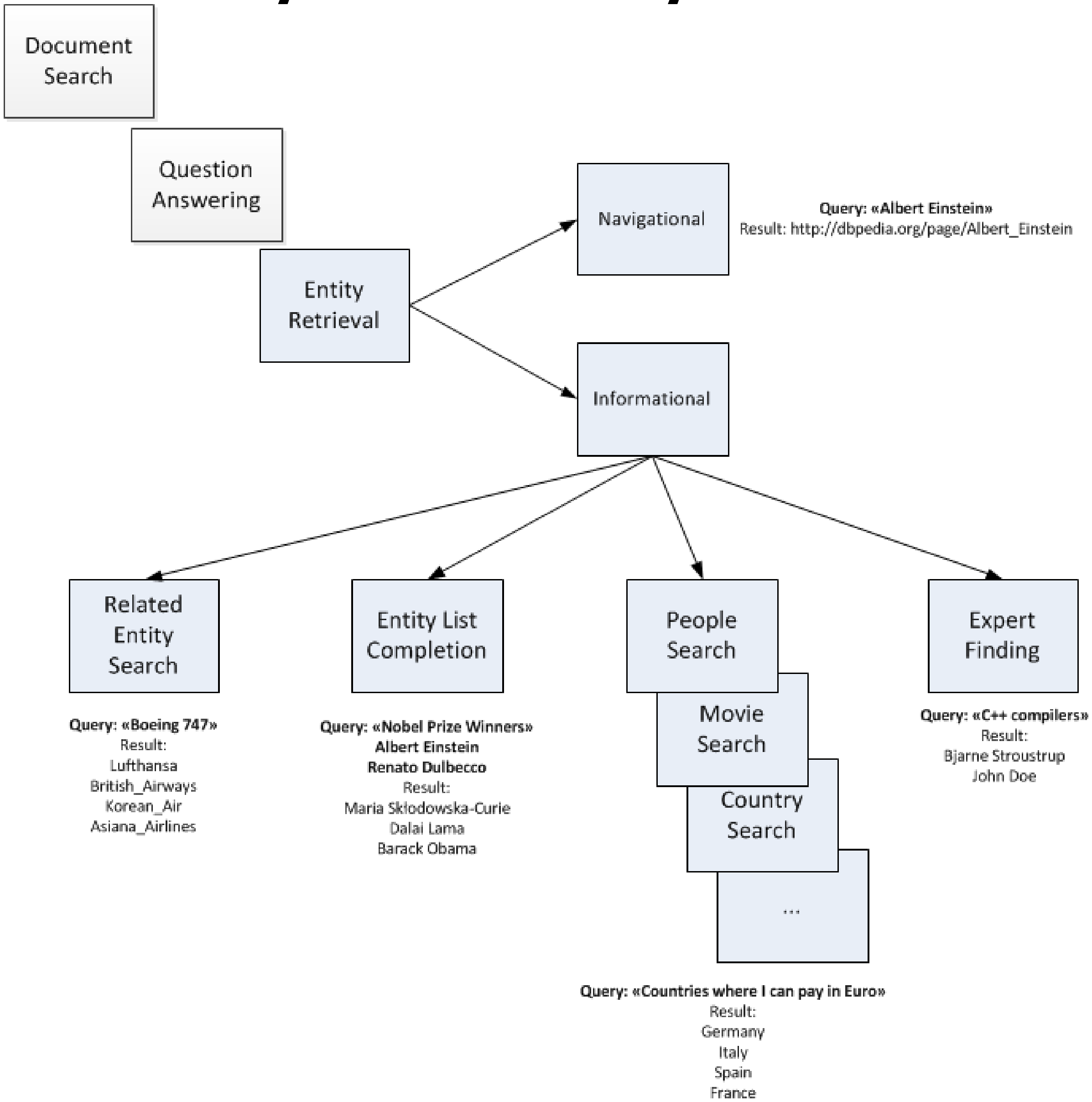


From Documents to Entities

- Entity Search



A taxonomy of Entity Search tasks



Query: «Albert Einstein»
Result: http://dbpedia.org/page/Albert_Einstein

Query: «Boeing 747»
Result:
Lufthansa
British_Airways
Korean_Air
Asiana_Airlines

Query: «Nobel Prize Winners»
Albert Einstein
Renato Dulbecco
Result:
Maria Skłodowska-Curie
Dalai Lama
Barack Obama

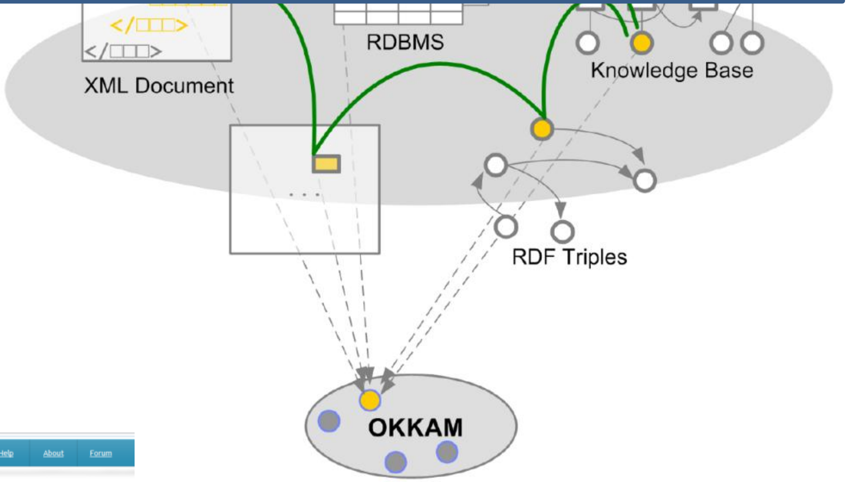
Query: «C++ compilers»
Result:
Bjarne Stroustrup
John Doe

