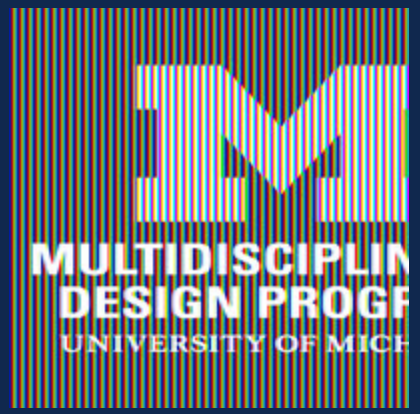


COLLEGE OF ENGINEERING
HONORS PROGRAM
UNIVERSITY OF MICHIGAN

NLP in Medical Document Retrieval

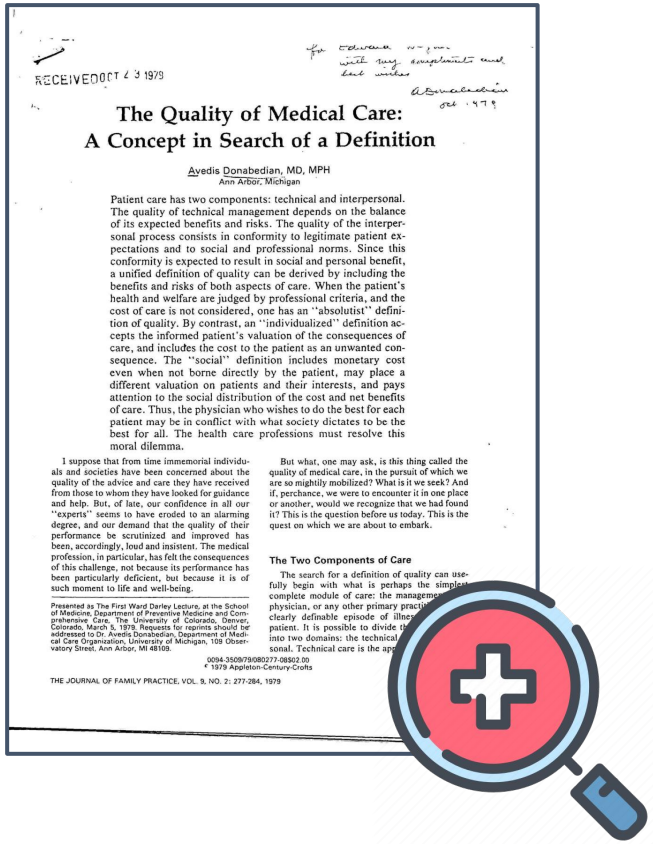
12/12/2020

Team: Ashwin Pothukuchi, Hongting Zhu, Joel Guo

Thanks to: Brian Noble, Kevin Hastie, and Daniel Dsouza

Background

- Large database with billions of records
- Authoritative sources for students & professionals
- Powerful and efficient search for medical papers



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The Quality of Medical Care:
A Concept in Search of a Definition

Avedis Donabedian, MD, MPH
Ann Arbor, Michigan

Patient care has two components: technical and interpersonal. The quality of technical management depends on the balance of its expected benefits and risks. The quality of the interpersonal process consists in conformity to legitimate patient expectations and to social and professional norms. Since this conformity is expected to result in social and personal benefit, a unified definition of quality can be derived by including the benefits and risks of both aspects of care. When the patient's health and welfare are judged by professional criteria, and the cost of care is not considered, one has an "absolutist" definition of quality. By contrast, an "individualized" definition accepts the informed patient's valuation of the consequences of care, and includes the cost to the patient as an unwanted consequence. The "social" definition includes monetary cost even when not borne directly by the patient, may place a different valuation on patients and their interests, and pays attention to the social distribution of the cost and net benefits of care. Thus, the physician who wishes to do the best for each patient may be in conflict with what society dictates to be the best for all. The health care professions must resolve this moral dilemma.

I suppose that from time immemorial individuals and societies have been concerned about the quality of the advice and care they have received from those to whom they have looked for guidance and help. But, of late, our confidence in all our "experts" seems to have eroded to an alarming degree, and our demand that the quality of their performance be scrutinized and improved has been, accordingly, loud and insistent. The medical profession, in particular, has felt the consequences of this challenge, not because its performance has been particularly deficient, but because it is of such moment to life and well-being.

