Polyrepresentative Clustering: A Study of Simulated User Strategies and Representations

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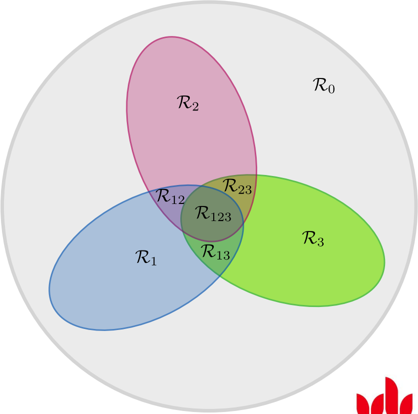
Outline

Introduction

- Principle of Polyrepresentation in IIR
- Multiple representations of information need and information object (documents)
  - Cognitive overlap supposed to contain relevant documents
- Combination of document clustering and polyrepresentation

Polyrepresentation and Clustering

- Polyrepresentation creates partitions
- Clustering partitions document sets too
- Can clustering help in creating polyrepresentative partitions?



Information Need-based Vector

- Let REP_{in} be the set of representations[1] of an information need *in*
- Motivated by the Optimum Clustering Framework (OCF) which is based on the probability of relevance (Fuhr et al., 2011)
- $\Pr(R|d, r_i)$ is computed for each document d and $r_i \in REP_{in}$

$$\vec{\tau}_{in}(d) = \begin{pmatrix} \Pr(R|d, r_1) \\ \vdots \\ \Pr(R|d, r_n) \end{pmatrix} \tag{1}$$

[1] search terms, work task, ideal answer, current info need, background knowledge

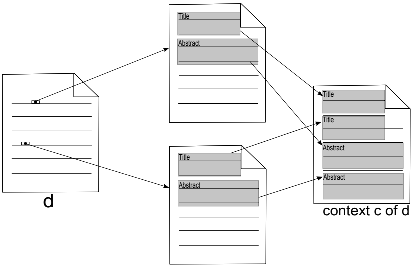
Document-based Polyrepresentation Vector

- REP_d consists of the different representations[2] rd_i of a document d
- thus the $\Pr(R|rd_i, q)$ for q (search terms in this case) is computed

$$\vec{\tau}_{doc}(d) = \begin{pmatrix} \Pr(R|rd_1, q) \\ \vdots \\ \Pr(R|rd_n, q) \end{pmatrix} \tag{2}$$

[2] title, abstract, body, context, references

Bibliographic context



Representation Concatenation and Combinations

IN and Doc representation concatenation and combinations were used

For example:

- Concatenation of $REP_{doc}|REP_{in}$:

$$\tau_{(in\ doc)}(d) = (P(R|d, r_1), \ldots, P(d, r_n), P(R|rd_1, q), \ldots, P(R|rd_m, q))\,.$$

- Combination of REP_{doc} or REP_{in}
  - for Doc : {title, abstract}, {title, body text}...
  - for IN: {search terms, work task}, {search terms, ideal answer}...

Simulated User Strategies

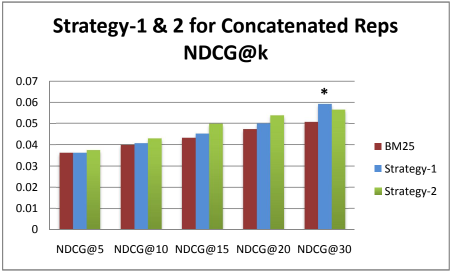
- Simulated User Strategy-1
  - From each cluster: take top l documents (sorted based on weights) and add them to a list
  - Sort documents in final list based on their weights and evaluate
- Simulated User Strategy-2
  - From first cluster take 1st document, add it to the list
  - Check if this document is relevant, if it is, then take next document from same cluster
  - If added document is not relevant switch to next cluster and take its first document
  - Follow the procedure until last cluster is reached
  - Sort documents in final list based on their weights and evaluate