Query: «Countries where I can pay in Euro»
Result:
Germany
Italy
Spain
France

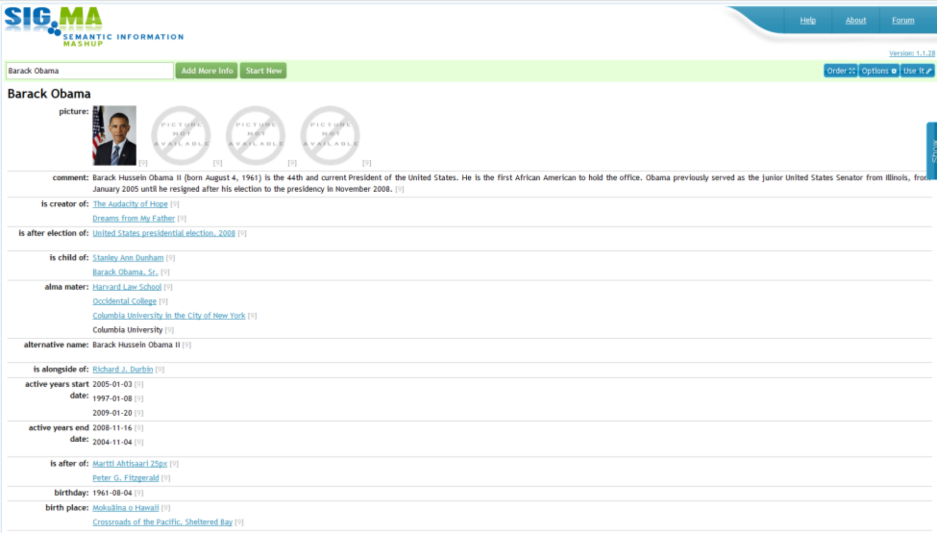
Entity Identification

An open and global service which can be used within existing applications to support the creators/editors of semantic web content to (re)use the same globally unique URI for **referring to the same entity in a systematic way**.

- – Okkam



- Sig.ma
  - – Building Entity Profiles



Barack Obama

Barack Obama

picture:	[9] [9] [9] [9]
comment:	Barack Hussein Obama II (born August 4, 1961) is the 44th and current President of the United States. He is the first African American to hold the office. Obama previously served as the junior United States Senator from Illinois, from January 2005 until he resigned after his election to the presidency in November 2008. [9]
is creator of:	The Audacity of Hope [9] Dreams from My Father [9]
is after election of:	United States presidential election, 2008 [9]
is child of:	Stanley Ann Dunham [9] Barack Obama, Sr. [9]
alma mater:	Harvard Law School [9] Occidental College [9] Columbia University in the City of New York [9] Columbia University [9]
alternative name:	Barack Hussein Obama II [9]
is alongside of:	Richard J. Durbin [9]
active years start date:	2005-01-03 [9] 1997-01-08 [9] 2009-01-20 [9]
active years end date:	2008-11-16 [9] 2004-11-04 [9]
is after of:	Martti Ahtisaari 25px [9] Peter G. Fitzgerald [9]
birthday:	1961-08-04 [9]
birth place:	Mokuāina o Hawaii [9] Crossroads of the Pacific, Sheltered Bay [9]

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    - Okkam
  - **Expert Finding**
    - In a company
  - Entity Ranking
    - In Wikipedia
    - On the Web
- Selected Papers

Expert Finding

- Scenario:
  - Executives need to create a team for a new project: find staff with the right expertise
  - Someone needs to solve a problem
- Goal:
  - Use the digital content available in the enterprise
  - Create a ranking of people who are experts in the given topic

Evidence of Expertise

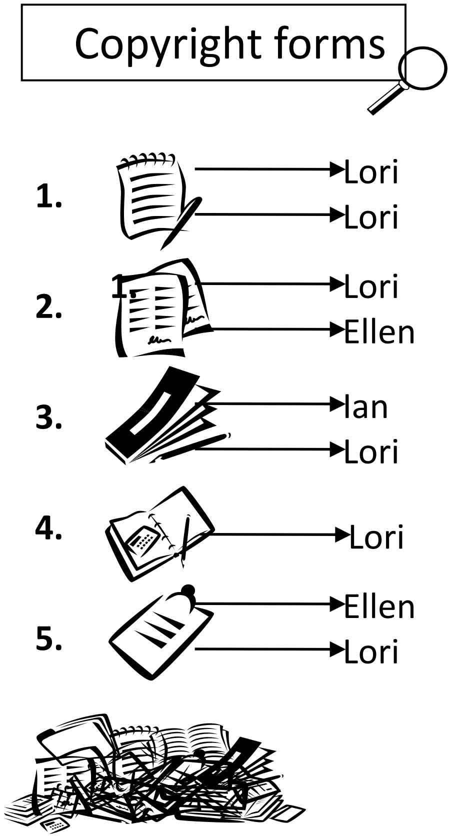
• Email or bulletin board messages	Content
• Corporate communications	
• Shared folders in file system	
• Resumes and homepages	
• Employee database	
• Email flow	Social networks
• Bibliographic information	
• Software library usage	
• Search and publication history	Activities
• Project time charges	

See also bibliography on TREC-ENT wiki:
http://www.ins.cwi.nl/projects/trec-ent/wiki/index.php/Bibliography

Two Basic Approaches

Who should I ask about the copyright forms?

- Document-based: rank docs, extract experts



Copyright forms

1. Lori
Lori

2. Lori
Ellen

3. Ian
Lori

4. Lori

5. Ellen
Lori

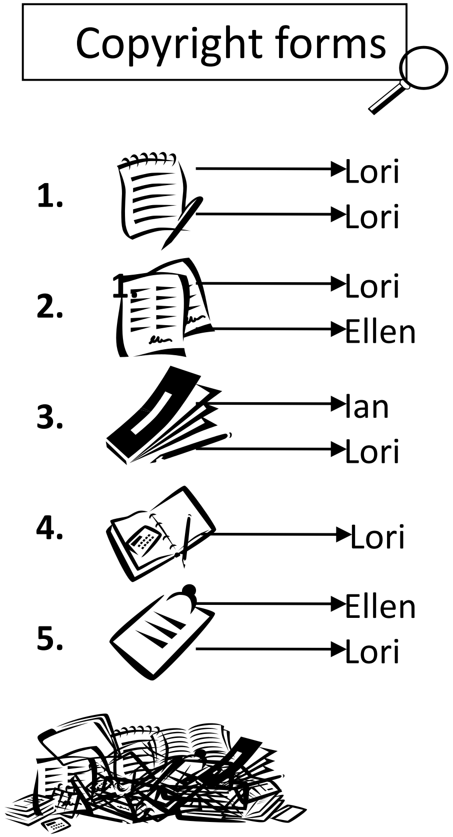
Document-based Expert Finding

- Find and score documents about the topic
  - Title about topic
  - Abstract about topic
- Aggregate scores for each distinct author

Two Basic Approaches

Who should I ask about the copyright forms?

