Network of Epidemiology Digital Objects

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CS6604 Class Project

Outline

- Problem Statement
- Requirement Specification
- Related work
- What a human would do?
- Modeling
- Evaluation

Client Problem Statement

- CINET
  - Computational and analytic environment for network science research and education.
- Goal: A RDF graph building service
  - Web crawling for contents related to epidemiology
  - RDF representation to interconnect digital objects

Client Problem Statement

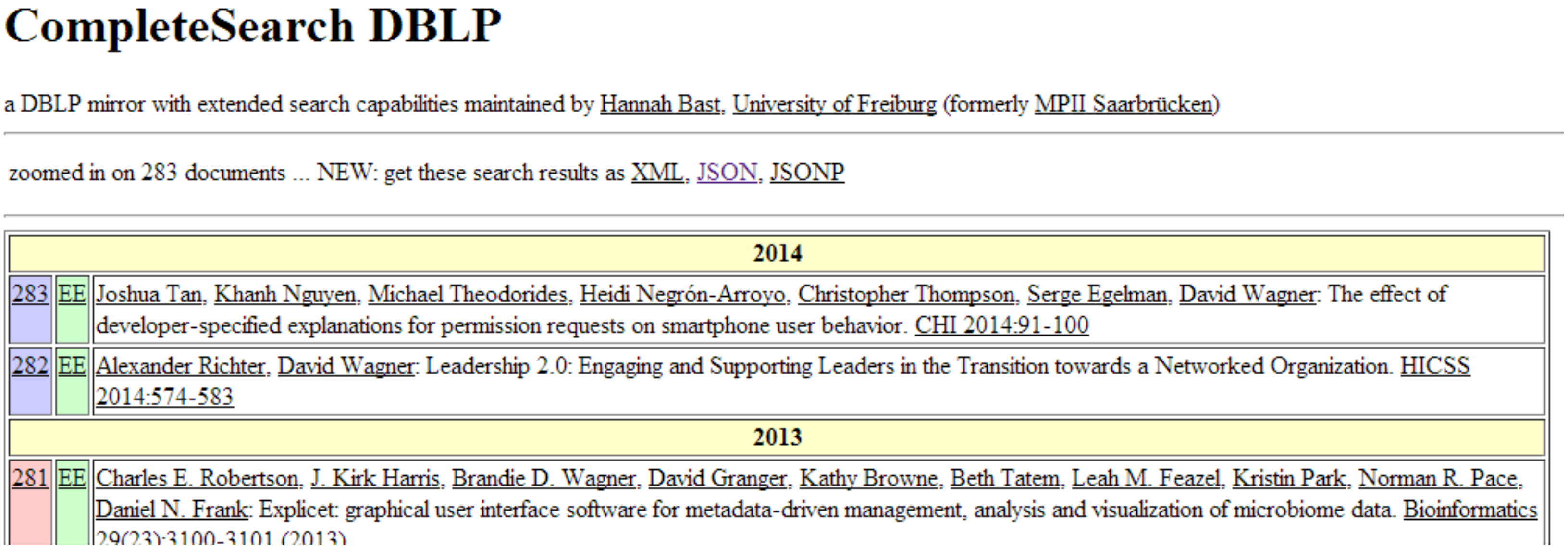
- Requirement: Build a connected network of:
  - Papers
  - Wiki pages
  - Websites
  - Videos
  - Other digital objects pertaining to epidemiology
- Representing using RDF for future graph analysis.

Refined Problem Statement

- Strongly connected digital objects & metadata
  - Include metadata to model the connection
  - Better represent the underlying correlation among digital objects
- Given a search request, provide resulting DO network:
  - Include all related digital objects
  - Strongly connected DOs are more related

Refined Problem Statement

- Automated process
  - Web exploration
  - Network construction
- Restricted digital objects
  - Research papers
- Web crawling (search engine from dblp)



