

Harnessing Semantics for Answer Sentence Retrieval

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Outline

Task

Answer sentence retrieval: What's the challenge?

Methodology

Lexical and semantic matching

Learning-to-rank approach

Result

A ranking experiment

Answer Sentence Retrieval

Some questions solicit multiple-sentences answers

- Non-factoid;
- Verbose;
- Not necessarily posed as effective queries.

Research questions:

- i. What best characterizes “answer finding” as a specialized retrieval task?*
- ii. Will incorporating semantics result in better performance?*

“What was the role of Portugal in World War II?”

Google During **World War II** the **Portuguese** Republic was an authoritarian political regime under António de Oliveira Salazar and the Estado Novo, often regarded as pro-fascist. Although **Portugal** was officially a neutral country, it exported goods to the Allies as well as Germany and other neutral countries.

Annotated answers from GOV2

Perfect **Portugal** supplied a variety of vital mineral resources for the Third Reich's **war** machine, including the ore for tungsten, a key additive used in the production of weapon-grade steel.

Excel The **Portuguese** Government allowed Jewish organizations to relocate from Occupied Europe to Lisbon during the **war**.

Good **Portugal** only provided some \$4 million of the some \$51 million the Allies initially sought with negotiations dragging on throughout the 1950s.

None Angola Civil **war** has been the norm in Angola since independence from **Portugal** in 1975.

Matching Questions to Answers

Lexical

Synonymy

Contextual

Structural

Factual

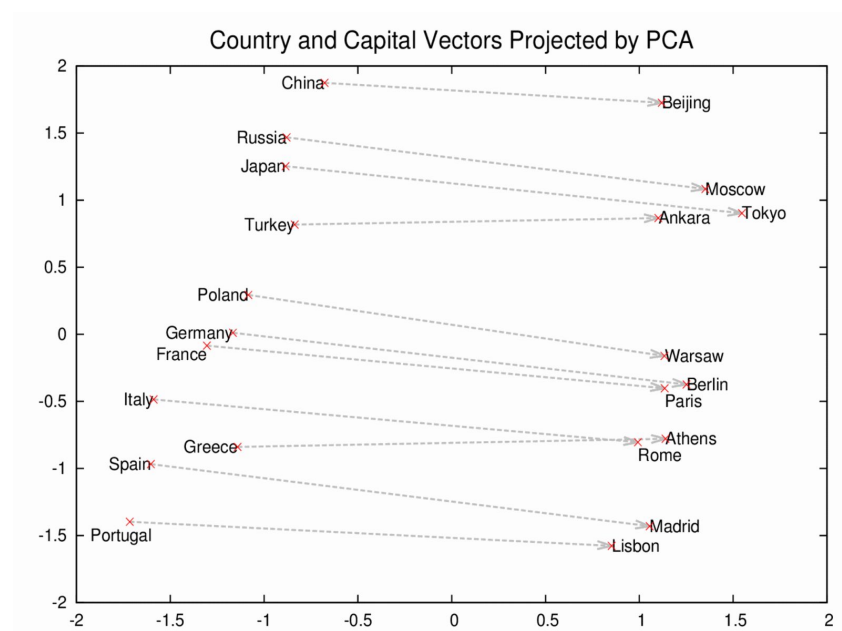
← What we're looking for

Semantic Representations

Explicit Semantic Analysis



Word2Vec



Gabrilovich and Markovitch. 2007. "Computing Semantic Relatedness Using Wikipedia-based Explicit Semantic Analysis." In *IJCAI*, vol. 7, pp. 1606-1611.

Mikolov et al. 2013. "Distributed representations of words and phrases and their compositionality." In *Advances in neural information processing systems*, pp. 3111-3119.

Features

Lexical Features (Metzler & Kanungo, 2008)

SentenceLength
SentenceLocation
ExactMatch
TermOverlap
SynonymOverlap
LanguageModel

1. Build index over a recent dump of English Wikipedia
2. Retrieve top-100 concepts for each sentence/query
3. Compute distance by cosine similarity

Semantic Features

ESACosineSimilarity
Word2Vec

1. Use the pretrained 100B word model on Google News
2. Compute distance by

$$\frac{1}{|Q||S|} \sum_{\vec{u} \in Q} \sum_{\vec{v} \in S} \frac{\vec{u} \cdot \vec{v}}{\|\vec{u}\| \|\vec{v}\|}$$

Learning to Rank

Collection	WebAP Dataset (82 topics, 991K sentences)
Feature Extraction	<ul style="list-style-type: none">● Metzler-Kanungo: 6 features● Semantic: 2 features (ESA and word2vec)
Rankers	<ul style="list-style-type: none">● Coordinate Ascent● MART