Experiment Setup

- PF (full text) sub collection of iSearch collection
  - 65 search tasks
- IN and Document vectors as discussed above
- Terrier 3.5 was used for indexing and retrieval
- Using k-means $2^{|REP|}$ number of cluster were computed
- BM25 to estimate $\Pr(R|rd_i, q)$ and $\Pr(R|d, r_n)$, then apply Strategy-1 resp. Strategy-2 (yields a ranking)
- Baseline BM25 ranking: CombSUM of $\Pr(R|rd_i, q)$ and $\Pr(R|d, r_n)$ (its respective concatenation and combination)

Evaluation Results

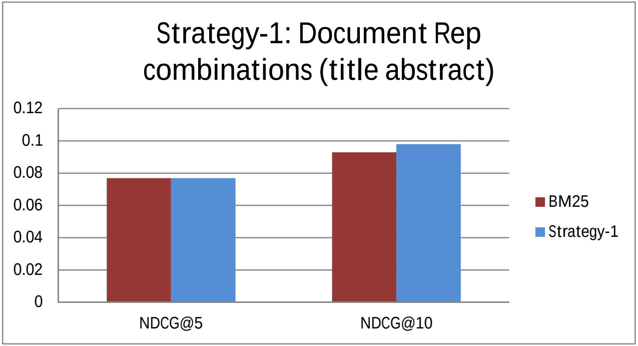
Strategy 1 & 2 for IN & Doc Reps Concatenated



* shows statistically significant difference from baseline at $p < 0.05$

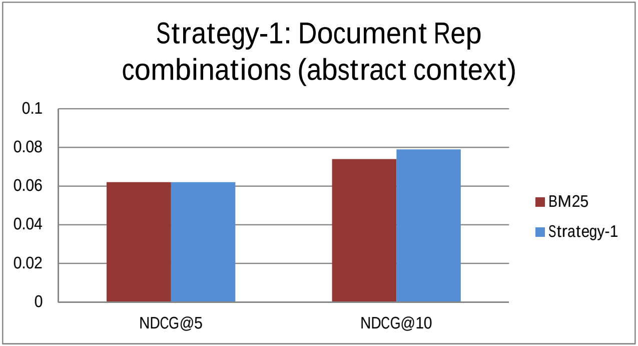
Evaluation Results

Strategy 1 for Doc Rep combination (title abstract)



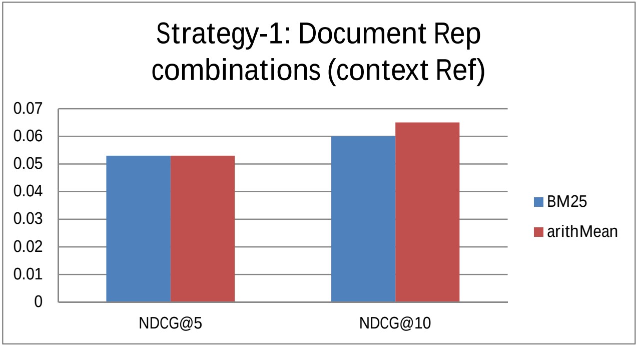
Evaluation Results

Strategy 1 for Doc Rep combination (abstract context)



Evaluation Results

Strategy 1 for Doc Rep combination (context reference)



Conclusion

- A polyrepresentative clustering strategy seems to improve effectiveness
- Bibliometric information i.e. citation context and references could be helpful as representations (but needs further investigation
- (Simulated) user strategies have potential to be used for Interactive IR evaluation

Norbert Fuhr, Marc Lechtenfeld, Benno Stein, and Tim Gollub. The Optimum Clustering Framework: Implementing the Cluster Hypothesis. *Information Retrieval*, 15(2):93–115, 2011. doi: 10.1007/s10791-011-9173-9. URL http://www.springerlink.com/content/p07276193341q351/.