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Adaptive Document Retrieval for Deep Question Answering

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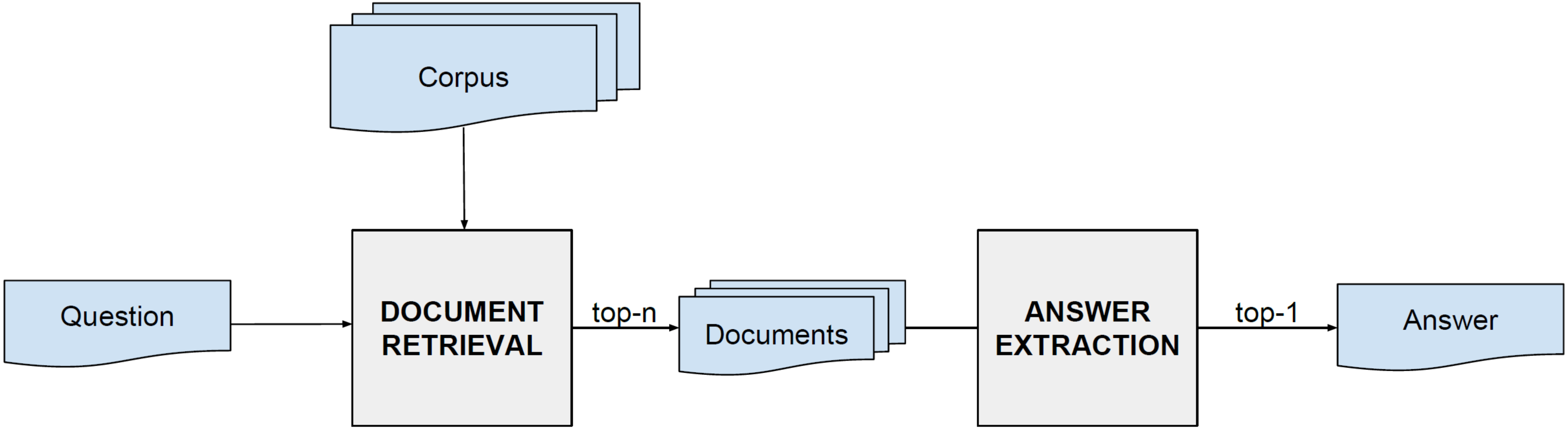
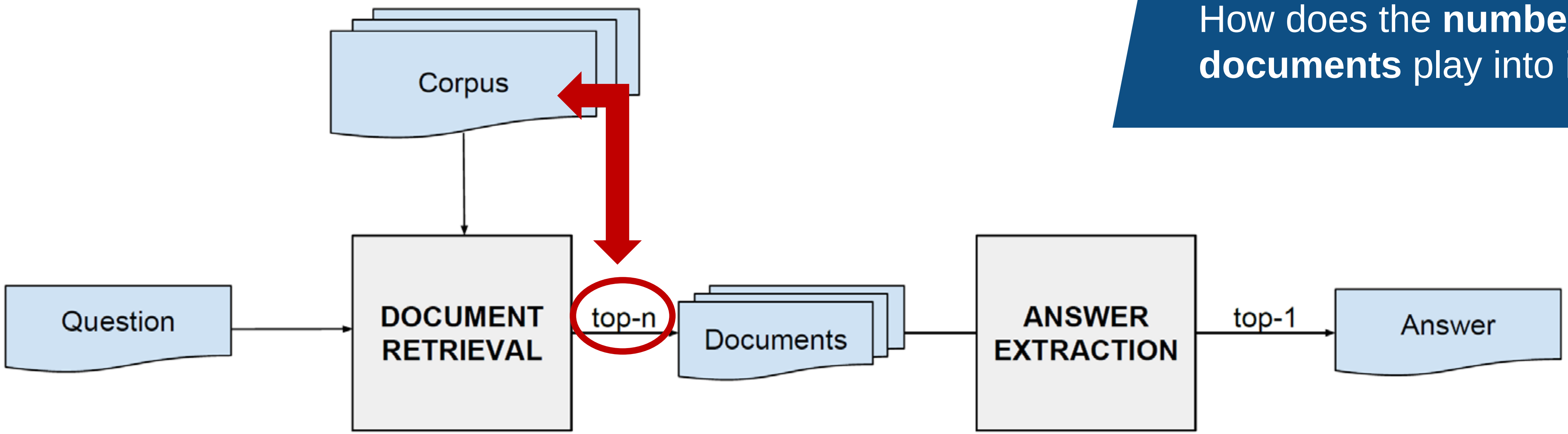
Content based QA systems with neural answer extraction



