

Applying Metasearch Technique to Medical Literature Retrieval for Evidence-Based Medicine

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Evidence-Based Medicine (EBM)

- ▶ EBM has been widely recognized as an important concept in medical domain
- ▶ Evidence-based health care is the conscientious use of current best evidence in making decisions about the care of individual patients or the delivery of health services
- ▶ Current best evidence is up-to-date information from relevant, valid research about the effects of different forms of health care
- ▶ Ghosh et al. said, future competence of the physician is not measured by his or her ability to recall facts but by the ability of incorporate the best current evidence into the patient's personal values

Evidence-Based Medicine (EBM)

- ▶ Elements of evidence based learning
 - ▶ **Asking**—converting the clinical puzzle into an answerable question
 - ▶ **Accessing**—searching to find the answer to that question
 - ▶ **Appraising**—critically evaluating the evidence to decide if it is, and if so how, reliable and robust
 - ▶ **Applying**—extracting the useful information and addressing the thorny issues of generalisability and "particularis-ability" to decide what clinical action is best
 - ▶ **Assessing**—evaluation of the process to integrate this element into the quality improvement cycle

Evidence-Based Medicine (EBM)

- ▶ Appraising

- ▶ Methodological quality classification
 - ▶ Is this study reliable?
- ▶ Study design, execution, analysis method
 - ▶ e.g. Inclusion and exclusion criteria for subject selection

Strength of persuasiveness	Type of study design
weak	Case report
	Case series study
	Ecologic study
	Cross-sectional study
	Case-control study
	Cohort study
Strong	Randomized controlled clinical trial

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PubMed

- ▶ Boolean search engine
- ▶ PubMed comprises more than 20 million citations for biomedical literature
- ▶ The effectiveness of Boolean search engine depends entirely on the user
 - ▶ To make proper use, users need to have training or certain amount of experience
- ▶ PubMed, operating on Boolean searching algorithm, ranks results by date
 - ▶ Building appropriate Boolean query and exhaustively exploring through search results might be cumbersome for clinicians

PubMed

- ▶ To examine the effects of doxycycline compared with placebo or no intervention on pain and function in patients with osteoarthritis of the hip or knee.

OVID MEDLINE

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Google Scholar

 [Advanced Scholar Search](#)

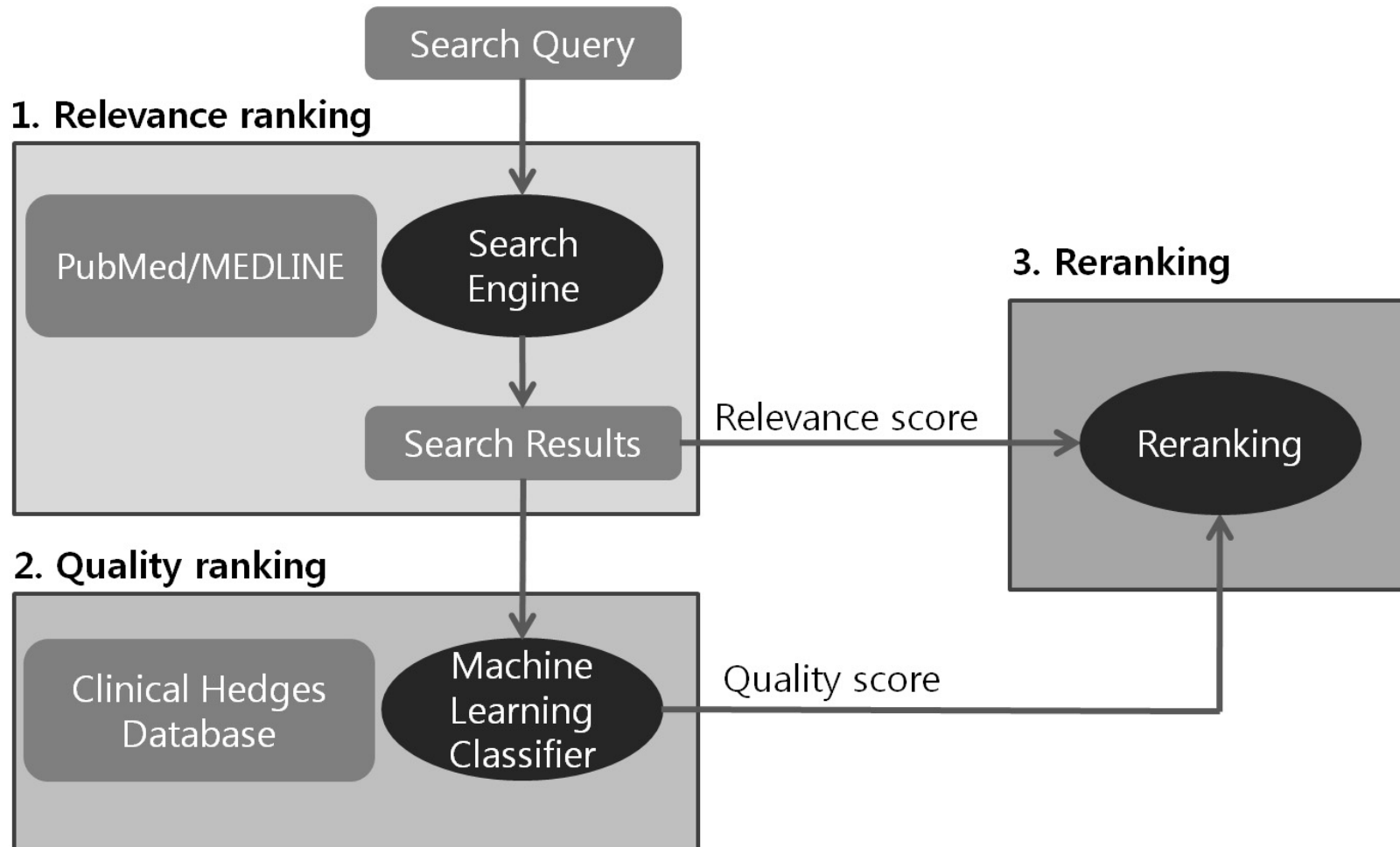
TH: How does Google Scholar rank search results?