CompleteSearch DBLP

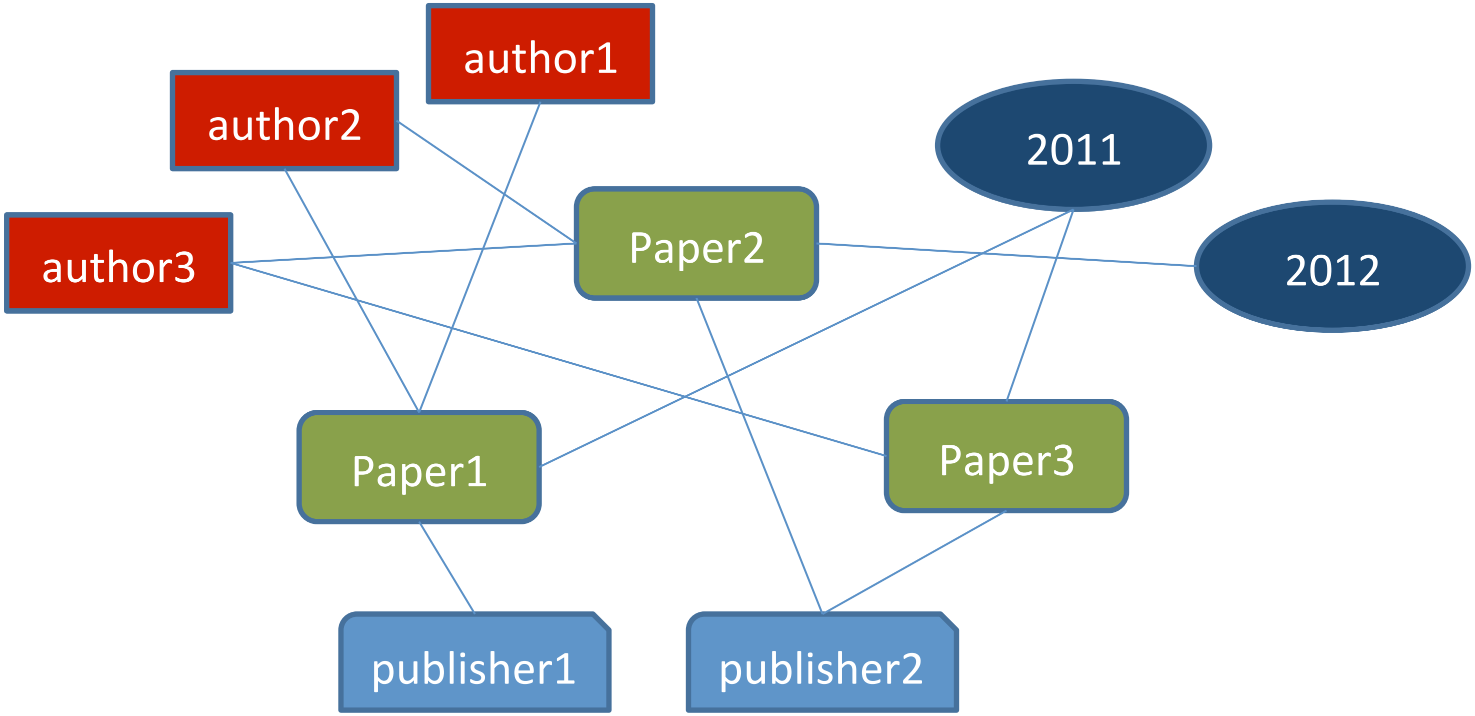
a DBLP mirror with extended search capabilities maintained by Hannah Bast, University of Freiburg (formerly MPII Saarbrücken)

zoomed in on 283 documents ... NEW: get these search results as XML, JSON, JSONP

		2014
283	EE	Joshua Tan, Khanh Nguyen, Michael Theodorides, Heidi Negrón-Arroyo, Christopher Thompson, Serge Egelman, David Wagner: The effect of developer-specified explanations for permission requests on smartphone user behavior. CHI 2014:91-100
282	EE	Alexander Richter, David Wagner: Leadership 2.0: Engaging and Supporting Leaders in the Transition towards a Networked Organization. HICSS 2014:574-583
		2013
281	EE	Charles E. Robertson, J. Kirk Harris, Brandie D. Wagner, David Granger, Kathy Browne, Beth Tatem, Leah M. Feazel, Kristin Park, Norman R. Pace, Daniel N. Frank: Explicet: graphical user interface software for metadata-driven management, analysis and visualization of microbiome data. Bioinformatics 29(23):3100-3101 (2013)

