A k-Nearest-Neighbour Method for

Classifying Web Search Results with Data in Folksonomies

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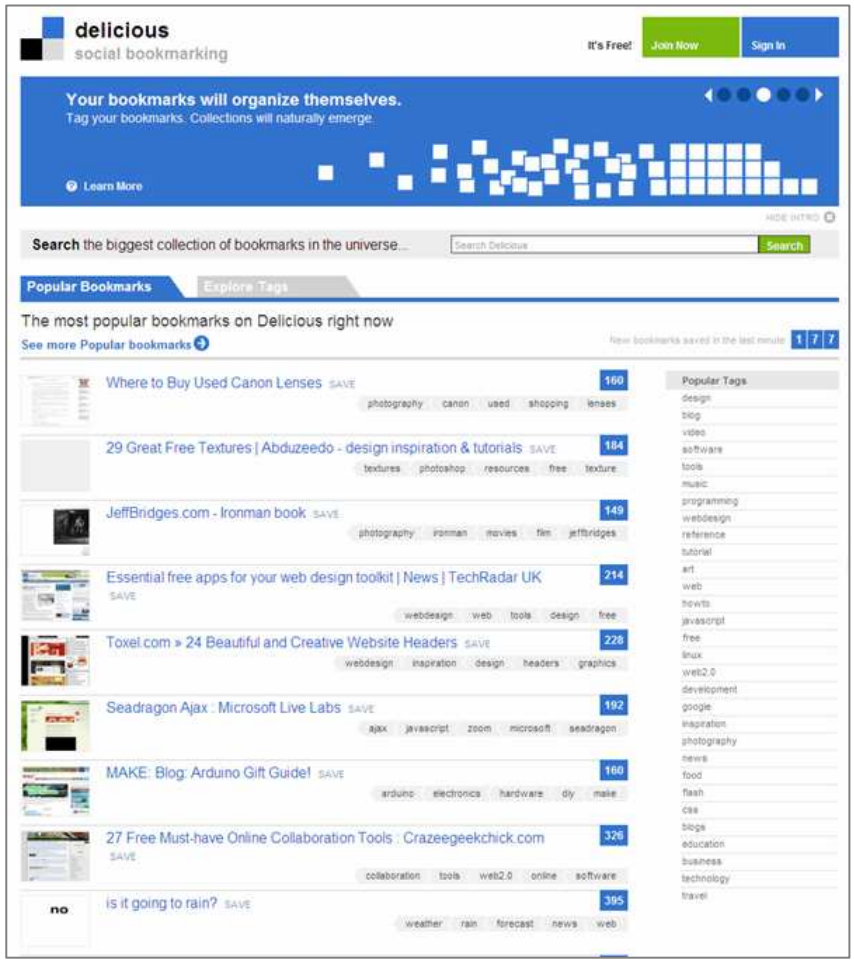
The Problem of Ambiguity

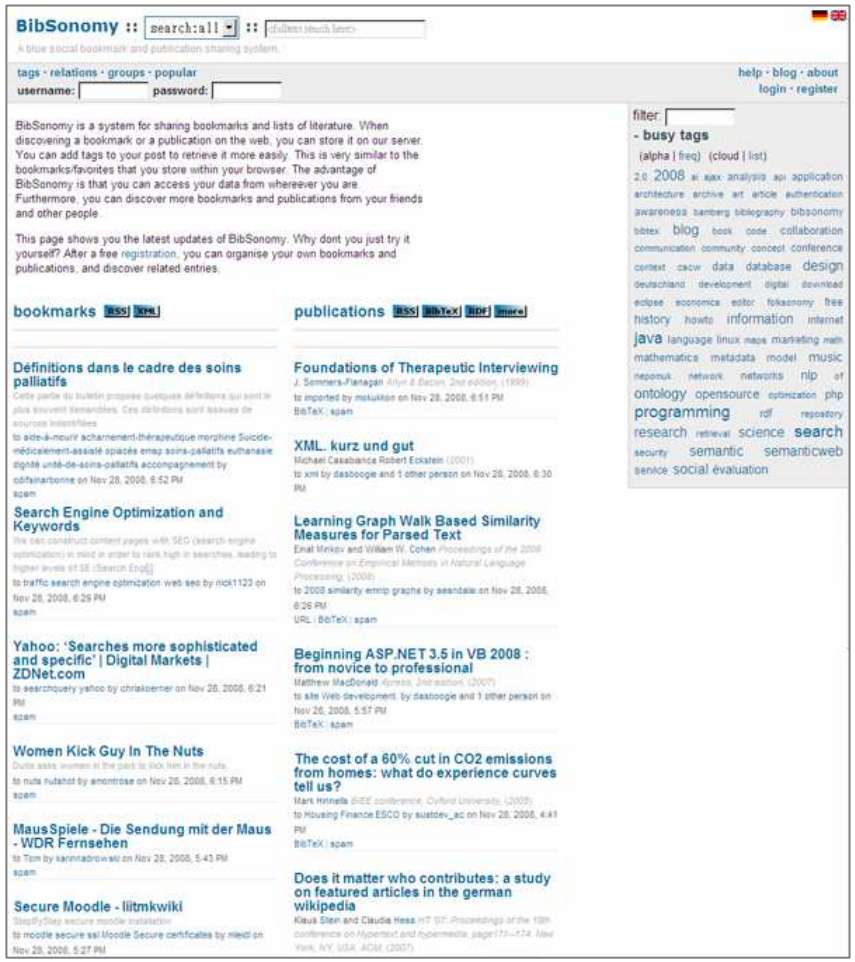
- Queries by ambiguous terms return many irrelevant results
- Example: *bridge*