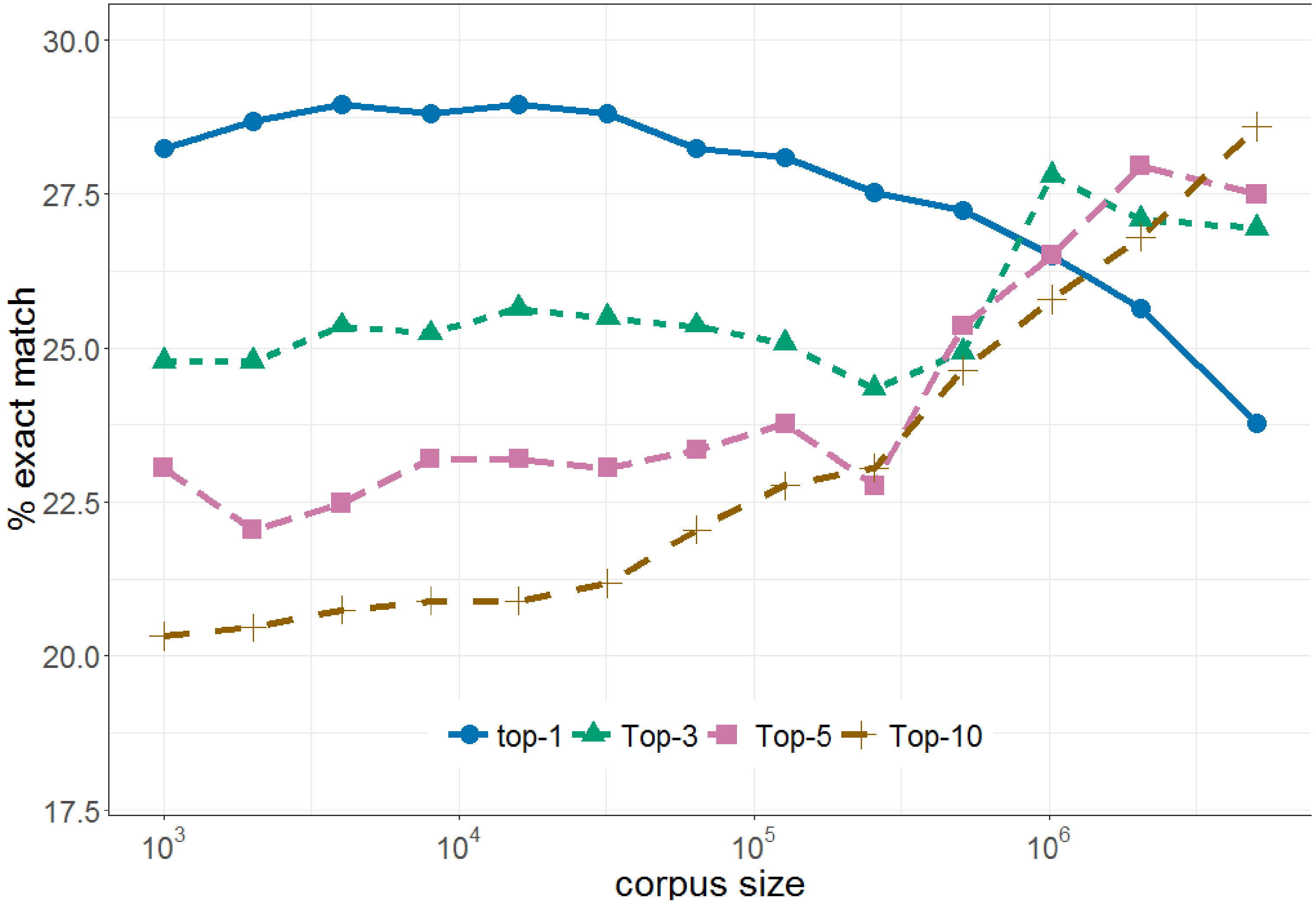
How does top-*n* document retrieval influence the performance of neural QA systems?

How does the **corpus size effect the over-all performance** of our QA system?