- Document-based: rank docs, extract experts



Copyright forms

1. Lori
Lori

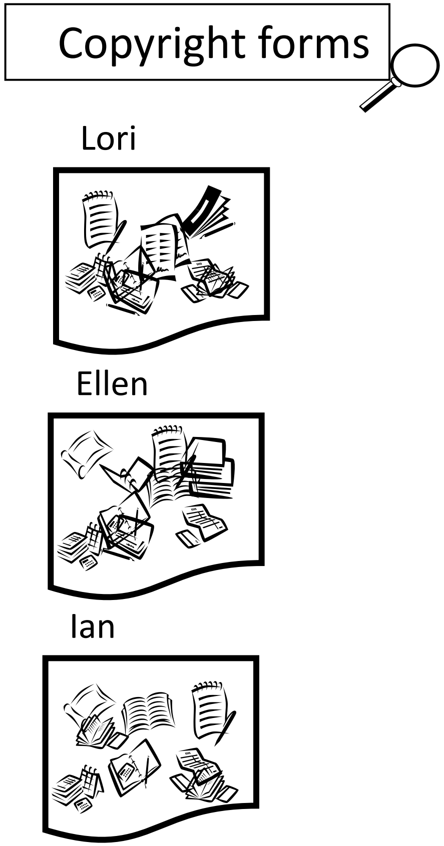
2. 1. Lori
Ellen

3. Ian
Lori

4. Lori

5. Ellen
Lori

- Candidate-based: rank candidate profiles



Copyright forms

Lori

Ellen

Ian

Additional Techniques

Research Systems

- Combine the two basic approaches
- Estimate the quality of the evidence
- Use of collection/structural knowledge
  - Treat emails different from documents
  - Treat email’s subject/sender/receiver different from body
  - Locate homepages
- Use social network extracted from co-authorship or email lists

See also TREC proceedings 2005-2007

Key Requirements

- **Identify** experts via self-nomination and/or automated analysis of expert communications, publications, and activities
- **Classify** the type and level of expertise of individuals and communities
- **Validate** the breadth and depth of expertise of an individual
- **Recommend** experts, including the ability to rank order experts on multiple dimensions including skills, experience, certification and reputation

Evaluating Expert Finding Systems

- TREC Enterprise track 2005-2008
  - http://www.ins.cwi.nl/projects/trec-ent/
- Standard test collection using
  - W3C website
  - CSIRO website
- Queries and manual relevance judgements
- Evaluation measures to compare systems

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Ranking…

- People
- Actors
- … Car companies

[i.e., insert your fav entity type here]

Entity Ranking!!!

Examples of *Entities* in Wikipedia

- Art museums and galleries
- Countries
- Famous people
- Monarchs of the British Isles
- Artists
- Magicians

Example Entity Ranking Scenarios

- Impressionist art museums in Holland
- Countries with the Euro currency
- German car manufacturers
- Artists related to Pablo Picasso
- Countries involved in WWI
- Actors who played Hamlet
- English monarchs who married French women

Many examples on http://www.ins.cwi.nl/projects/inex-xer/topics/

Entity Ranking

- Topical query Q
- Entity (result) type T_X
- A list of entity instances Xs

- An entity is represented by its Wikipedia page
- Systems employ categories, structure, links

Tasks

- Entity Ranking (ER)
  - Given Q and T, provide Xs
- List Completion (LC)
  - Given Q and Xs[1..m]
  - Return Xs[m+1..N]

Topic 60

Q

Title

olympic classes dinghy sailing

X_s

Entities

470 (dinghy) (#816578)
49er (dinghy) (#1006535)
Europe (dinghy) (#855087)

T_X

Categories

dinghies (#30308)

Description

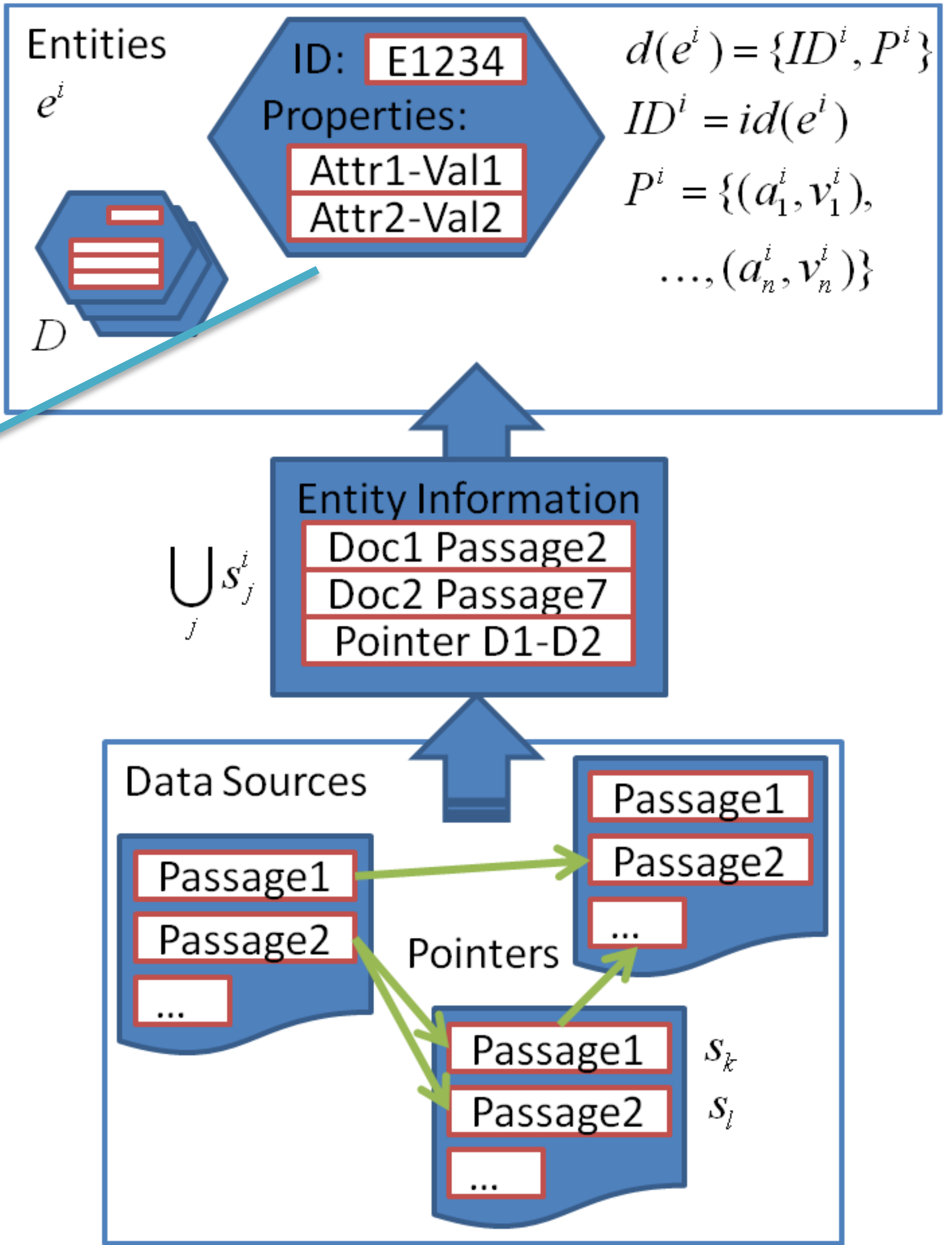
The user wants the dinghy classes that are or have been olympic classes, such as Europe and 470.