  1) a kind of card games;
  2) a form of architectural structure;
  3) a design pattern in software development;
  4) a device in computer networking

Introduction



Delicious



BibSonomy

Collaborative Tagging Systems

- Aggregate user-contributed metadata of Web resources
- Provide rich information about the relations between different tags
- Sources for understanding how keywords are used on the Web

Multiple Meanings of Tags

- Tags have multiple meanings, or they are used in different contexts
- It is possible to extract related tags in different contexts
- E.g. sf:

  (california, bayarea, travel, ...) ➔ San Francisco
  (scifi, fantasy, fiction, ...) ➔ Science Fiction

Our Proposal

- Building classifiers using data in folksonomies:

Wikipedia page of San Francisco

The City and County of San Francisco is the fourth most populous city in **California** and the 14th most populous city in the United States ... Among the most densely populated cities in the country, San Francisco is part of the San Francisco **Bay Area** ... The city is located at the tip of the San Francisco Peninsula, with the Pacific Ocean to the west, ...

→ San Francisco

Wikipedia page of Science Fiction

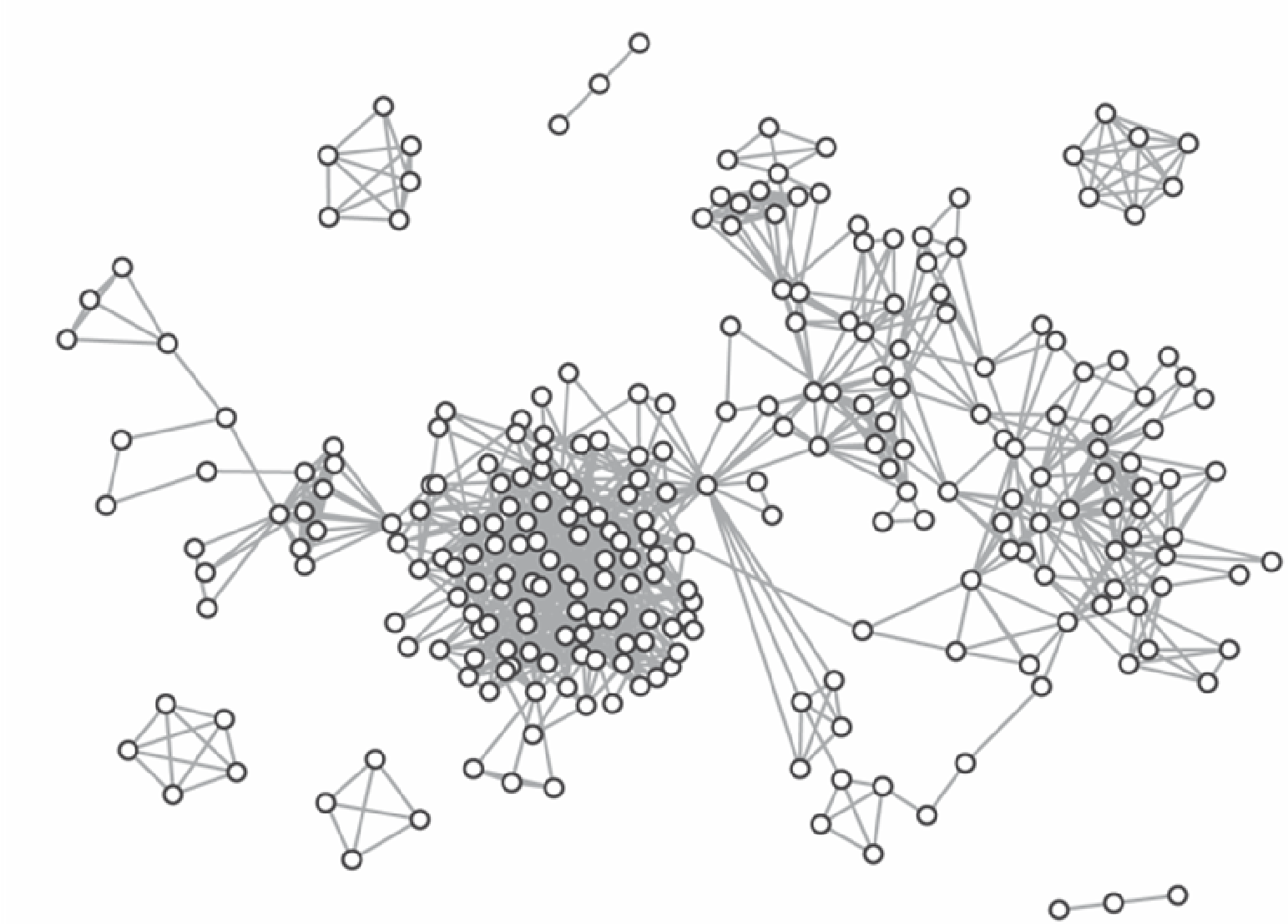
Science fiction (abbreviated SF or **sci-fi** with varying punctuation and capitalization) is a broad genre of **fiction** that often involves speculations based on current or future science or technology. Science fiction is found in books, art, television, films, games, theatre, and other media ... this includes **fantasy**, horror, and related genres.