Meta-data for DO

- Authors, key words, publisher, year
- Given papers {Paper1} {Paper2} {Paper3}
  - P1: author1, author2, publisher 1, 2011, {keywords}
  - P2: author2, author3, publisher 2, 2012, {keywords}
  - P3: author 3, publisher 2, 2011, {keywords}
- The resulting network through the meta-data:

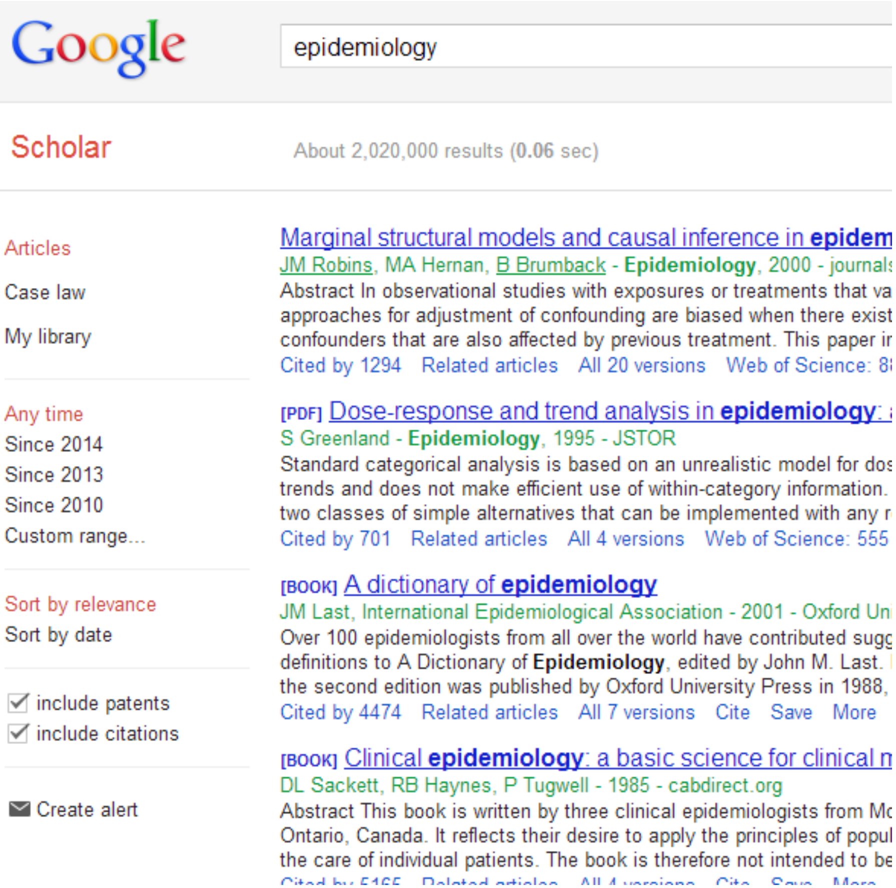


Requirement Specification

- Undirected crawling or normal search engine not sufficient:
  - Results un-organized
  - Little specialization
  - Ambiguity
  - Relations and connections not available

Requirement Specification

What's available



epidemiology

Scholar

About 2,020,000 results (**0.06** sec)

Articles

Case law

My library

Any time

Since 2014

Since 2013

Since 2010

Custom range...

Sort by relevance

Sort by date

☑ include patents

☑ include citations

✉ Create alert

Marginal structural models and causal inference in **epidem**

JM Robins, MA Hernan, B Brumback - **Epidemiology**, 2000 - journals

Abstract In observational studies with exposures or treatments that va approaches for adjustment of confounding are biased when there exist confounders that are also affected by previous treatment. This paper ir

Cited by 1294 Related articles All 20 versions Web of Science: 8

[PDF] Dose-response and trend analysis in **epidemiology**:

S Greenland - **Epidemiology**, 1995 - JSTOR

Standard categorical analysis is based on an unrealistic model for dos trends and does not make efficient use of within-category information. two classes of simple alternatives that can be implemented with any r