How does the **number of selected documents** play into it?



Varying top-*n* retrieval under a dynamic corpus

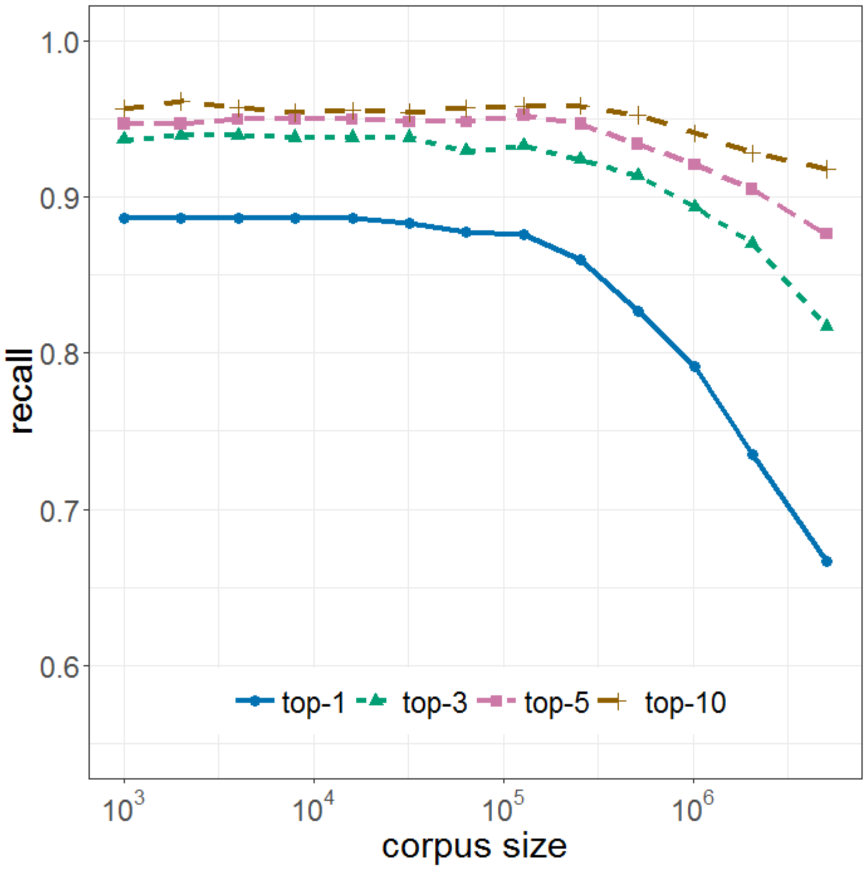


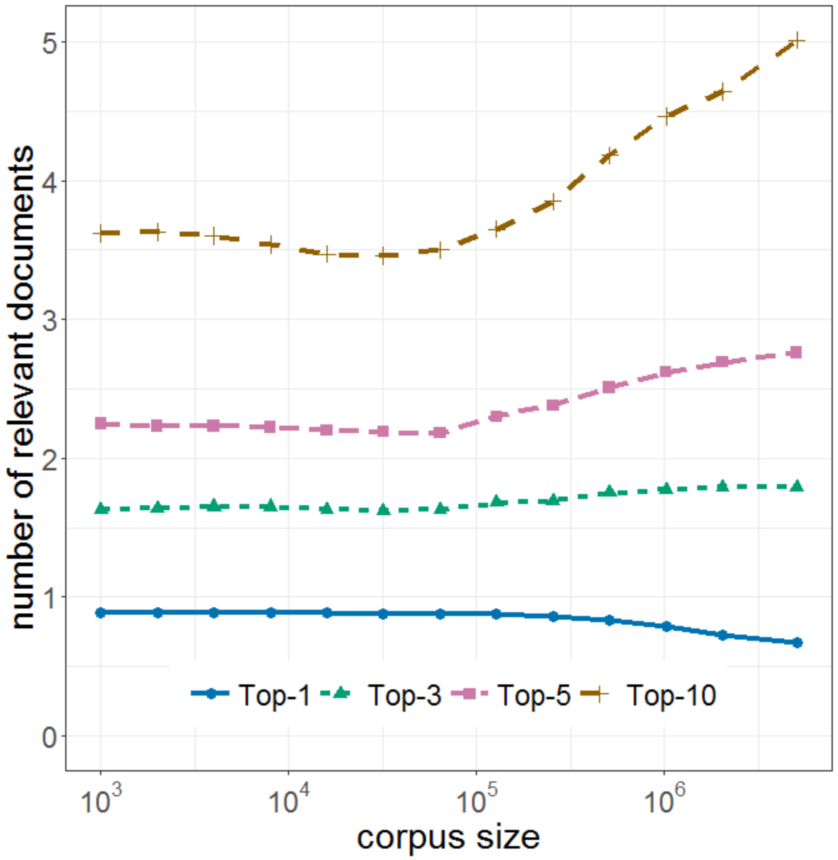
Findings

- For small corpora, a top-1 system outperforms any other configuration
- For bigger corpora, a top-*n* system preforms better than any top-1

Experiments based on DrQA System:
Chen, Danqi, et al. "Reading Wikipedia to Answer Open-Domain Questions." *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics* (2017)

Document retrieval under a dynamic corpus



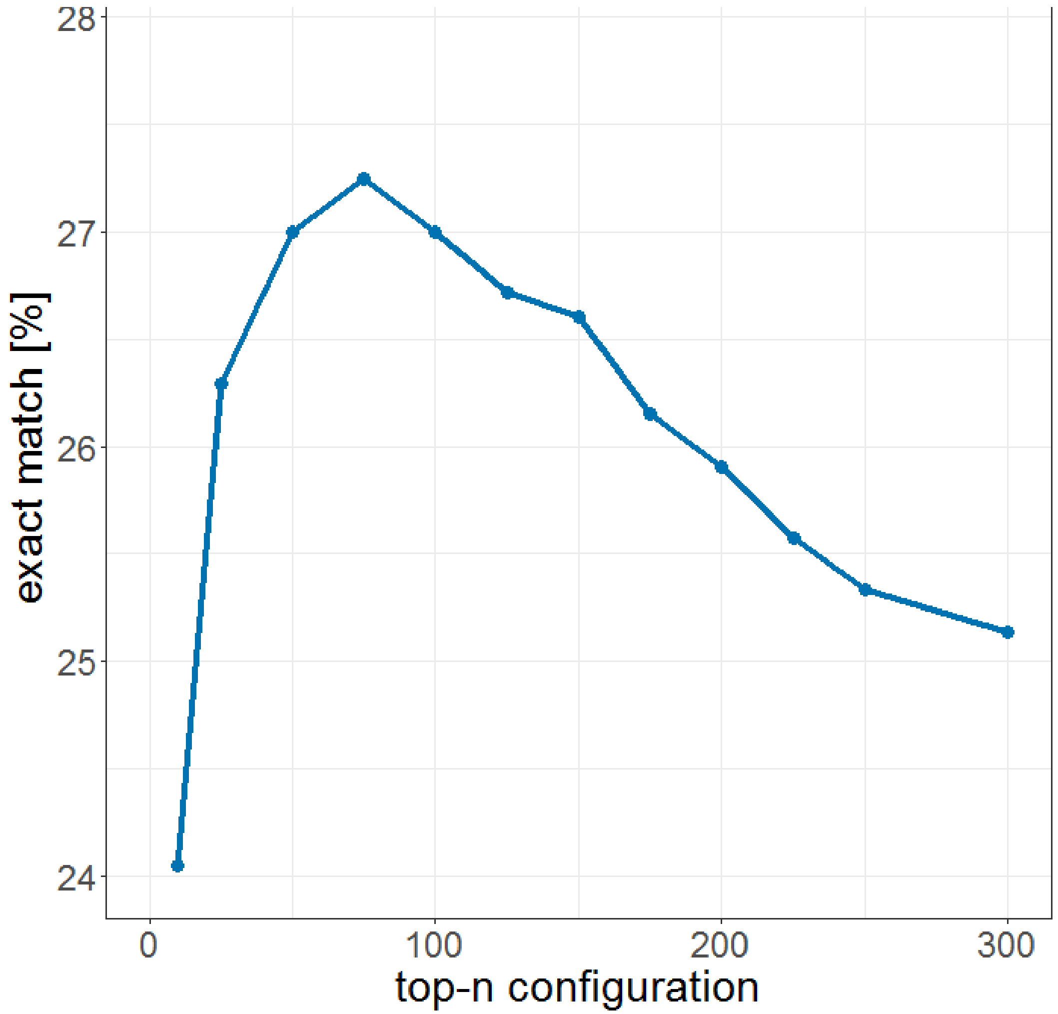


Findings

- The **recall@1** is very volatile when the corpus grows
- **Top-*n*** retrieval results in a higher density of information