→ Science Fiction

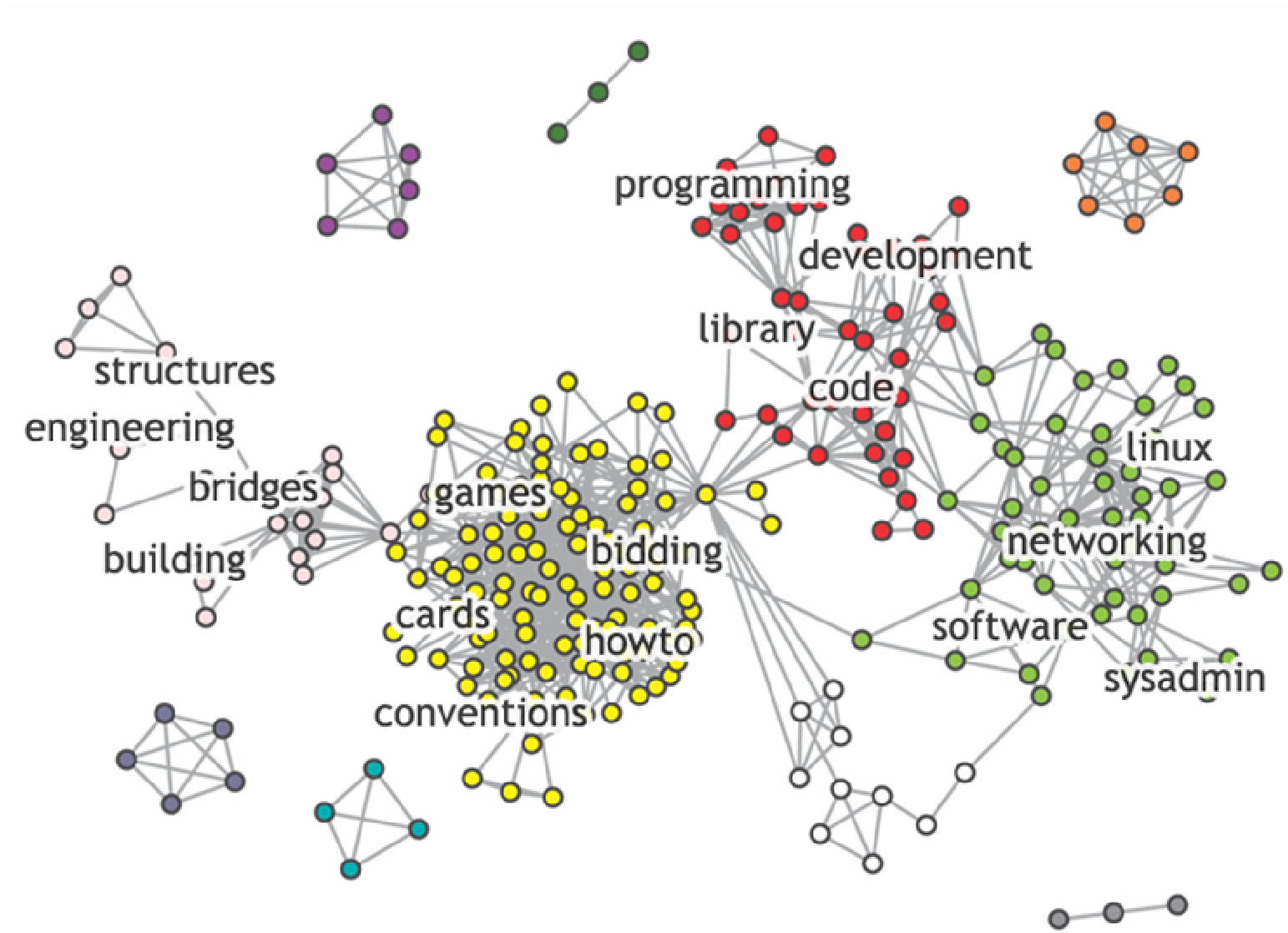
Clustering of Folksonomy Networks

- Construct a document network from a folksonomy
- Cluster documents based on the users who have used the tag on the documents
  (the community-discovery algorithm described in [Newman 2004] is used in this paper)
- Extract frequently co-occurred tags as representations of the different classes (meanings)