Cited by 701 Related articles All 4 versions Web of Science: 555

[BOOK] A dictionary of **epidemiology**

JM Last, International Epidemiological Association - 2001 - Oxford Un

Over 100 epidemiologists from all over the world have contributed sugg definitions to A Dictionary of **Epidemiology**, edited by John M. Last. the second edition was published by Oxford University Press in 1988,

Cited by 4474 Related articles All 7 versions Cite Save More

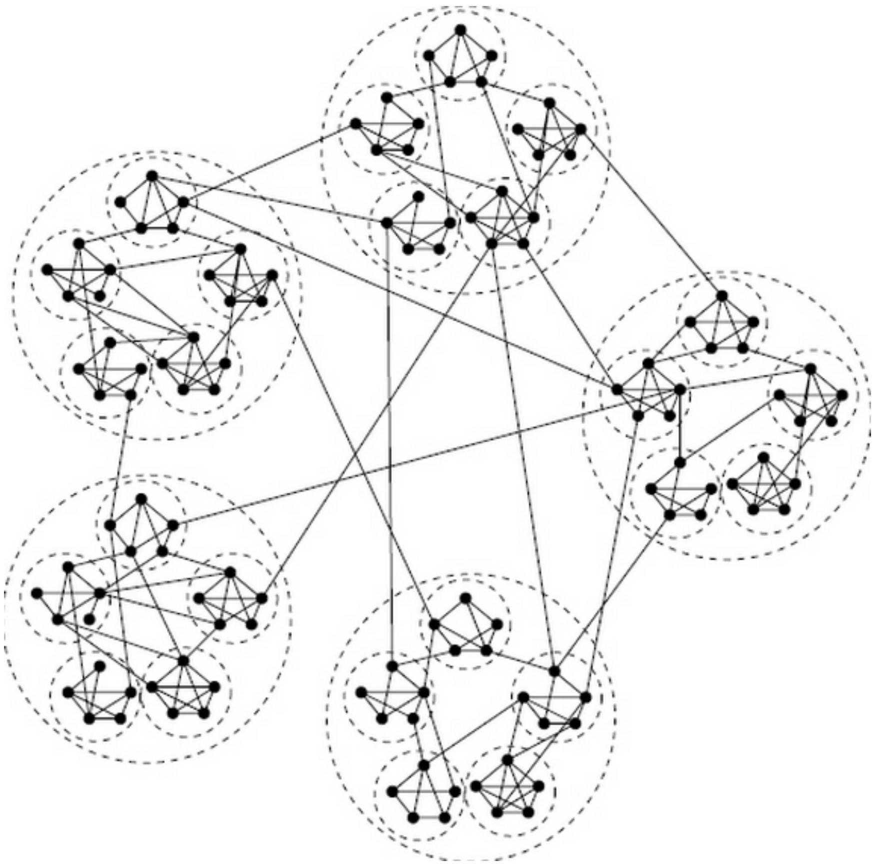
[BOOK] Clinical **epidemiology**: a basic science for clinical n

DL Sackett, RB Haynes, P Tugwell - 1985 - cabdirect.org

Abstract This book is written by three clinical epidemiologists from Mc Ontario, Canada. It reflects their desire to apply the principles of popul the care of individual patients. The book is therefore not intended to be

Cited by 5165 Related articles All 4 versions Cite Save More

What we want



Related Work

- Web crawling topics
  - Building efficient, robust and scalable crawler
  - Traversal order of the web graph
  - Re-visitation of previously crawled content
  - Avoid problematic and undesirable content
  - Crawling “deep web” content

Christopher Olston and Marc Najork. 2010. Web Crawling. *Found. Trends Inf. Retr.* 4, 3 (March 2010), 175-246.