Narrative

The expected answers are the olympic dinghy classes, both historic and current. Examples include Europe and 470.

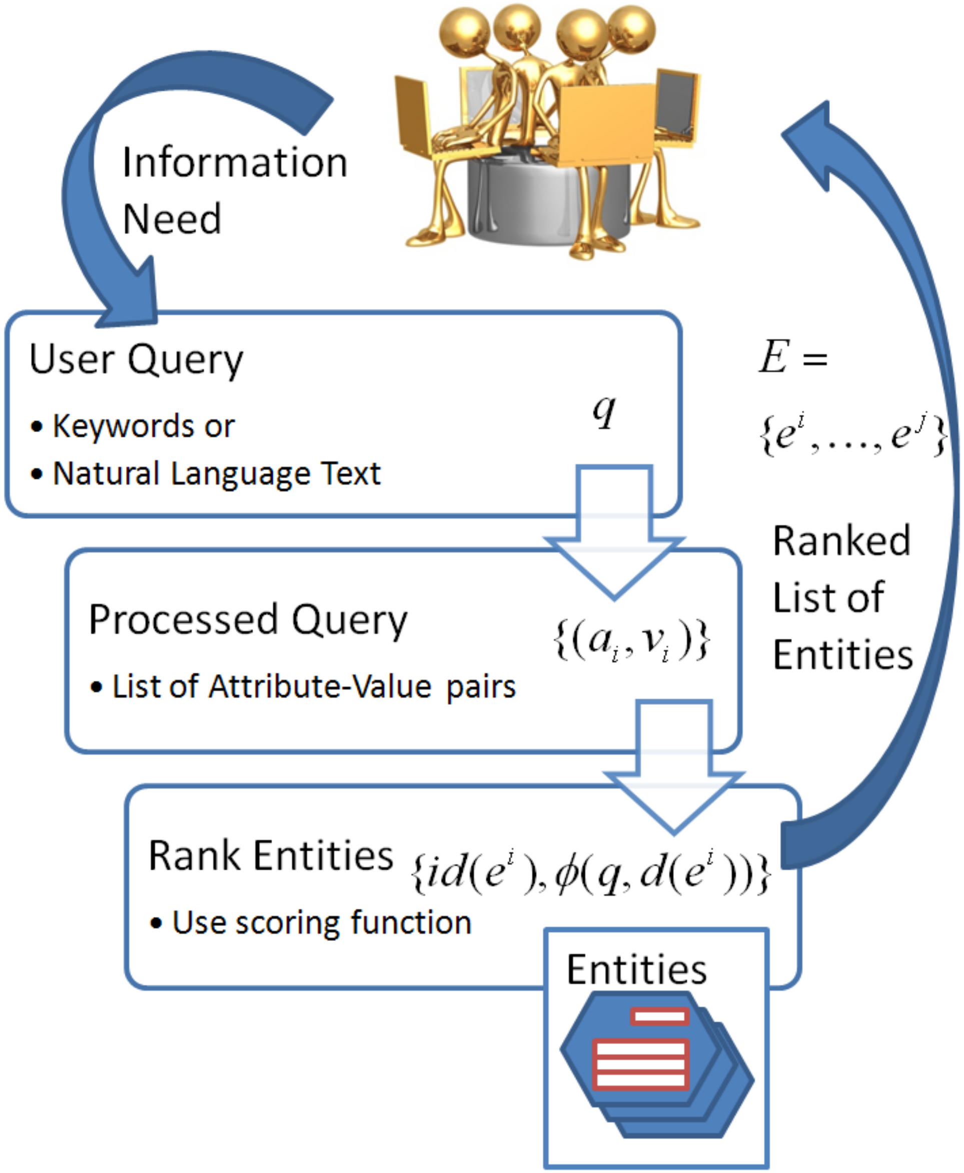
Formal Model for Entity Ranking

- Indexing
  - Entities
  - Data Sources



"Alexandre Pato"
ID: ap12dH5a
(born in; 1989)
(playing with; acm15hDJ)