Clustering of Folksonomy Networks



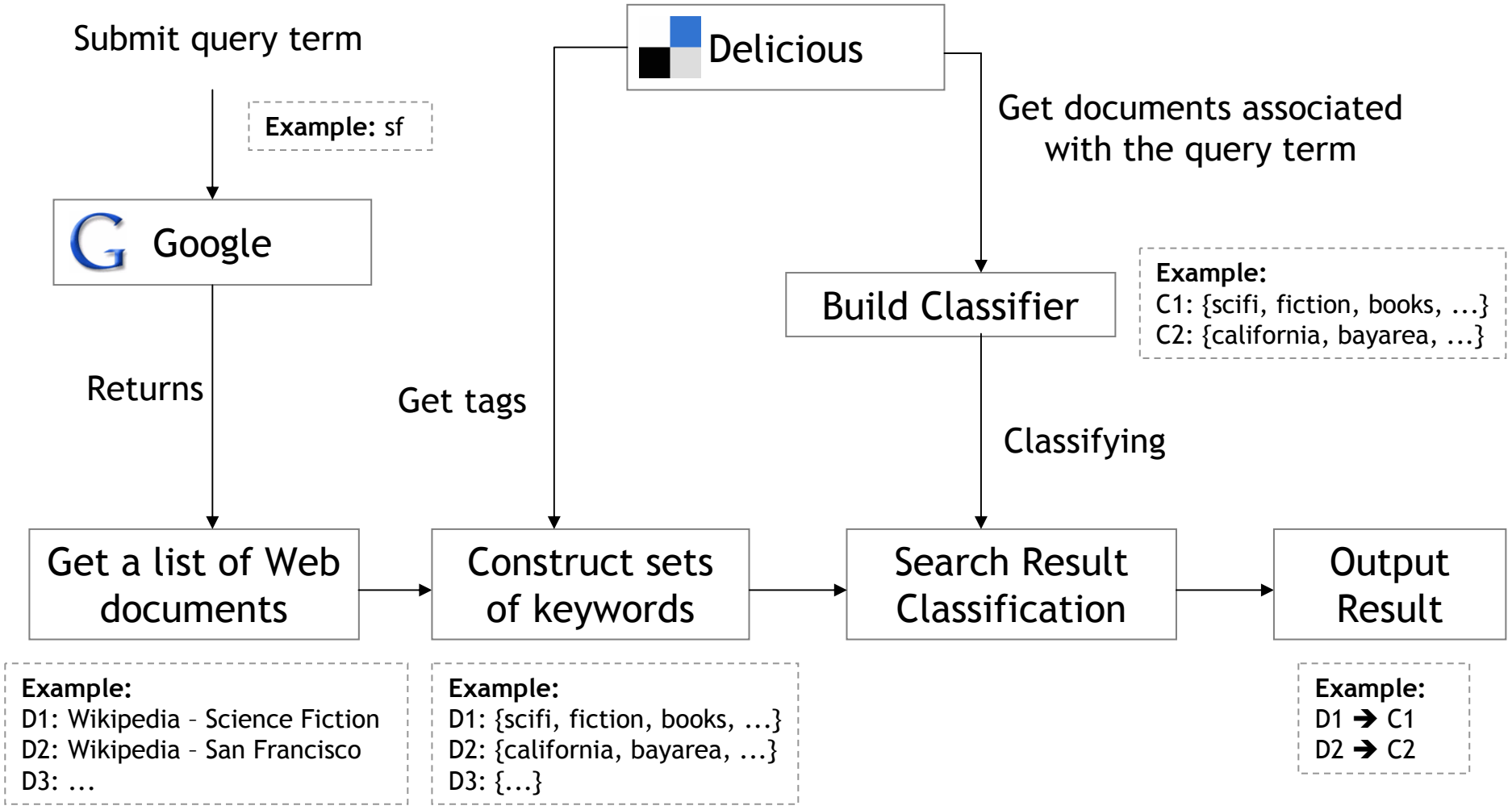
Clustering of Folksonomy Nework



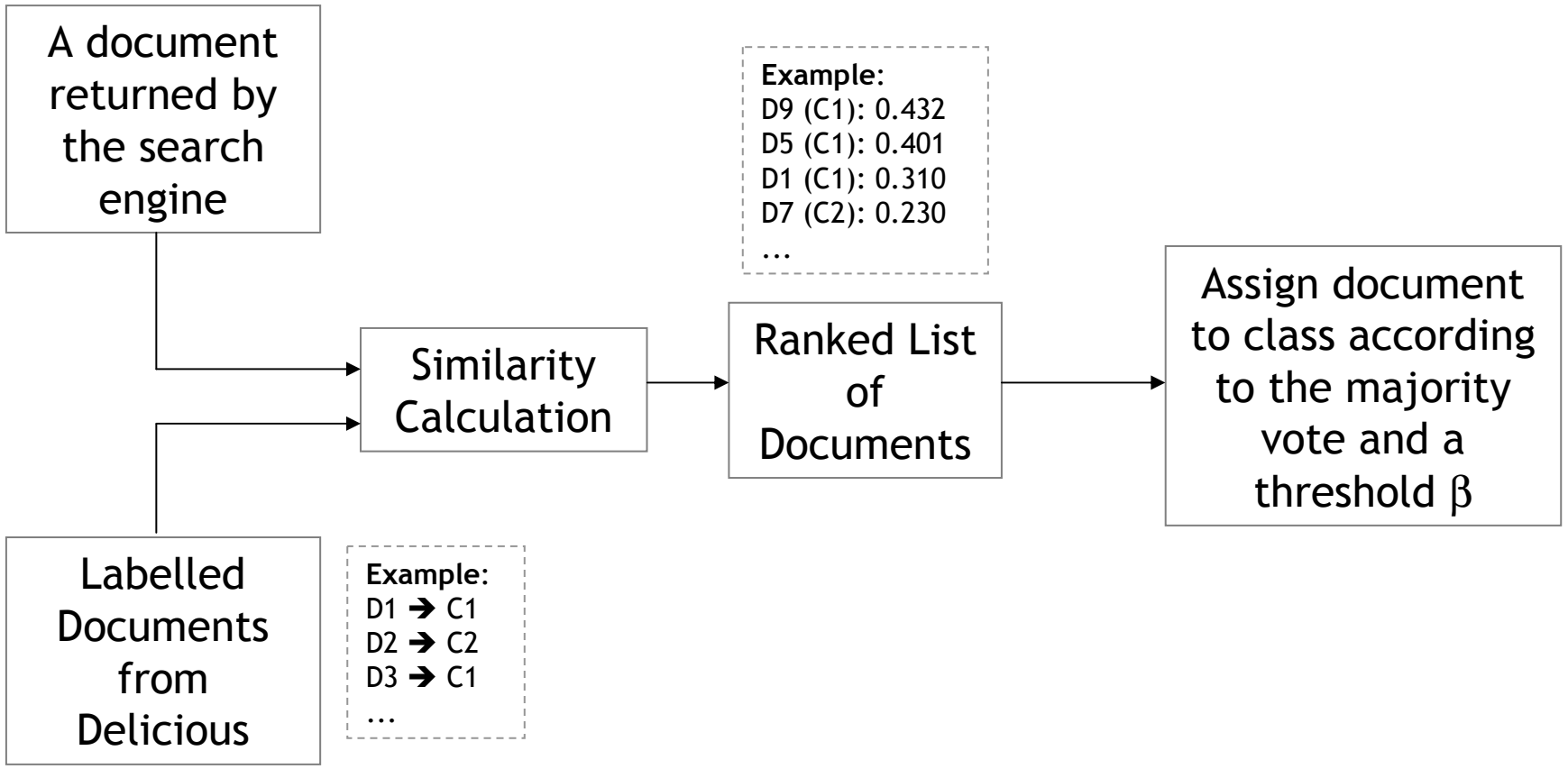
Clustering of Folksonomy Nework

Design pattern	bridge, programming, development, library, code, ruby, tools, software, adobe, dev
Card game	bridge, games, cards, game, imported, howto, conventions, card, bidding, online
Computer networking	bridge, networking, linux, network, howto, software, sysadmin, firewall, virtualization, security
Architecture	bridge, bridges, structures, engineering, science, physics, school, education, building, reference

Web Search Result Classification



k-Nearest-Neighbour Classifier



Data Preparation

- Ten tags which are used in multiple contexts in Delicious are chosen
- Documents associated with the tags as well as the users who assigned the tags are retrieved