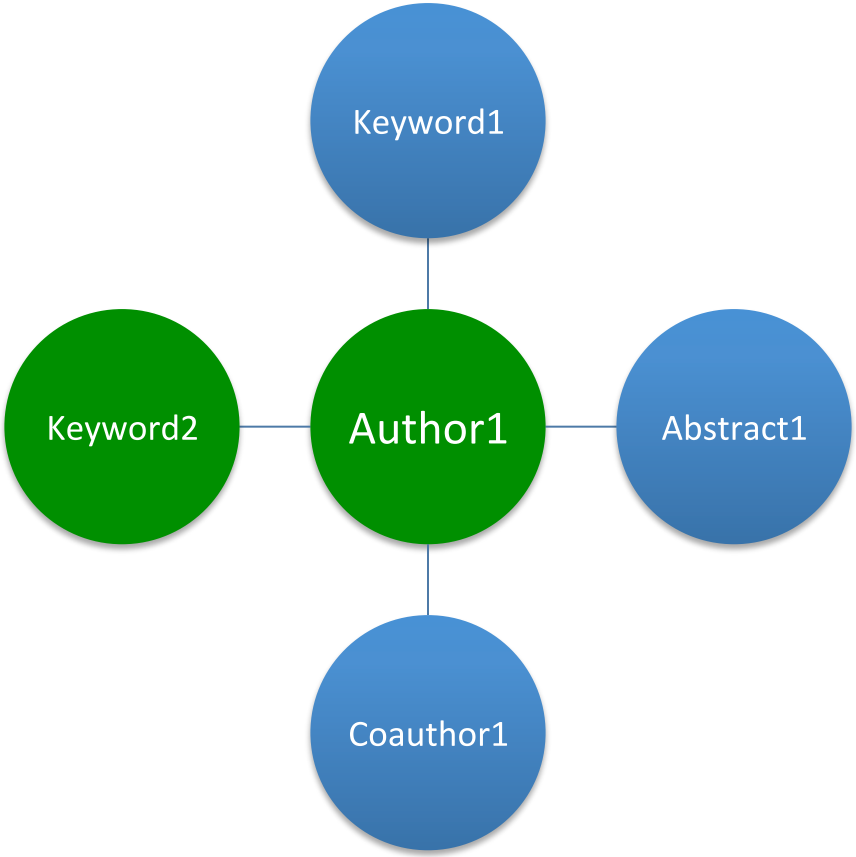
Why can a human do this better?

A user is interested in "Disease propagation"

1. Set N = {Disease propagation}
2. Search using N and gets R
3. Splits R into A and B
4. Selects A as relevant; extracts terms and connections; augments N
5. Ignores or stashes away B
6. Repeat from 1 with updated network N

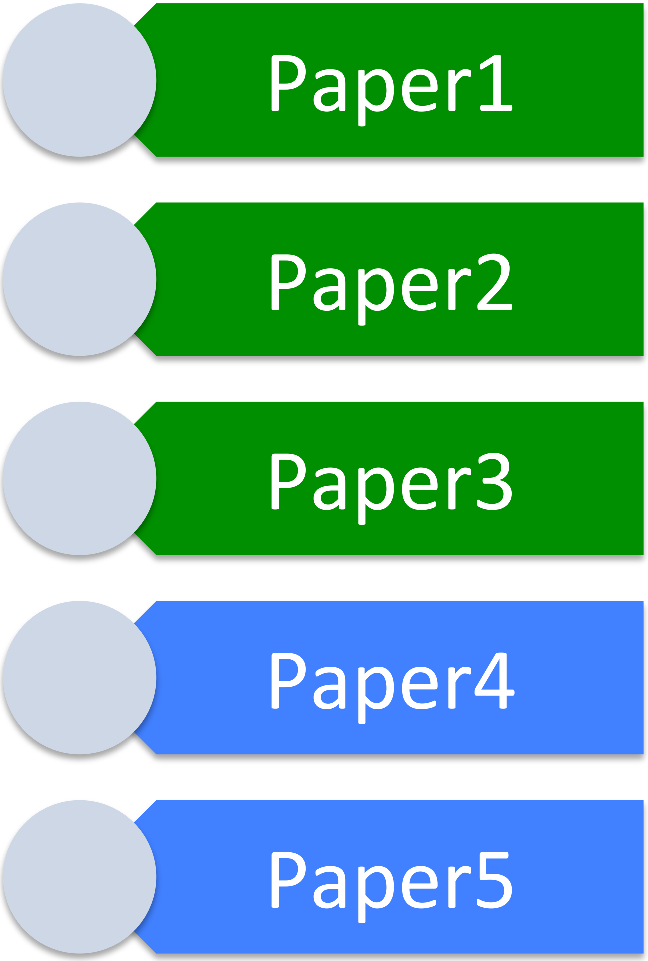
Desired Property 1: Connected Growth

- A relevant paper shares nodes and edges in the network N
- Not all of the paper becomes relevant at once
- What is shared changes over time