AA: We try to rank search results as a researcher in the area would. We take into account many factors, including who wrote the article, where it was published, how relevant the article is to the query, and what other articles have said about it.

- ▶ ‘plug-in-the-keyword-and-hope-for-the-best-tool’? ²
- ▶ Poor choices for serious search questions, such as clinical queries, bibliographic reviews, comprehensive literature searches, or other questions that require a more sophisticated approach

7 1. *An interview with Anurag Acharya, Google Scholar lead engineer.* **94**(1): p. 97-99.
2. Vine, R., *Google Scholar.* Journal of the Medical Library Association 2006.

Experiment



Metasearch

- ▶ **Linear combination**

Reranking Score = *Relevance score* + *Quality score*

- ▶ **Weighted linear combination**

Reranking Score = α * *Relevance score* + β * *Quality score*

- ▶ **Multiplicative combination**

Normalized Quality Score = $(\text{Quality score} - \text{Min}) / (\text{Max} - \text{Min})$

Reranking Score = *Relevance score* * *Normalized Quality score*

- ▶ **Weighted multiplicative combination.**

Reranking Score = $(\text{Relevance score})^\alpha * (\text{normalized Quality score})^\beta$

Metasearch

- ▶ **Borda-fuse**

Reranking Score = $1 / (\text{Relevance rank} + \text{Quality rank})$

- ▶ **Weighted Borda-fuse**

Reranking Score = $1 / (\alpha * \text{Relevance rank} + \beta * \text{Quality rank})$

- ▶ **SVM^{rank}**

Test collection – *Cochrane Reviews*

[Intervention Review]

Donepezil for mild cognitive impairment  Query

Objectives  Information need

To assess the effects of donepezil in people with mild cognitive impairment but no diagnosis of dementia.

1. Identification of relevant studies from a number of different sources
2. Selection of studies for inclusion and evaluation of their strengths and limitations on the basis of clear, predefined criteria

Gold Standard

REFERENCES

References to studies included in this review

401 *{published data only}*

* Salloway S, Ferris S, Kluger A, Goldman R, Griesing T, Kumar D, Richardson S, for the Donepezil '401' Study Group. Efficacy of donepezil in mild cognitive impairment. *Neurology* 2004;**63**: 651–657.

Chen 2006 *{published data only}*

Chen X, Magnotta VA, Duff K, Boles Ponto LL, Schultz SK. Donepezil effects on cerebral blood function in older adults with mild cognitive deficits. *Journal of Neuropsychiatry and Clinical Neurosciences* 2006;**18**(2):178–185.

References to studies excluded from this review

Ozenli 2007 *{published data only}*

Ozenli Y, Yagci D, Karaca S. Efficacy of donepezil on cognitive functions in mild cognitive impairment. *Klinik Psikofarmakoloji Bulteni* 2007;**17**(2):62–67.

Pelton 2008 *{published data only}*

* Pelton GH, Harper OL, Tabert MH, Sackeim HA, Scarmeas N, Roose SP, Devenand DP. Randomized double-blind placebo-controlled donepezil augmentation in antidepressant-treated elderly patients with depression and cognitive impairment: a pilot study. *International Journal of Geriatric Psychiatry* 2008;**23**(7):670–676.