Formal Model for Entity Ranking



Information Need

User Query

- Keywords or
- Natural Language Text

q

Processed Query

- List of Attribute-Value pairs

$\{(a_i, v_i)\}$

Rank Entities

$\{id(e^i), \phi(q, d(e^i))\}$

- Use scoring function

Entities

$E = \{e^i, \ldots, e^j\}$

Ranked List of Entities

- Searching
  - Users' Information Need
  - Entity Ranking System

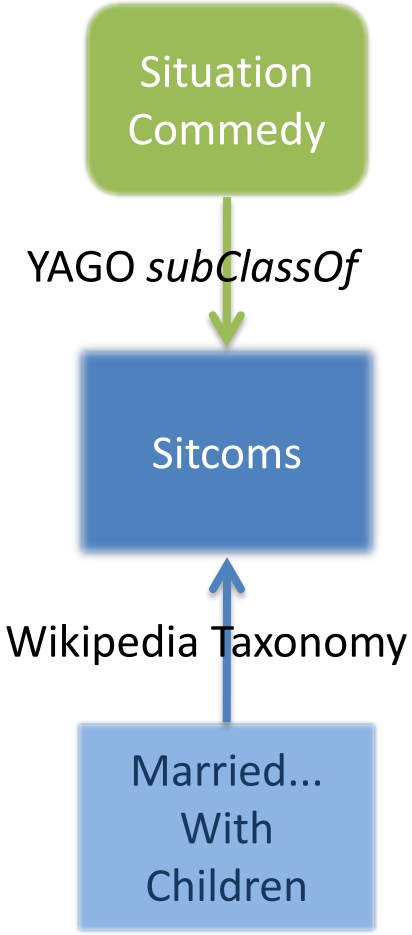
Wikipedia

- Encyclopedia
  - multilingual, Web-based, free-content, openly-editable: errors are promptly corrected
- Articles:
  - balanced, neutral, and encyclopedic, containing notable verifiable knowledge
- Categories / sub-categories
- Links, anchor text (Germany -> Albert Einstein)

Approaches to ES in Wikipedia

- Exploit and refine the category structure
  - Wordnet to find entity types (e.g., a professor is a person)
- Extend the query
  - Synonyms and related words (Wordnet synsets)
- Exploit the link structure
  - Links in Wikipedia are usually entities
  - Search Keywords also in anchor text of outLinks

YAGO

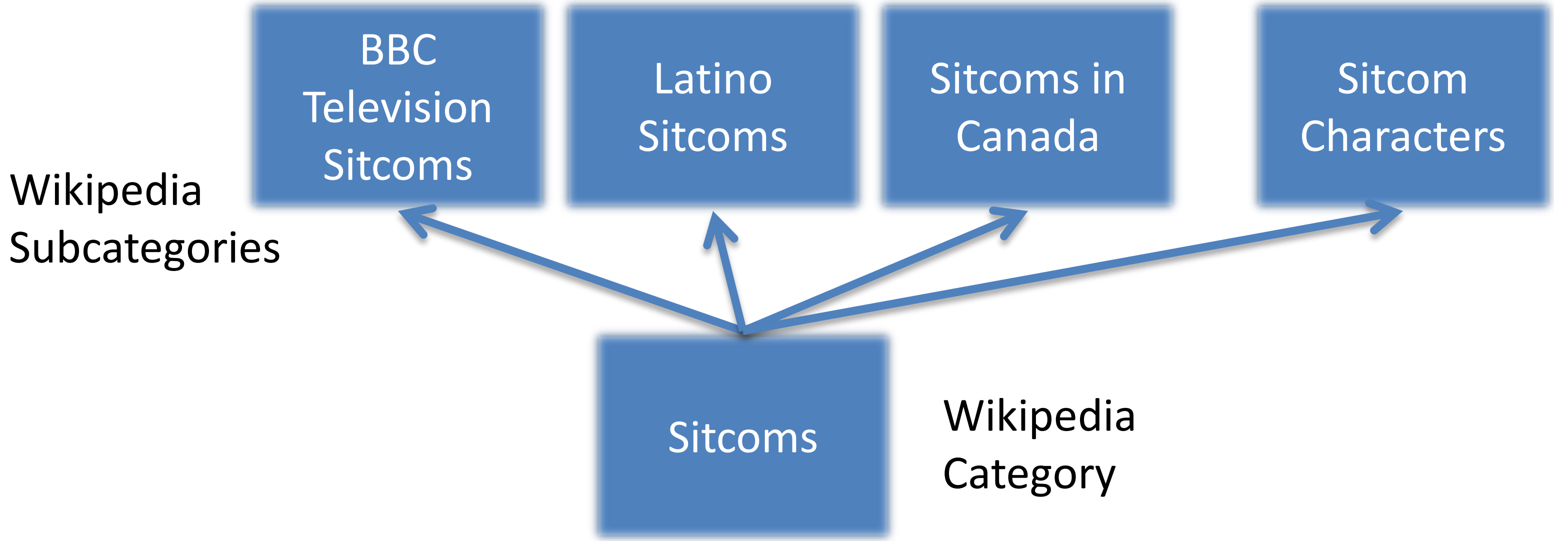


- Suchanek et al. 2007
- Highly accurate ontology (>95%)
- Extracted from Wikipedia + WordNet
- Provides semantic concepts describing Wikipedia entities

Category Based Search

- Query expansion by modifying category information
  - Subcategories
    - Extracted from Wikipedia
  - “Children” Categories
    - Filtered using the YAGO subClassOf relation
  - “Sibling” Categories
    - Extracted from Wikipedia
    - Having with the same YAGO type

