Modern Information Retrieval

Retrieval Evaluation

Reference Collections

CFC: The Cystic Fibrosis Collection

Performance Evaluation

- Most common measures of system performance are *time* and *space*
- *Time*: how fast does the system run?
- *Space*: what fraction of the available resources does the system consume?
- Time x Space: good metrics for data retrieval systems and for IR systems
- But, since answers in an IR system are only approximate, we must also evaluate the *quality* of those answers!

Retrieval Performance Evaluation

- To evaluate the quality of the approximate answers, we compare them with a set of *ideal* answers (provided by specialists).
- Clearly, we can only do this for a set of pre-defined example information requests, also referred to as *reference topics.*
- For each reference topic, the *ideal answer set* is provided.
- The documents used for generating the various ideal answer sets form a *reference collection*.

Retrieval Performance Evaluation

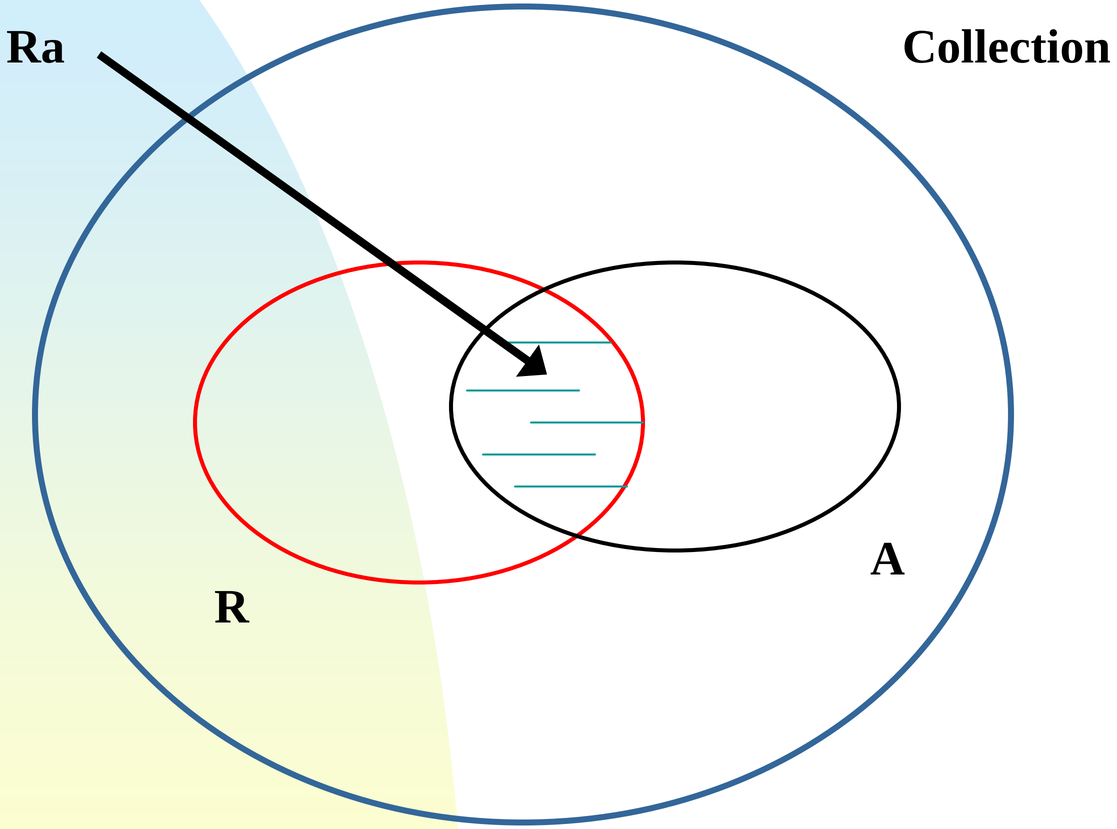
- The evaluation of the quality of a ranking algorithm involves then:
    - ◆ a reference collection
    - ◆ a set of reference topics
    - ◆ an ideal answer set for each reference topic
- The answers generated by a ranking algorithm (such as the vector model) are compared with the ideal answer sets to determine *how good* is the ranking.
- This process of evaluating the quality of a ranking is usually referred to as *retrieval performance evaluation*.