- Testing dataset obtained by submitting query to Google and obtaining the top 50 pages returned

Classifiers Built

Tag	Context	Class Label
sf	San Francisco	sanfrancisco, bayarea, san, francisco, california, travel, events
	Science fiction	scifi, fiction, books, sci-fi, literature, writing, science, fantasy
soap	Cleaning agent	soapmaking, diy, recipes, crafts, shopping, making, howto
	Web services	webservices, webservice, programming, web, xml, soa, java
wine	Software application	linux, ubuntu, howto, windows, software, tutorial, emulation
	Beverage	food, shopping, drink, vino, cooking, alcohol, blog, news
xp	Windows XP	windows, software, tools, pc, computer, tech, winxp, microsoft
	Extreme programming	software, programming, process, methodology, development

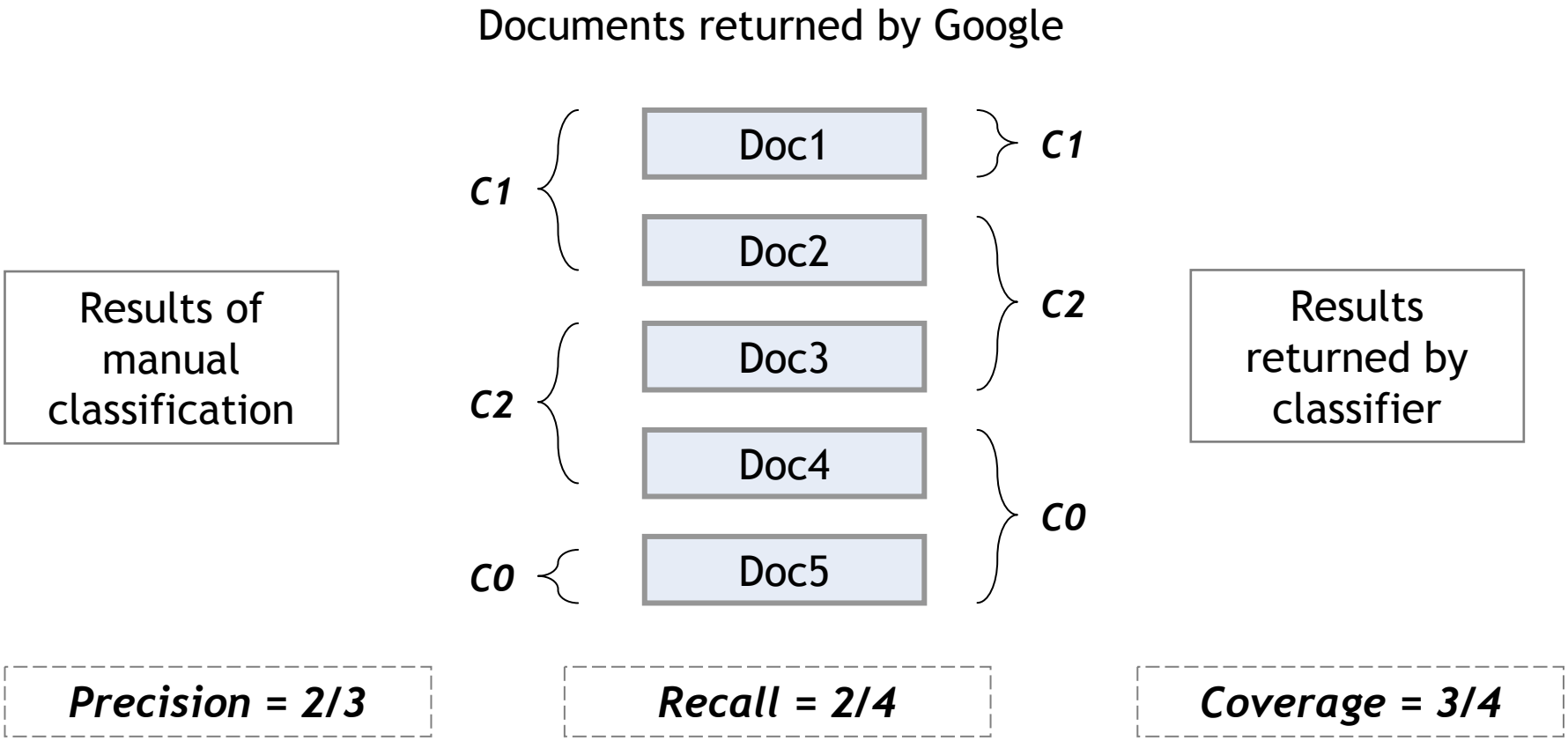
Performance Measures

- ***Precision***
  Measures the percentage of documents which are classified correctly.