Subcategories



BBC Television Sitcoms

Latino Sitcoms

Sitcoms in Canada

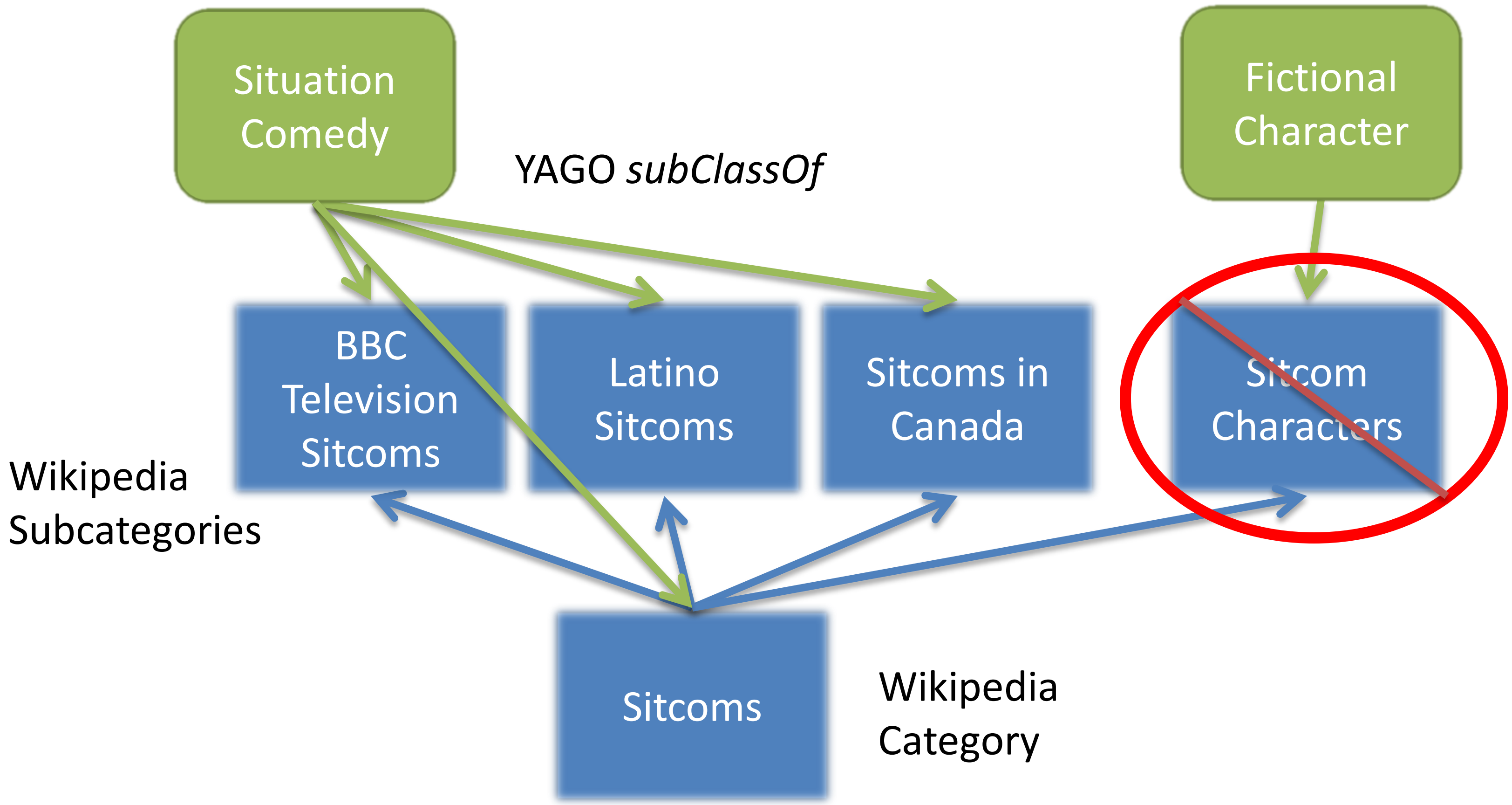
Sitcom Characters

Wikipedia Subcategories

Sitcoms

Wikipedia Category

“Children” Categories



Situation Comedy

Fictional Character

YAGO *subClassOf*

BBC Television Sitcoms

Latino Sitcoms

Sitcoms in Canada

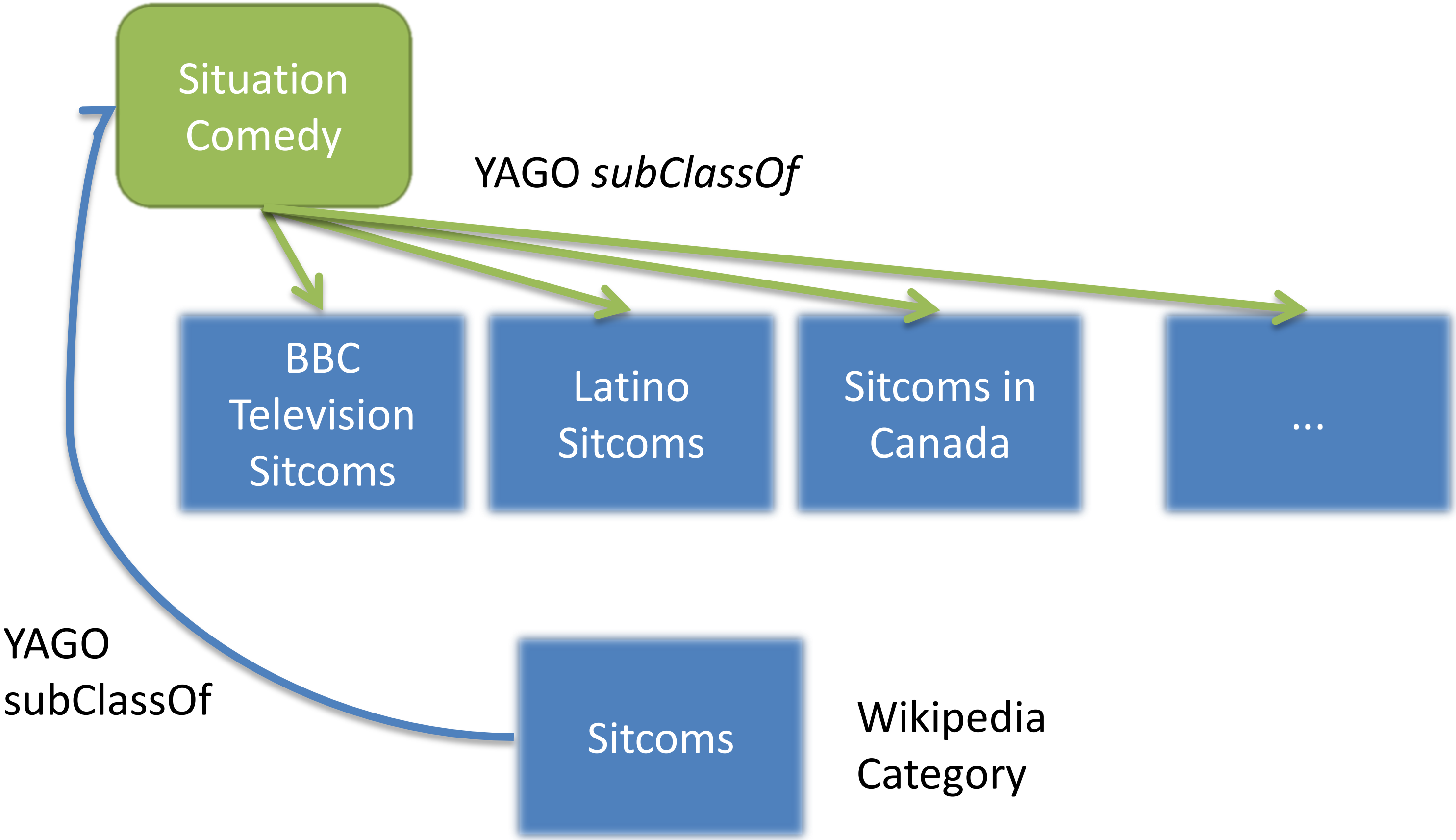
~~Sitcom Characters~~

Wikipedia Subcategories

Sitcoms

Wikipedia Category

“Sibling” Categories

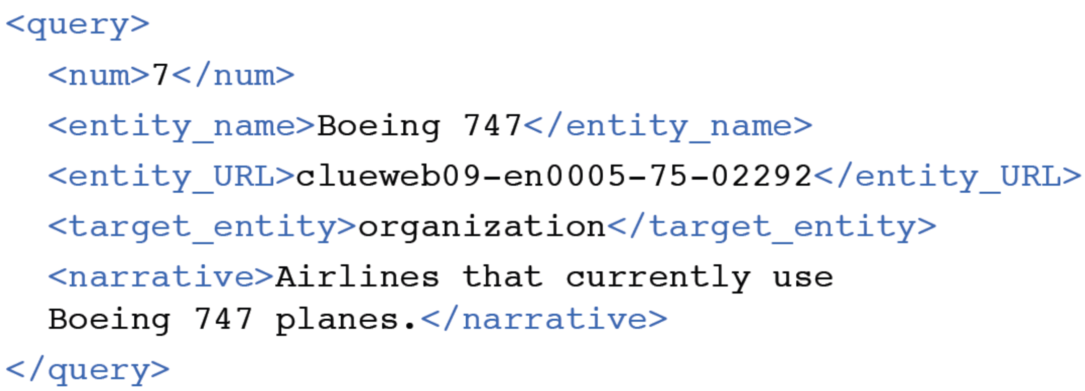


Evaluating ES in Wikipedia

- INEX Entity (XER) track 2007-2009
  - http://www.inex.otago.ac.nz/tracks/entity-ranking/entity-ranking.asp
- Standard test collection using
  - Wikipedia dump from 2006
  - Wikipedia dump from 2009 + extracted entities and types from Wordnet
- Queries and manual relevance judgements
- Evaluation measures to compare sytems