Desired Property 2: Grouping

- Only a small fraction of a document is shared with network N
- The rest is used to group papers

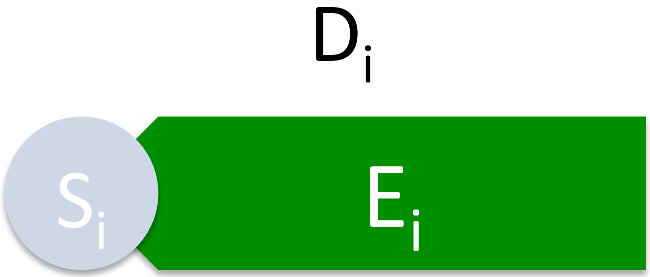


Modeling: Digital Object

- Is represented as a set of edges
  - $D_i = \{(x_1,y_1),\ldots, (x_n,y_n)\}$
- Connections are determined by predicates over kind of vertex
  - (x,y): Paper p, authored by x, is published in y
- From a generative point-of-view, an edge in a paper comes from
  - A shared network
  - Or, a local network

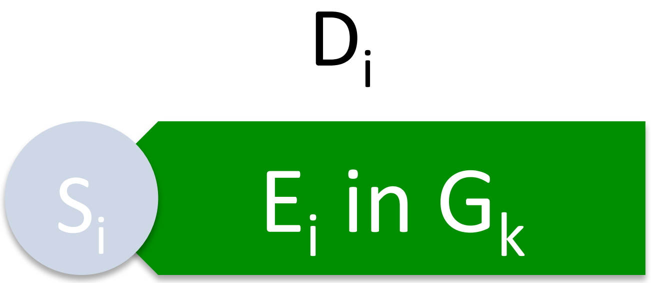
Modeling: Split-View of Digital Object

- A paper’s edges can be split into two parts
  - $D_i = S_i + E_i$
  - Shared set: S_i
  - Local set: E_i



Modeling: Grouping

- Each D_i belongs to a group
- Groups are determined w.r.t. unshared edges E_i
- No need to determine number of groups beforehand



$$P(k \mid \alpha) \prod_{(x,y)\in E_i} P(x,y \mid G_k)$$

Modeling: Network

- Connectivity
  - Allow (x,y) only if x is reachable from root nodes
- Smoothness
  - Allow (x,y) only if path connecting to x from root has decreasing weights

Edge is either shared or local based on

$$\underset{\varepsilon \in \{N, G_k\}}{\operatorname{argmax}} P(x, y \mid \varepsilon)$$

satsifying connectivity and smoothness constraints when shared.

The Entire Process

Model

1. Start with root nodes, e.g., “Disease propagation” in N
2. Generate search query from N
3. Crawl and add new digital objects
4. Learn random variables for sharing (Si, Ei) and grouping (Gi)
5. Goto step 2

Human

1. Set N = {Disease propagation}
2. Search using N and gets R
3. Splits R into A and B
4. Selects A as relevant; extracts terms and connections; augments N
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Evaluation: Against a Search Engine

- **Goal:** Relevance
- Set a starting topic
- Perform k related queries
  - Let R_i be the sets of query results ranked by the search engine
  - Learn network N
  - For each paper p selected by N
    - Get best rank of p according to R_i
  - Compare ranks against relevance determined by N
- Are there lowly ranked results that are higher in N and vice versa?

Evaluation: Against a Digital Library

- **Goal:** Completeness
- Pick a digital library for digital objects with a categorical browsing service
- Pick a starting point
  - Learn network N
  - Evaluate completeness of network N against the digital library

Thank You!

Questions?