Precision and Recall

- Retrieval performance evaluation is often measured in terms of two metrics: *precision* and *recall*.
- Let,
  - ◆ I : an example information request (topic)
  - ◆ R : the ideal answer set for the topic I
  - ◆ |R| : number of docs in the set R
  - ◆ A : the answer set generated by a ranking strategy we wish to evaluate
  - ◆ |A| : the number of docs in the set A

Precision and Recall

- Relationship between the sets R and A, given I.



|Ra|
Recall = -----
|R|

|Ra|
Precision = -----
|A|

Precision and Recall

- The viewpoint using the sets R, A, and Ra, does not consider that documents presented to the user are ordered (i.e., ranked).
- User sees a ranked set of documents and examines them starting from the top.
- Thus, precision and recall vary as the user proceeds with his examination of the set A.
- Most appropriate then is to plot a curve of precision versus recall.

Precision and Recall

- Let Rq be the set of relevant docs for a query q
  - Rq = {d3, d5, d9, d25, d39, d44, d56, d71, d89, d123}

- Consider a new retrieval algorithm that yields the following set of docs as answers to the query q:

1. **d123**
2. d84
3. **d56**
4. d6
5. d8
6. **d9**
7. d511
8. d129
9. d187
10. **d25**
11. d38
12. d48
13. d250
14. d113
15. **d3**

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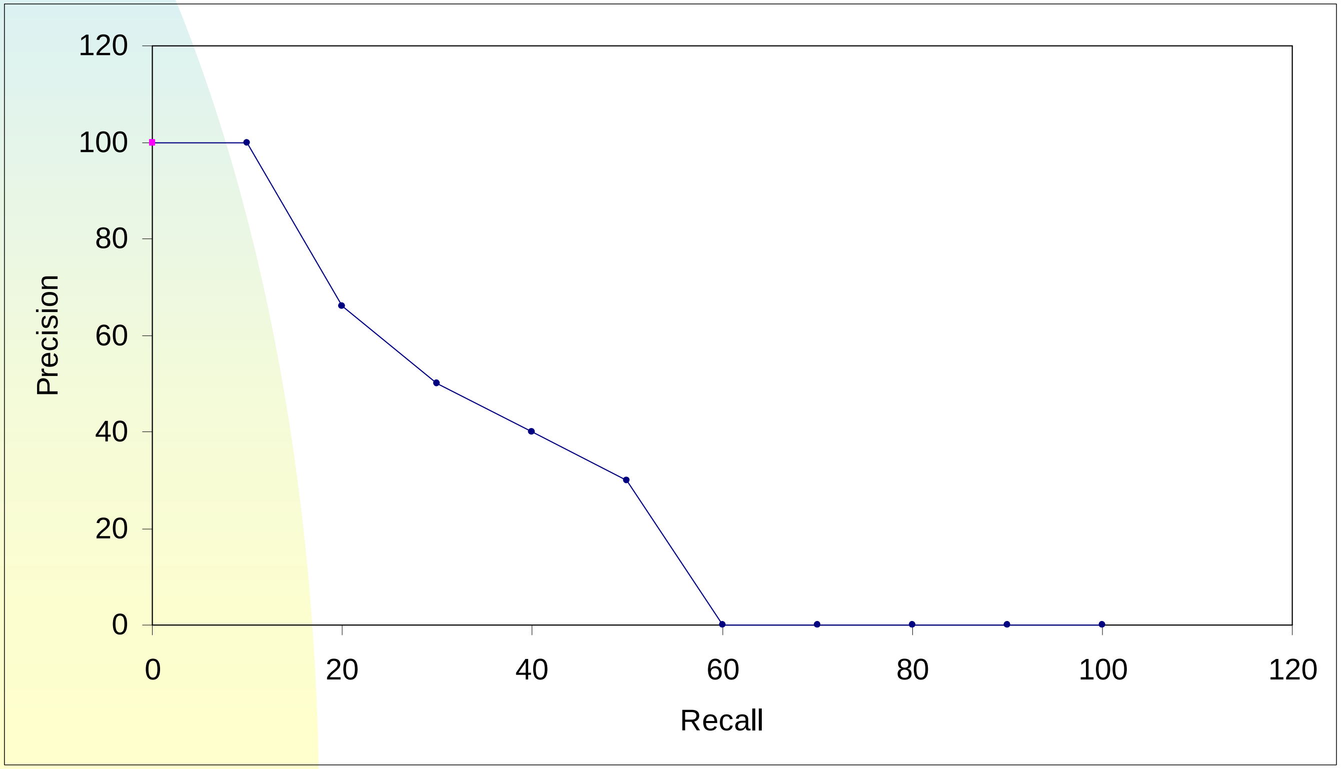