- ***Recall***
  Measures the percentage of classifiable documents which are classified correctly

- ***Coverage***
  Measures the proportion of documents the classifiers are able to classify

An Example


Documents returned by Google
Doc1
Doc2
Doc3
Doc4
Doc5
C1
C2
C0
C1
C2
C0
Results of manual classification
Results returned by classifier
Precision = 2/3
Recall = 2/4
Coverage = 3/4

Evaluation

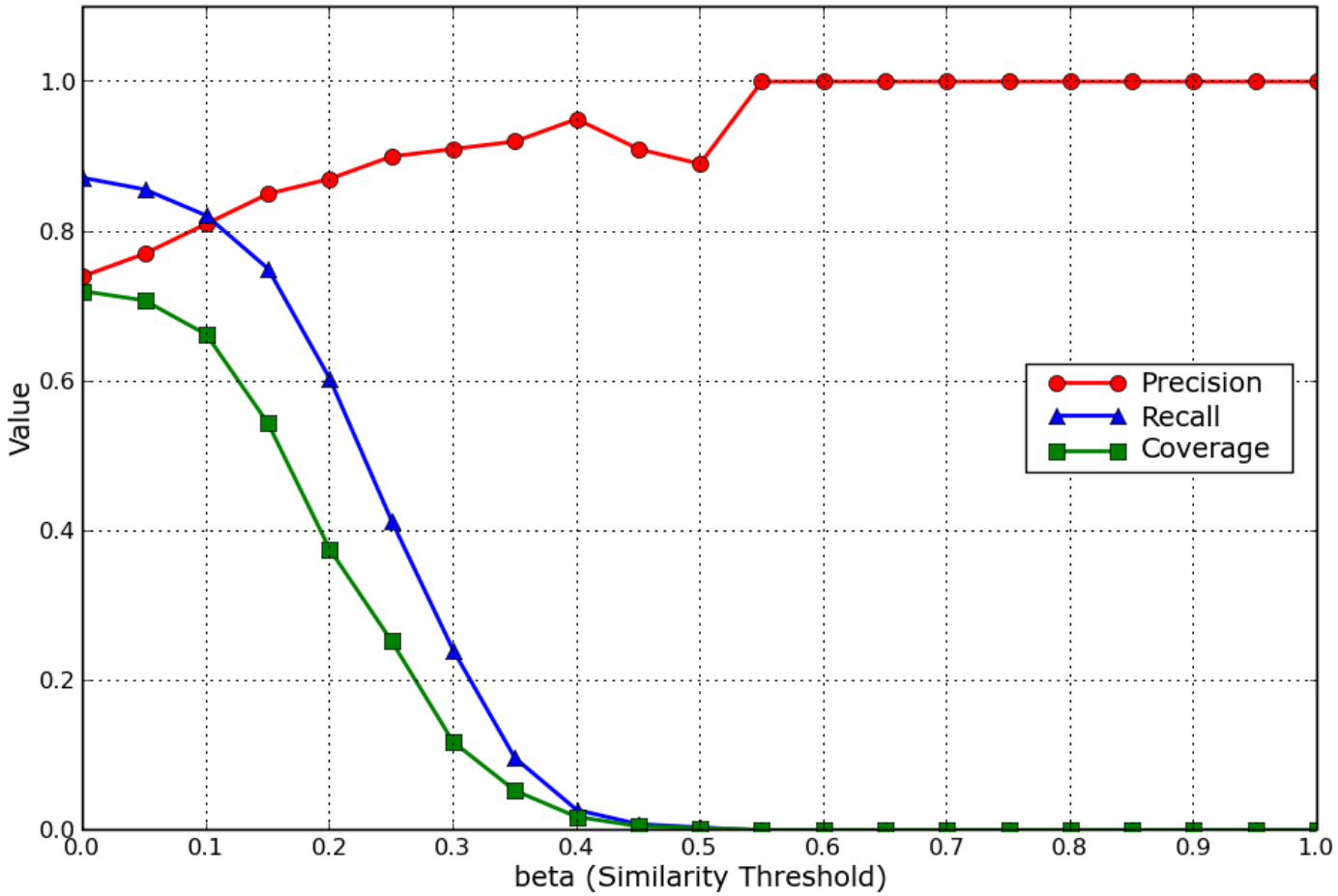


Figure 1. Precision, recall and coverage against different values of β.