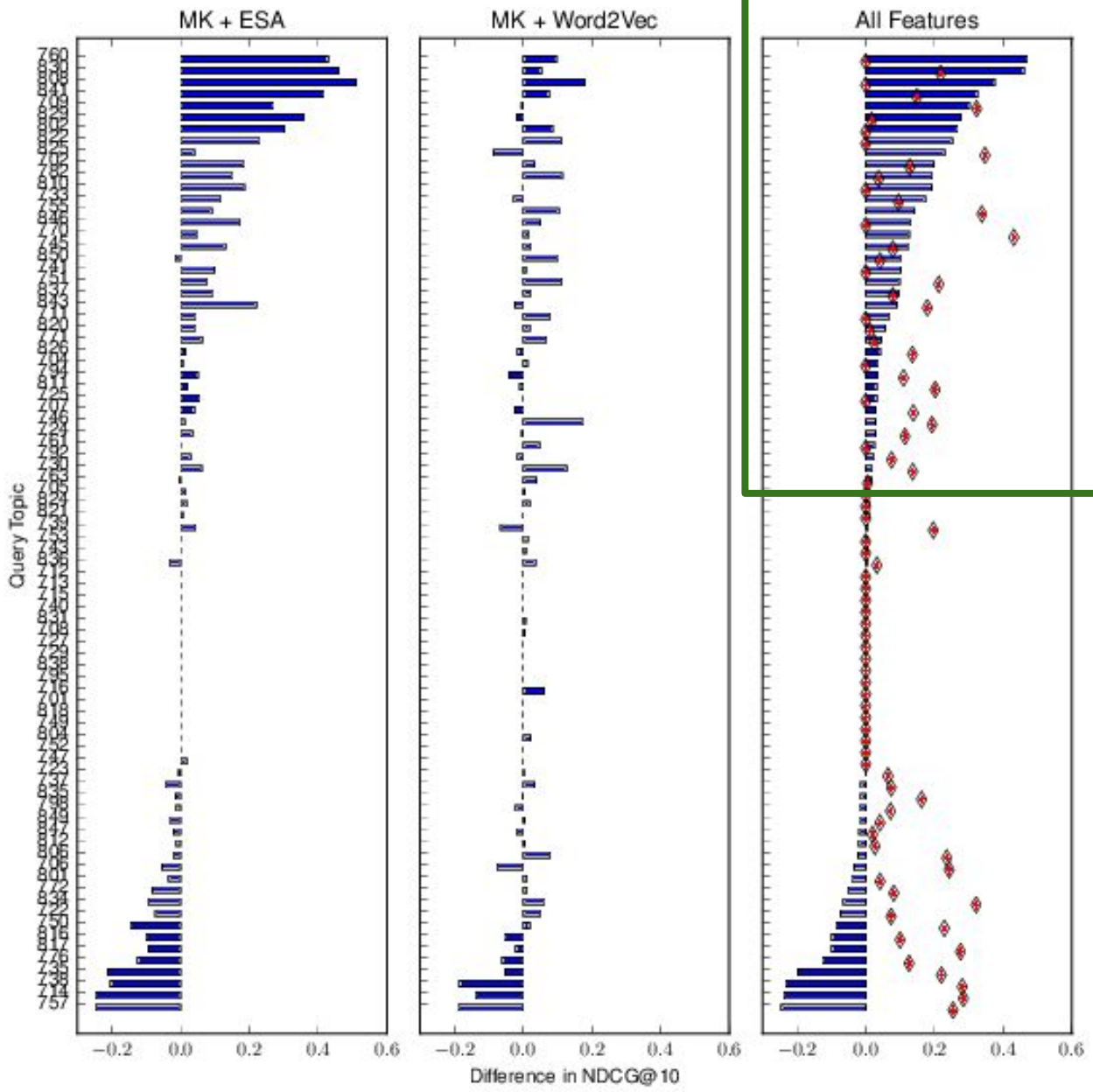
WebAP Dataset <https://ciir.cs.umass.edu/downloads/WebAP/>
RankLib <http://sourceforge.net/p/lemur/wiki/RankLib/>

Result: Single Features

Feature	NDCG@10	P@10	MRR
SentenceLength	0.0036	0.0037	0.0174
SentenceLocation	0.0000	0.0000	0.0056
ExactMatch	0.0194	0.0220	0.0529
TermOverlap	0.0618	0.0622	0.1978
SynonymOverlap	0.0272	0.0293	0.1058
LanguageModel	0.0721	0.0866	0.1980
ESACosineSimilarity	0.1053	0.1171	0.2690
Word2Vec	0.0634	0.0720	0.1924