Ranking Entities on the Web

- TREC Entity Track 2009-2010
  - 50M web pages (including Wikipedia)
  - Find related entities (return homepages)



```
<query>
  <num>7</num>
  <entity_name>Boeing 747</entity_name>
  <entity_URL>clueweb09-en0005-75-02292</entity_URL>
  <target_entity>organization</target_entity>
  <narrative>Airlines that currently use
  Boeing 747 planes.</narrative>
</query>
```

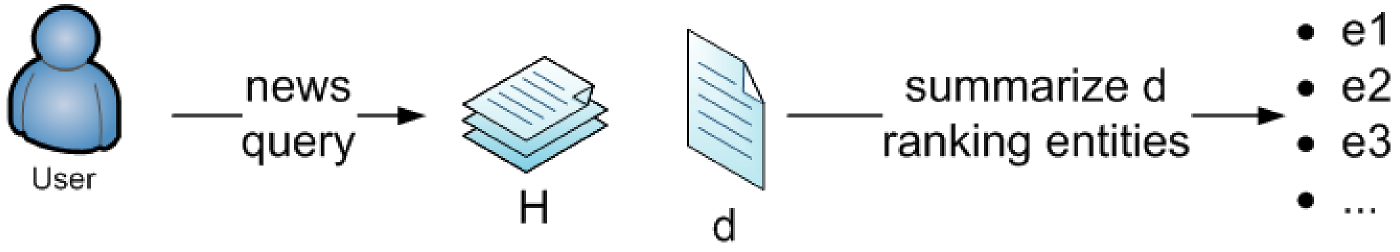
Ranking Entities on the Web

- Approaches
  - Use Wikipedia (and infoboxes) as background info
  - Extract entities from tables and lists
  - Find the homepage given the entity name (see ENS)
    - Barack Obama -> www.barackobama.com
- In 2010: 1 billion web pages

Time-Aware Entity Retrieval

- In some cases the time dimension is available
  - News collections
  - Blog postings
- An Entity Search system can exploit the past to find relevant entities