But what, one may ask, is this thing called the quality of medical care, in the pursuit of which we are so mightily mobilized? What is it we seek? And if, perchance, we were to encounter it in one place or another, would we recognize that we had found it? This is the question before us today. This is the quest on which we are about to embark.

The Two Components of Care

The search for a definition of quality can usefully begin with what is perhaps the simplest complete module of care: the management by a physician, or any other primary practi clearly definable episode of illnes patient. It is possible to divide th into two domains: the technical sonal. Technical care is the app

Presented as The First Ward Darley Lecture, at the School of Medicine, Department of Preventive Medicine and Comprehensive Care, The University of Colorado, Denver, Colorado, March 5, 1979. Requests for reprints should be addressed to Dr. Avedis Donabedian, Department of Medical Care Organization, University of Michigan, 109 Observatory Street, Ann Arbor, MI 48109.

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But...

- Difficult search query composition
- Inaccurate results from outdated algorithm

How to improve?

- Similar document suggestion with user-selected result
- Unsupervised learning

Dataset collection

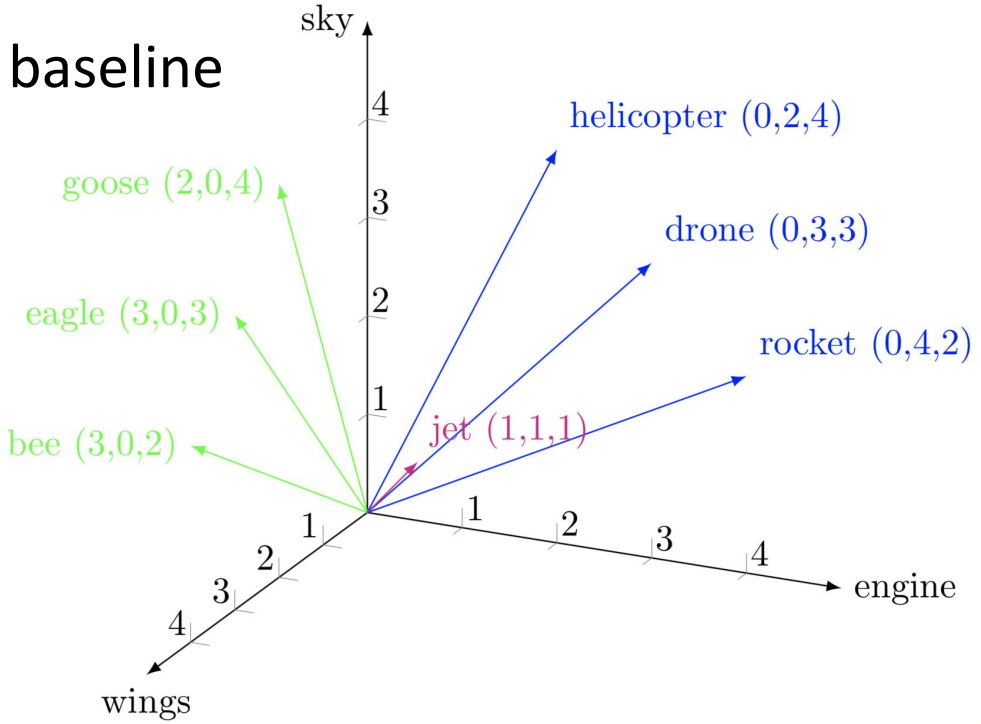
- Corpora.xml from sponsors
- Popular research databases
- Comparison and evaluation

Deep Learning in NLP

- Generally higher performance
- NLP tasks include:
  - Machine translation
  - ***Document summarization and classification***
  - Word prediction
- Popular deep learning models for NLP include:
  - Word2Vec, GloVe, fastText
  - RNN-based: LSTM, ELMo
- Transformer-based: BERT variants, XLNet, OpenAI Transformer

Document to Vector

- Represent document as a numeric vector which best describes it characteristics
- Cluster vectors based on vector cosine similarity
- Measured accuracy
- Compared with the old algorithm in use as baseline