Evaluation

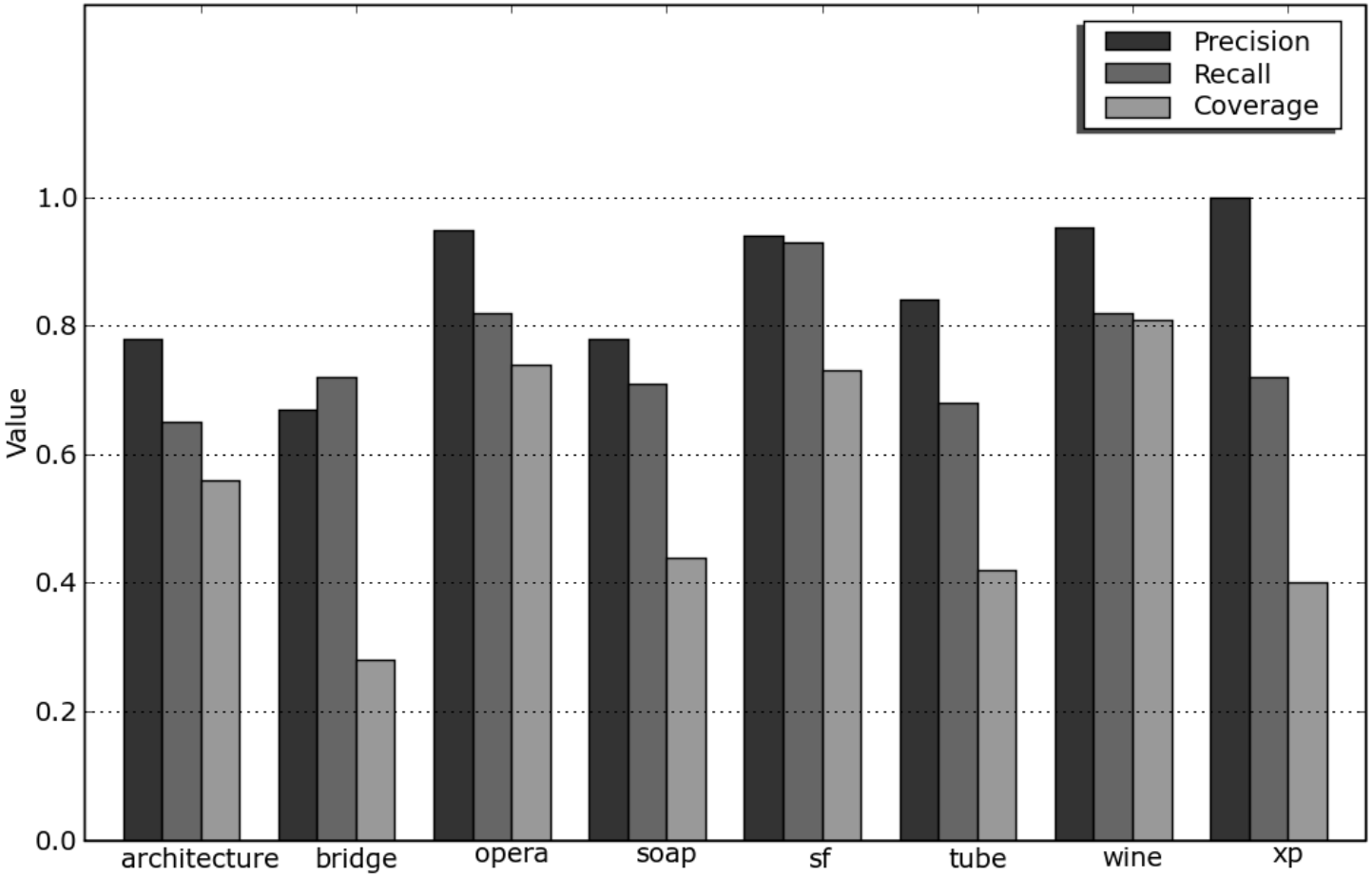
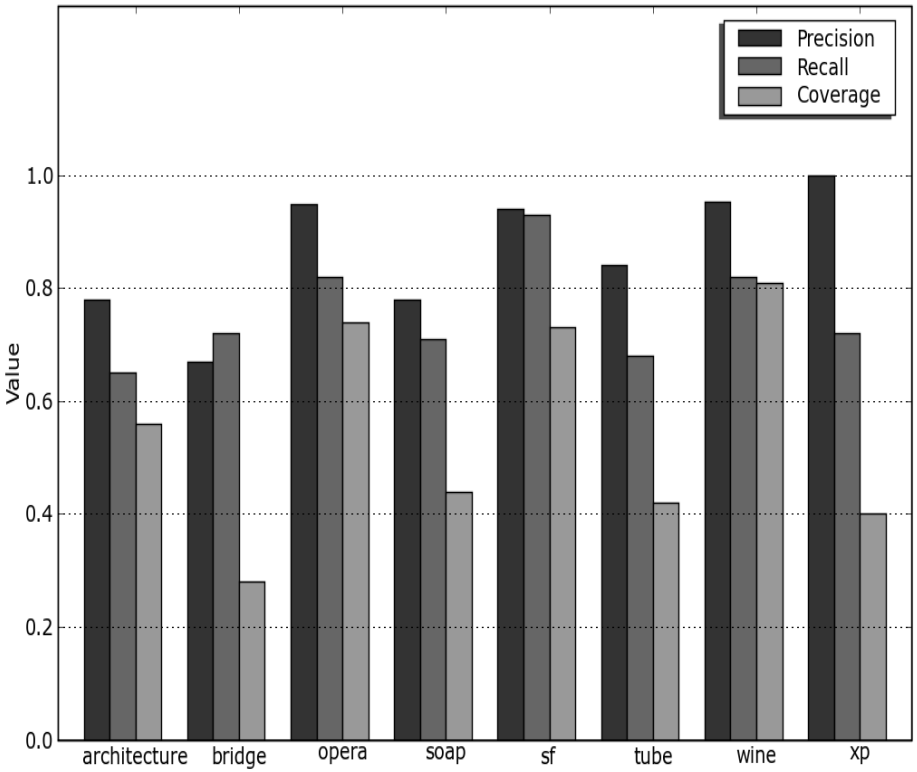