Precision and Recall

- Precision: a single query. What if multiple queries?
- Let Nq be the number of queries considered. Then,

$$\boxed{\mathrm{Avg}(P(r)) = \mathrm{sum} \; \frac{P_i(r)}{N_q}}$$

where, Pi(r) : precision at recall level r for the ith query.

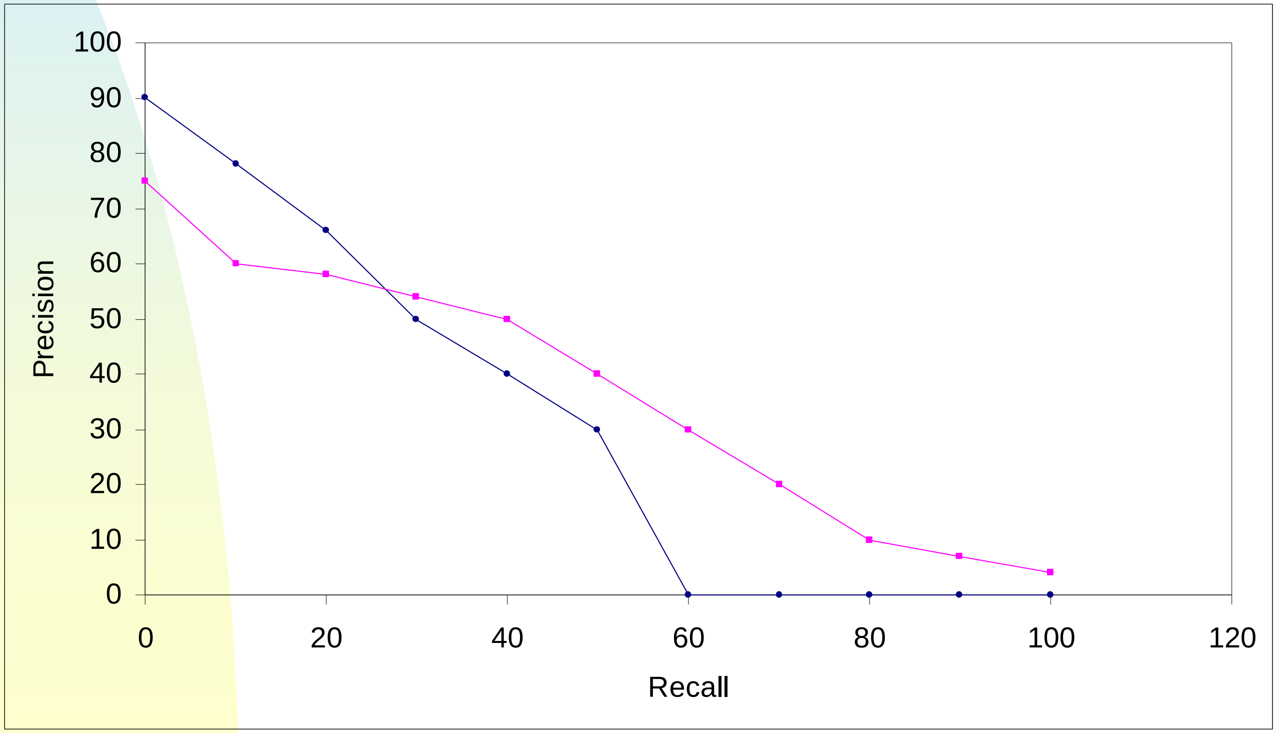
- In case the set Rq of relevant docs includes less than 10 docs, use interpolation:

$$\boxed{P(r_j) = \max_{r_j \le r \le r_{j+1}} P(r)}$$

where P(rj) is precision at recall level rj.

Precision and Recall

- Two distinct algorithms can be compared, over a set of Nq queries, by examing their curves of average precision and recall.



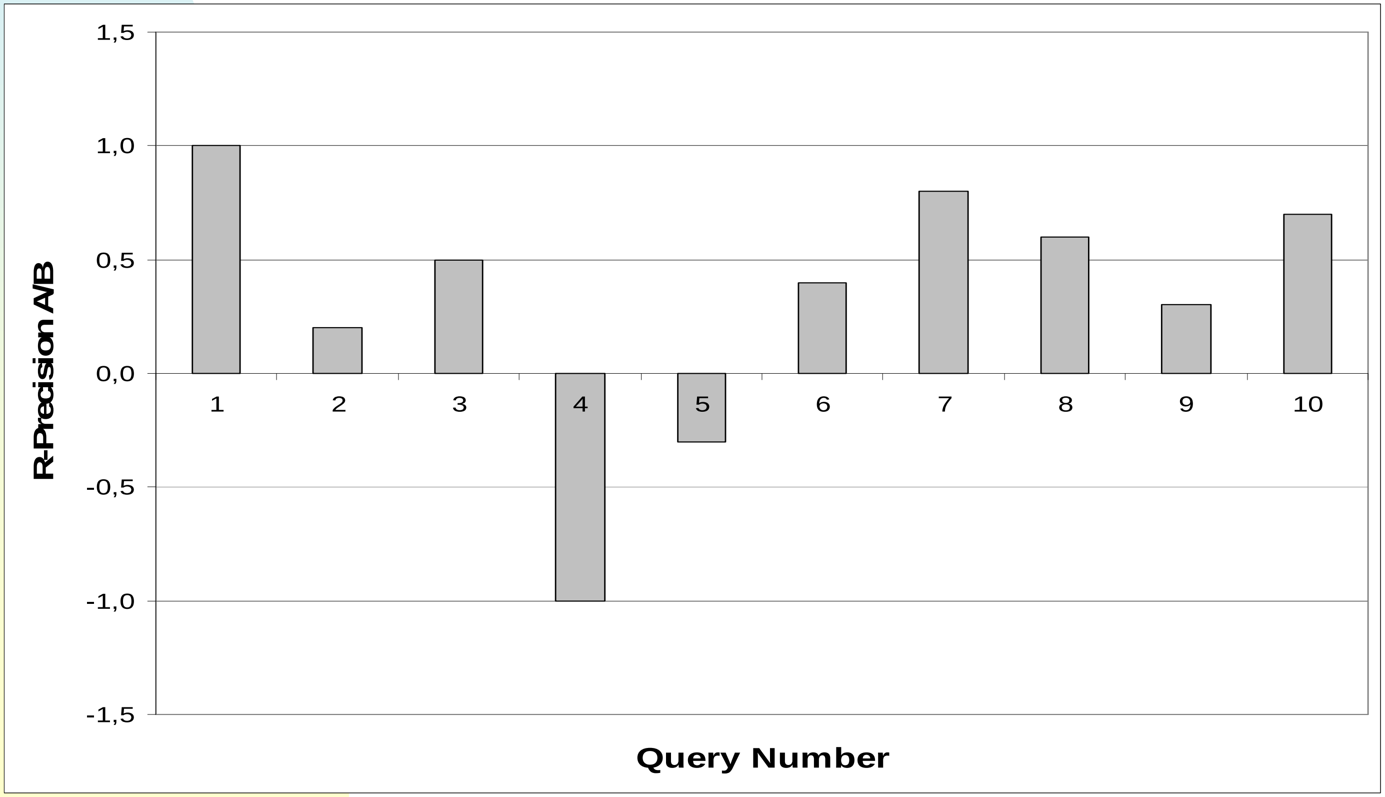
Single Value Summaries

- Precision and recall: average over Nq queries.
- How to evaluate retrieval performance over individual queries?
- Use a single number to summarize retrieval performance for each query.
- Let,
    - R be the total number of relevant docs for a query q.
- Define,
    - R-Precision: precision at the point at which exactly R docs have been examined.

Single Value Summaries

- Consider two retrieval algorithms A and B.
- Let,
  - RPa(i) : R-precision for algorithm A for the ith query
  - RPb(i) : R-precision for algorithm B for the ith query

$$\boxed{RPa/b(i) = RPa(i) - RPb(i)}$$



Trec Collection

- Standard reference collection most referred to nowadays.
- Annual Trec Conference at NIST, Maryland.
- Companies and research groups can then compare their retrieval systems.
- Reference collections are prepared for these comparative experiments:
  - Trec-3 : reference collection with 2 GBytes
  - Trec-6 : reference collection with 5.8 GBytes

Trec Collection

- Trec-6 is composed of docs from:
  - WSJ: Wall Street Journal
  - AP: Associated Press
  - ZIFF: Computer Selects, Ziff-Davis
  - FR: Federal Register
  - DOE: US DOE Publications
  - SJMN: San Jose Mercury News
  - PAT: US Patents
  - FT: Financial Times
  - CR: Congressional Record
  - FBIS: Foreign Broadcast Information Service
  - LAT: LA Times

Trec Collection

- Docs at TREC are represented in SGML:

```
<doc>
<docno> WSJ880406-0090 </docno>
<hl> AT&T Unveils New Services </hl>
<author> Janet Guyon </author>
<text>