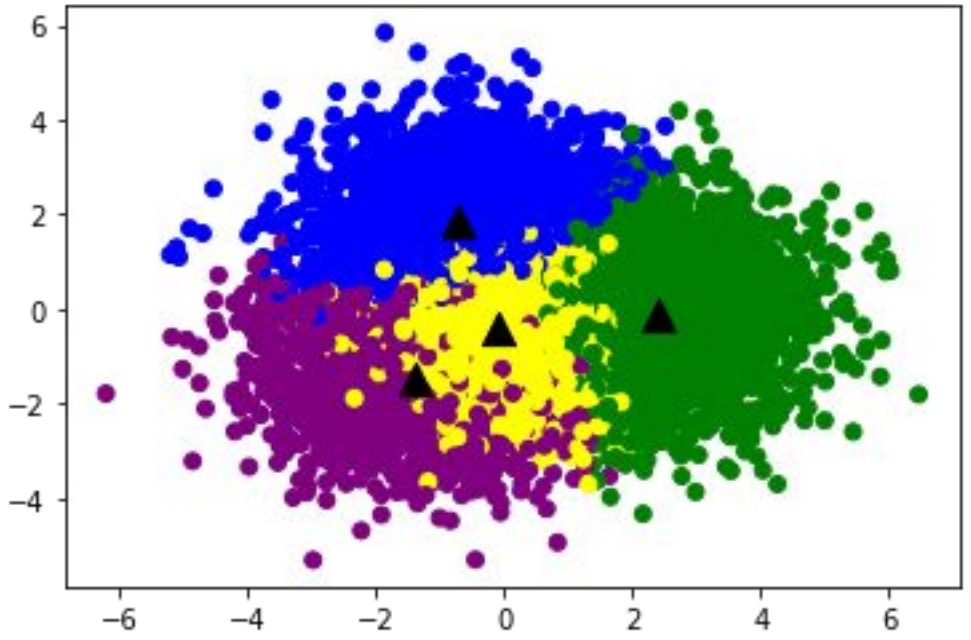


Performance Evaluation

- K-Means Clustering on all documents
- Textual coherence
  - calculate Jensen-Shannon Divergence (JSD) for every cluster
  - Normalize and average the JSD for the entire corpus
- Grant-to-linkage evaluation (G2A)
  - Grant-based similarity
  - How many similar articles have the same grant
  - herfindahl-hirschman index