Result: Learning to Rank

Feature Set	Algorithm	NDCG@10	P@10	MRR
MK	Coordinate Ascent	0.0667	0.0788	0.1954
MK + ESA		0.1080*	0.1221*	0.2694
MK + Word2Vec		0.0810	0.0936	0.2278
All Features		0.1114**	0.1240*	0.2778
MK	MART	0.0603	0.0699	0.1754
MK + ESA		0.0994**	0.1119*	0.2404
MK + Word2Vec		0.0699	0.0769	0.1985
All Features		0.0953*	0.1088**	0.2363



Run	Rel	Top-1 Sentence
<i>711: What security measures have been employed at train stations due to heightened security concerns?</i>		
MK	0	The biggest concern in the minds of security personnel is the possibility of a person boarding a bus or train with a gun or other weapon.
MK+ESA	0	Two major cooperatives in the fertilizer industry, Farmland and CF Industries, have always been aware of potential security concerns, but both have increased their guard as security threats have become a heightened concern in a post-Sept. 11 world.
MK+Word2Vec	3	"Amtrak responded admirably to the crisis, quickly training personnel on heightened security and safety procedures, assigning more security officers to stations and trains, and requiring passengers to bring photo identifications for security checks," Schumer wrote.
<i>770: What is the state of Kyrgyzstan-United States relations?</i>		
MK	0	(3) Kyrgyzstan concluded a bilateral investment treaty with the United States in 1994.
MK+ESA	4	The extension of unconditional normal trade relations treatment to the products of Kyrgyzstan will enable the United States to avail itself of all rights under the World Trade Organization with respect to Kyrgyzstan.
MK+Word2Vec	0	(begin text) U.S. DEPARTMENT OF STATE Office of the Spokesman January 15, 2002 Media Note RELIGIOUS LEADERS FROM KYRGYZSTAN EXAMINE ISLAM IN THE UNITED STATES


Feedbacks






“It is somewhat disappointing that the improvements over ESACosineSimilarity are rather limited.”


Author 1: I share your feeling





“Enhance the by-topic analysis and more detailed analysis...”


Author 2: Don't wanna read too much out of the data.





 **Mark Sanderson** @IR_oldie · Aug 22
"Harnessing Semantics for Answer Sentence Retrieval" using Word2Vec & ESA.
Appearing at #cikm2015 ESAIR workshop marksanderson.org/publications/m...


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 **Claudia Hauff** @CharlotteHase · Aug 24
[@IR_oldie](#) Interesting! ESA > Word2Vec. Do you think this is an artifact of the used training corpora? Or is it the task (corpus)?


   





 **Mark Sanderson** @IR_oldie · Aug 24
[@CharlotteHase](#) Best guess is that it's the task

   1 

 **Mark Sanderson** @IR_oldie · Aug 24
[@CharlotteHase](#) [@damiano10](#) adds "Wikipedia has more coverage than the pre-trained word2vec model. ESA is a less sparse feature"

   2 

 **Claudia Hauff** @CharlotteHase · Aug 24
[@IR_oldie](#) [@damiano10](#) good to know! I might have to look into re-training word2vec then for our projects. We are trying similar things.

   2 

ESA remains the single most useful feature as of today



Fernando Diaz @fdiaz_msr · Aug 24

@CharlotteHase @IR_oldie @damiano10 often, the more similar to the target, the more helpful the external corpus. dx.doi.org/10.1145/114817...



1



Fernando Diaz @fdiaz_msr · Aug 24

@CharlotteHase @IR_oldie @damiano10 which suggests massive query expansion (with target or auxiliary corpus) as a baseline for these exp's.



Claudia Hauff @CharlotteHase · Aug 25

@fdiaz_msr @IR_oldie @damiano10 Read the paper! Thanks for the pointer! Do you think this generalized beyond adhoc search?



Fernando Diaz @fdiaz_msr · Aug 25

@CharlotteHase @IR_oldie @damiano10 it depends on the task but I'd definitely try it whenever PRF or dimensionality reduction is reasonable.



1



Damiano Spina @damiano10 · Aug 25

@fdiaz_msr @CharlotteHase @IR_oldie Many thanks for the paper! We should definitely try external query expansion :-)



Don't tell Fernando we haven't done anything yet.

Conclusions

Significant improvements via adding both features

- And there's still room for improvement

What to expect next?

Enhancements: Linked entities, substructures

Tasks: Snippet generation, summarization

Thank You!

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