American Telephone & Telegraphy Co.
introduced the first of a new generation of
phone services with broad ...
</text>
</doc>
```

Trec Collection

- Topics at TREC are detailed descriptions of information needs:

  <top>

  <num> Number: 168

  <title> Topic: Financina AMTRAK

  <desc> Description:

  A document will address the role of the Federal Government in financing the operation of the National Railroad Transportation Corporation (AMTRAK).

  <narr> Narrative: A relevant document must provide information on the government´s responsability to make AMTRAK an economically viable entity.

  </top>

Benchmark Tasks at Trec-6

- General:
  - Ad hoc
  - Routing
- Specific:
  - Chinese
  - Filtering (new incoming doc relevant?)
  - Interactive (user interacts with system)
  - NLP
  - Cross Languages
  - High precision (retrieve 10 docs in 5 minutes)
  - Spoken document retrieval (broadcast news)
  - Very Large Corpus (7.5 million documents; 20 GBytes)

CFC Collection

- 1,239 documents indexed with the term *cystic fibrosis* in the National Library of Medicine's MEDLINE
- Each doc record is composed of:

MEDLINE accession number
title
major subjects
abstract
citations

author
source
minor subjects
references

CFC Collection

- 100 information requests with extensive relevance judgements:
  - 4 separate relevance scores for each request
  - Scores proviced by human experts and by a medical bibliographer
  - Each score:
    - 0 (not relevant)
    - 1 (marginally relevant)
    - 2 (strongly relevant)

CFC Collection

- Small and nice collection for experimentation
- Number of information requests is large relative to the collection size
- Good relevance judgements
- For online access:
  - http://www.dcc.ufmg.br/irbook
  - http://www.sunsite.dcc.uchile.cl/irbook
  - http://www.sims.berkeley.edu/~hearst/irbook