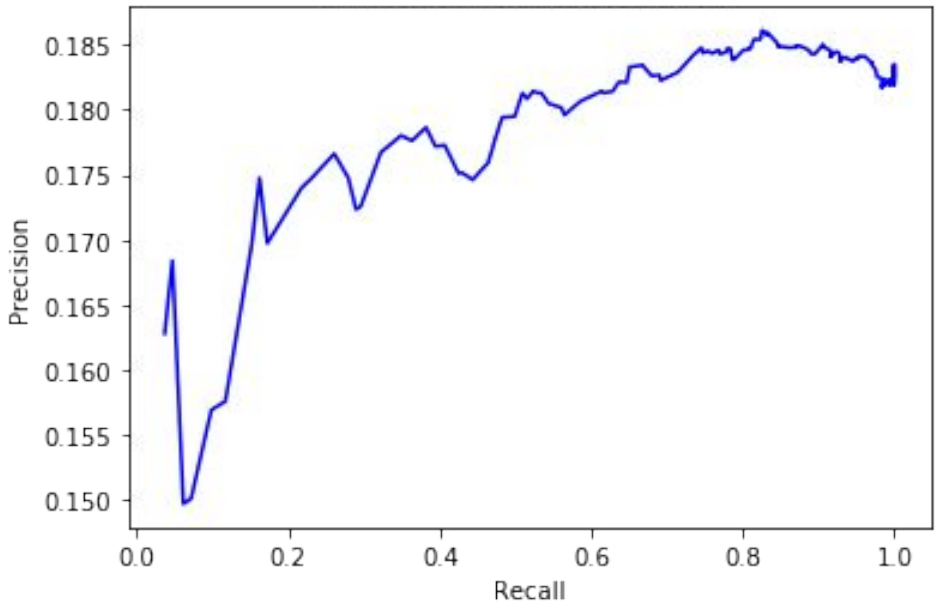
Result - Textual coherence

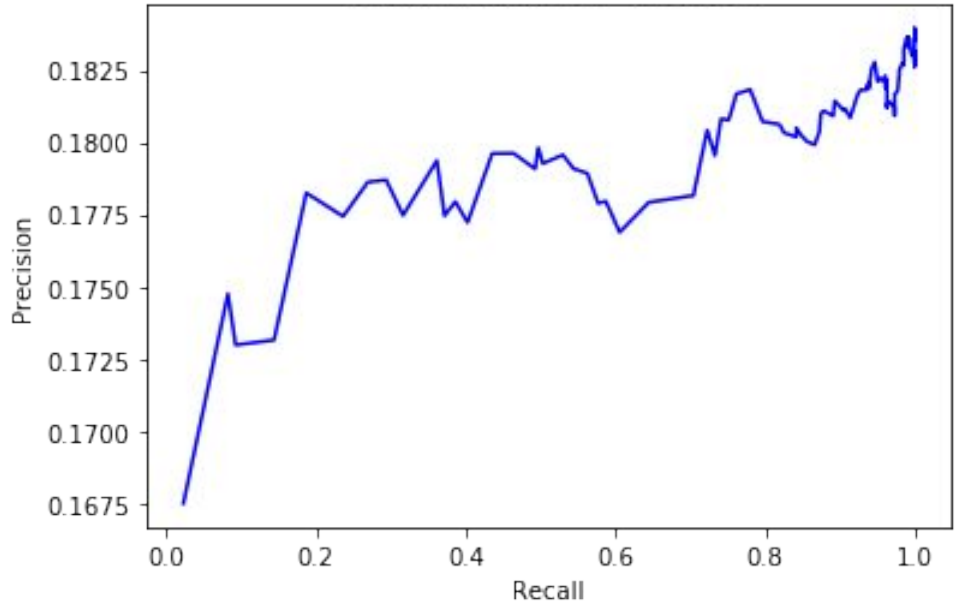
- Textual Coherence of new clustering solution: 0.198
- Textual Coherence of old clustering solution: 0.194
- Biased towards old solution, still promising to see new outperform old by 2%



Result - G2A

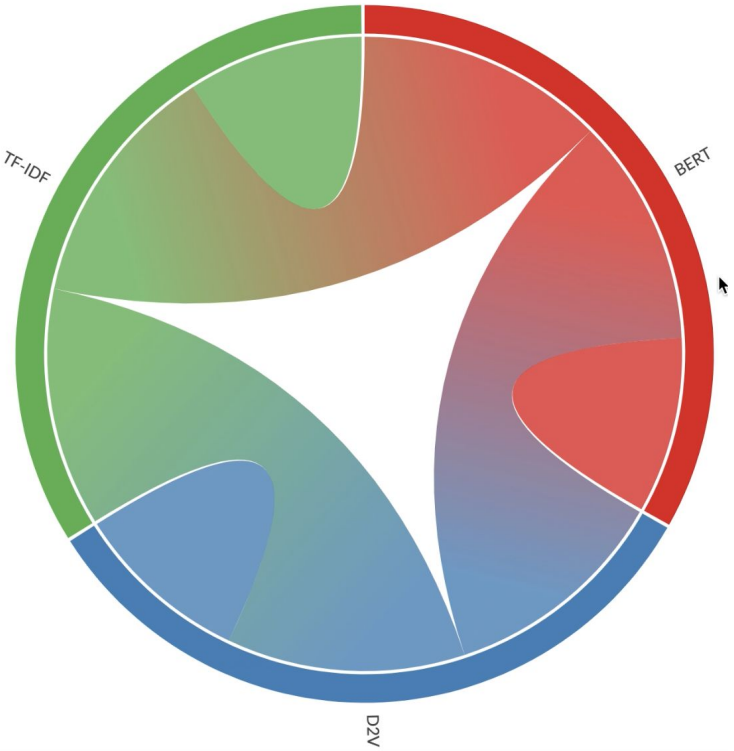
- New vs Old
- Higher precision, faster convergence





Conclusion

- Better similarity from retrieved documents
- Very low cost of evaluation instead of expensive human rating
- Great scalability for large corpus



Future challenge

- Integrate query information
- Ranker on similarity results
  - Telescoping
  - Learn-to-rank rankers

Thank you!