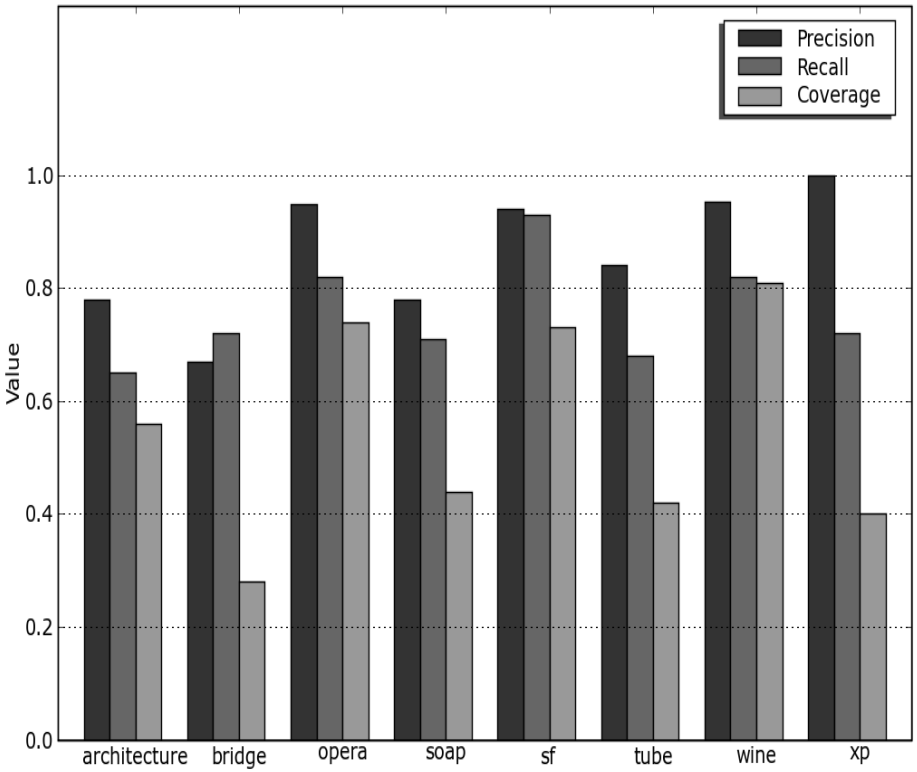
Figure 2. Precision, recall and coverage for different tags. ($k = 11$, $\beta = 0.15$)

Precision



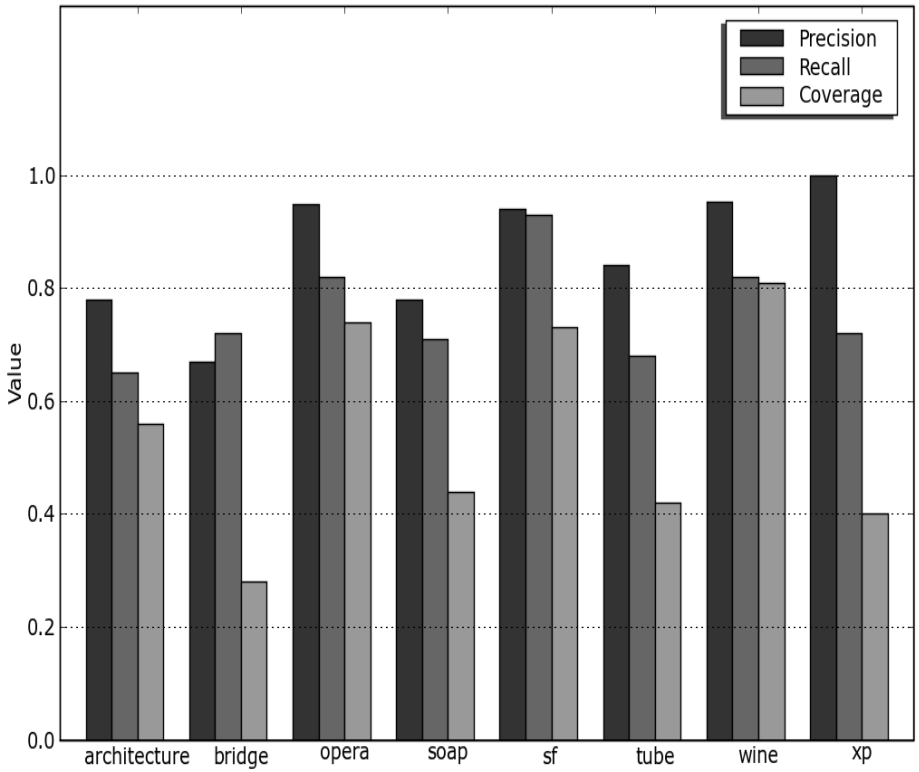
- Precision is generally quite high (67-100%)
- Clustering process provides good basis for the kNN classifier
- Low precision cases: different keywords even for same context

Recall



- Recall ranges from 65% to 93%
- Some documents cannot be classified (recognised)
- Mainly because that keywords do not match well

Coverage



- Has the largest range: 28-81%
- Due partly to low recall
- Some contexts not discovered by the clustering process (e.g. tube)
- Also, there are irrelevant results (e.g. bridge)

Conclusions

- Folksonomies offer rich information on the relations and semantics of tags, and can be used to enhance Web search
- Advantages over using of dictionaries or thesauruses (able to keep up with new meanings)
- Future research directions:

1. Building more comprehensive classifiers
2. Use of other clustering methods
3. Larger scale of evaluation

Thank You!

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