Time-Aware Entity Retrieval



User

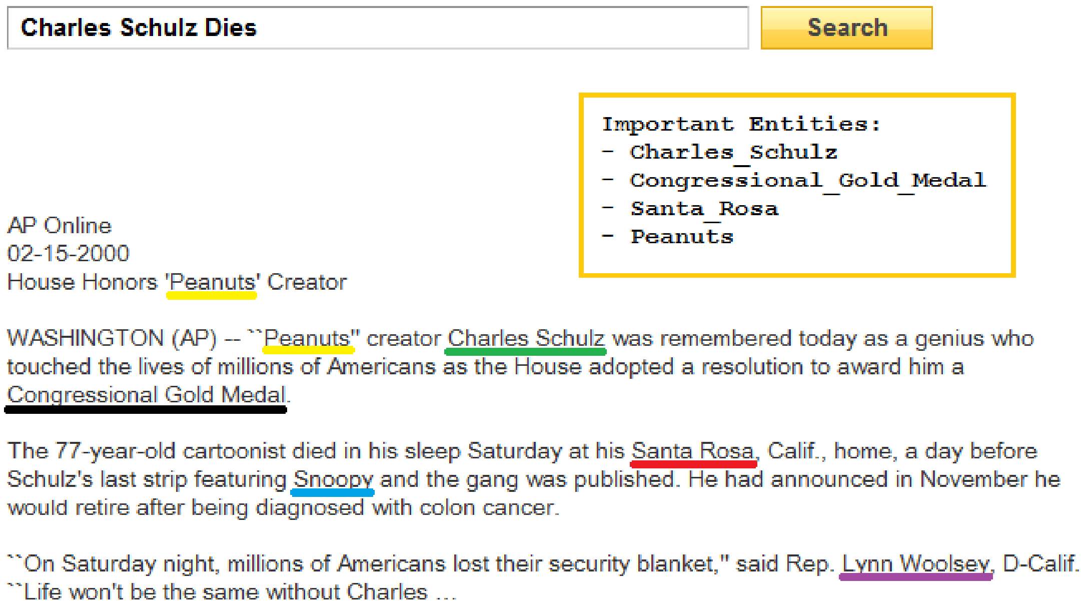
news query

H

d

summarize d ranking entities

- e1
- e2
- e3
- …



Charles Schulz Dies

```
Important Entities:
- Charles_Schulz
- Congressional_Gold_Medal
- Santa_Rosa
- Peanuts
```

AP Online
02-15-2000
House Honors 'Peanuts' Creator

WASHINGTON (AP) -- ``Peanuts'' creator Charles Schulz was remembered today as a genius who touched the lives of millions of Americans as the House adopted a resolution to award him a Congressional Gold Medal.

The 77-year-old cartoonist died in his sleep Saturday at his Santa Rosa, Calif., home, a day before Schulz's last strip featuring Snoopy and the gang was published. He had announced in November he would retire after being diagnosed with colon cancer.

``On Saturday night, millions of Americans lost their security blanket,'' said Rep. Lynn Woolsey, D-Calif. ``Life won't be the same without Charles …

- Gianluca Demartini, Malik Muhammad Saad Missen, Roi Blanco, and Hugo Zaragoza. **TAER: Time Aware Entity Retrieval**. ACM Conference on Information and Knowledge Management. 2010.

ES Commercial systems

- Entity Ranking
  - http://www.google.com/squared/search?q=german+beers
- List Completion
  - http://labs.google.com/sets?hl=en&q1=ferrari&q2=mbw&q3=mercedes&q4=&q5=&btn=Small+Set+(15+items+or+fewer)
- Related entities
  - http://correlator.sandbox.yahoo.net/index.php/concepts/beer

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Selected Papers

- Krisztian Balog, Leif Azzopardi, Maarten de Rijke. **Formal models for expert finding in enterprise corpora**. ACM SIGIR Special Interest Group on Information Retrieval Conference. 2006.

- Gianluca Demartini, Claudiu S. Firan, Tereza Iofciu, Ralf Krestel, Wolfgang Nejdl. **Why finding entities in Wikipedia is difficult, sometimes.** Information Retrieval, Springer. 2010.

- Rianne Kaptein, Pavel Serdyukov, Arjen de Vries, Jaap Kamps. **Entity Ranking using Wikipedia as a Pivot**. ACM Conference on Information and Knowledge Management. 2010.

- Marc Bron, Krisztian Balog, Maarten de Rijke. **Ranking Related Entities: Components and Analyses**. ACM Conference on Information and Knowledge Management. 2010.

Formal models for expert finding in enterprise corpora

- Expert Finding task
- Compares the two approaches:
    - Model experts based on the associated docs
    - Locate relevant documents, then finds the experts
- Defines probabilistic models

Why finding entities in Wikipedia is difficult, sometimes

- ER and LC in Wikipedia
- Uses WordNet (see Introduction to Information Integration)
  - Refining the category structure
- Rewrites the query using Natural Language Processing techniques

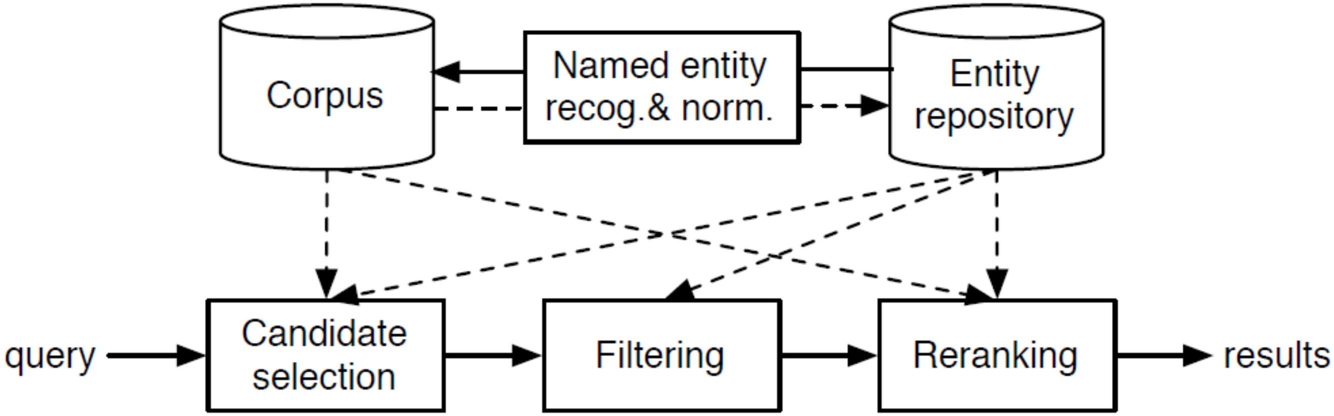
- Demo: http://serwi.L3S.uni-hannover.de

Entity Ranking using Wikipedia as a Pivot

- Related Entities task
- First finds relevant web pages
- Then finds relevant entities using Wikipedia "external links" and types
- Can deal with most of (but not all) the queries

Ranking Related Entities: Components and Analyses

- Related Entities task



- High recall (can find most of the relevant entities)
- Problems with ranking (entities of the wrong type are returned)

¿Questions?

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