Test collection – *Cochrane Reviews*

Test Collection	Source	Number
Corpus	Journal Citations (2009 MEDLINE®/PubMed®)	17,764,826
Queries	Title of <i>Cochrane Reviews</i>	145
Gold Standard	<i>References Included</i>	1,559

Among 17 million documents, search 11 gold standard documents per each query

Experimental result

Reranking method	MAP %
Relevance ranking	7.4
Quality ranking (Baseline)	8.2
Linear Combination	13.0
Multiplicative Combination	16.4
Borda-fuse	19.6
Weighted Linear Combination	14.7
Weighted Multiplicative Combination	16.0
Weighted Borda Fuse	16.0
SVM ^{rank}	14.5

On the Dark side

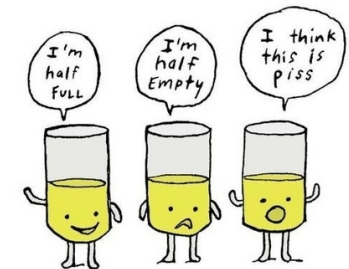
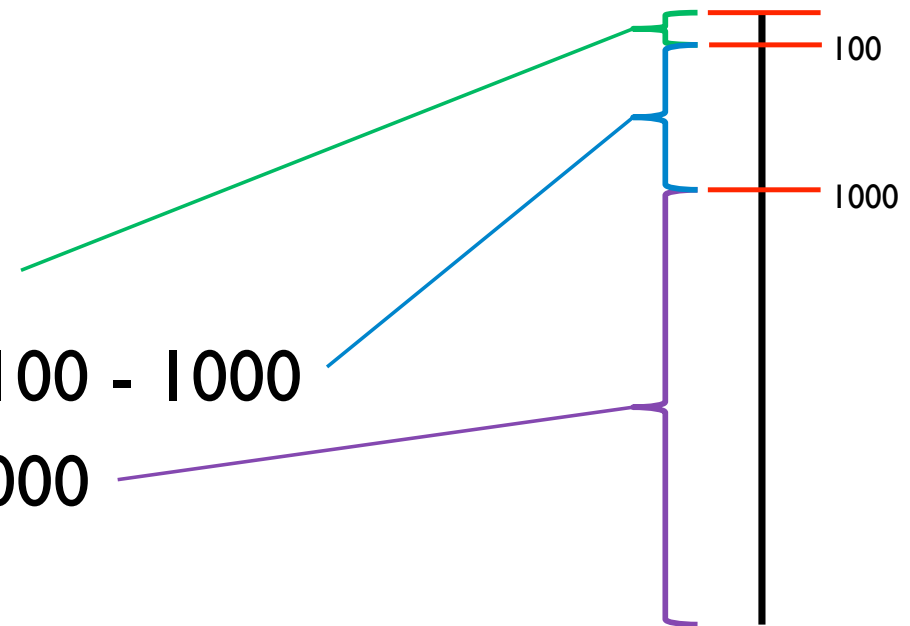


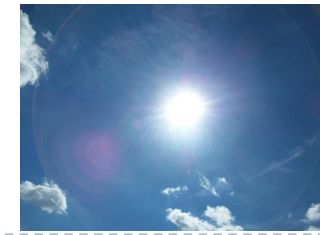
- ▶ MAP approached almost 20%, but far from 100%

Recall

Among gold standard documents,

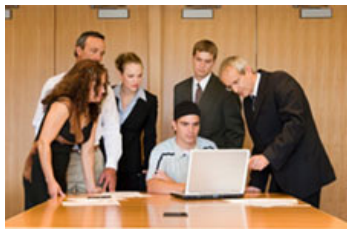
- ▶ 25% : ranked within top 100
- ▶ 25% : ranked between rank 100 - 1000
- ▶ 50% : ranked outside rank 1000





On the Bright side

- ▶ Not all users are sophisticated user
- ▶ Highly time efficient and convenient



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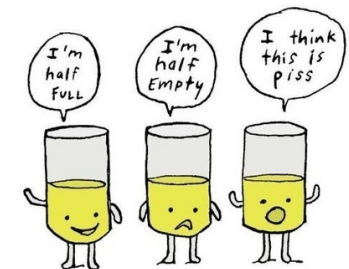
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‘Doxycycline for osteoarthritis of the knee or hip’



Conclusion

- ▶ Confronted with difficulty of complex search task in medical domain, we tried to build effective search system, by reflecting relevance and quality aspects together into the ranking algorithm

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