Experiments based on DrQA System:
Chen, Danqi, et al. "Reading Wikipedia to Answer Open-Domain Questions." *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics*

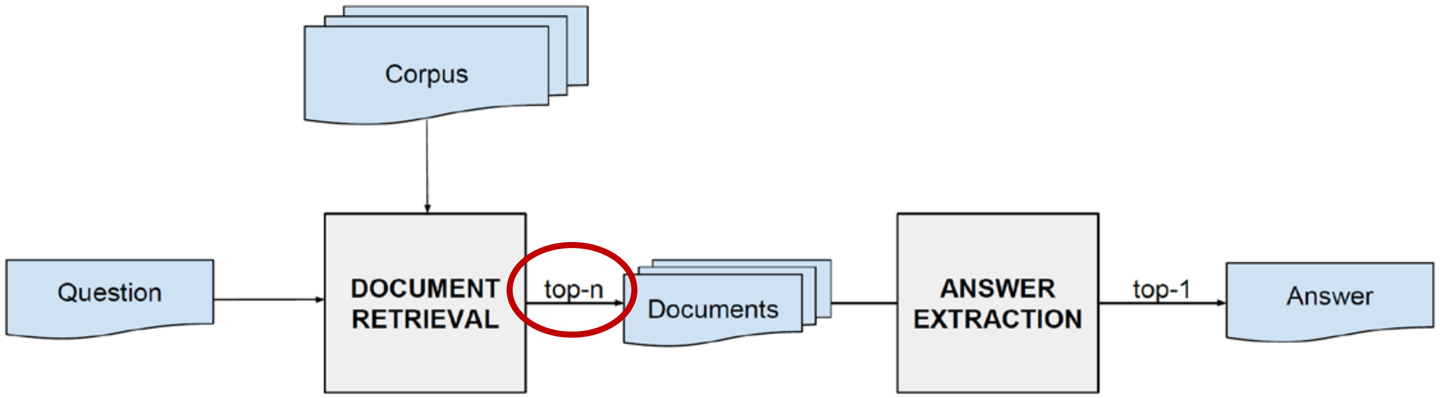
Varying top-*n* retrieval under a static corpus



Findings

- In the beginning, **selecting more paragraphs** results in higher performance
- Selecting **too many paragraphs** results in a performance loss

The noise information trade-off in neural question answering



Noise-information trade-off

- Pick a **query dependent number of documents** to select
- Select enough documents to answer the question
  → but not too many to select a wrong candidate answer

A threshold baseline for adaptive retrieval

- Number of documents is determined independently for every query

$$n_i = \max_k \sum_{j=1}^{k} s_i^{(j)} < \theta$$

$s_i^{(j)}$ score of document *j*, in query *i*

- **The Idea:** The more confident we are, the less documents we want to select

A ordinal regression model for adaptive retrieval

- We model the **number of top-*n* documents** by

$$y_i = f([s_i^{(1)}, \ldots, s_i^{(\tau)}]) = \lceil s_i^T \beta \rceil$$

- **The Idea:** Learn the **cut-off point** by minimizing

$$\mathcal{L} = \| \lceil X\beta \rceil - y \|_1 + \lambda \, \|\beta\|_2$$

- For prediction, we use an **additional off-set**

$$\hat{n}_i = \lceil {s'}_i^T \hat{\beta} \rceil + b$$

Results on the full Wikipedia corpus

	SQuAD	TREC	WebQuestions	WikiMovies
DrQA (Chen et al., 2017)†	29.3	27.5	18.5	36.6
Threshold-based ($\theta = 0.75$)	**29.8**	28.7	19.2	38.6
Ordinal regression ($b = 1$)	29.7	28.1	19.4	38.0
Ordinal regression ($b = 3$)	29.6	**29.3**	**19.6**	38.4
R^3 (Wang et al., 2018)	29.1	28.4	17.1	**38.8**

†: Numbers vary slightly from those reported in the original paper, as the public repository was optimized for runtime performance.

Experiment

- [DrQA] system #1
- Corpus: Full Wikipedia

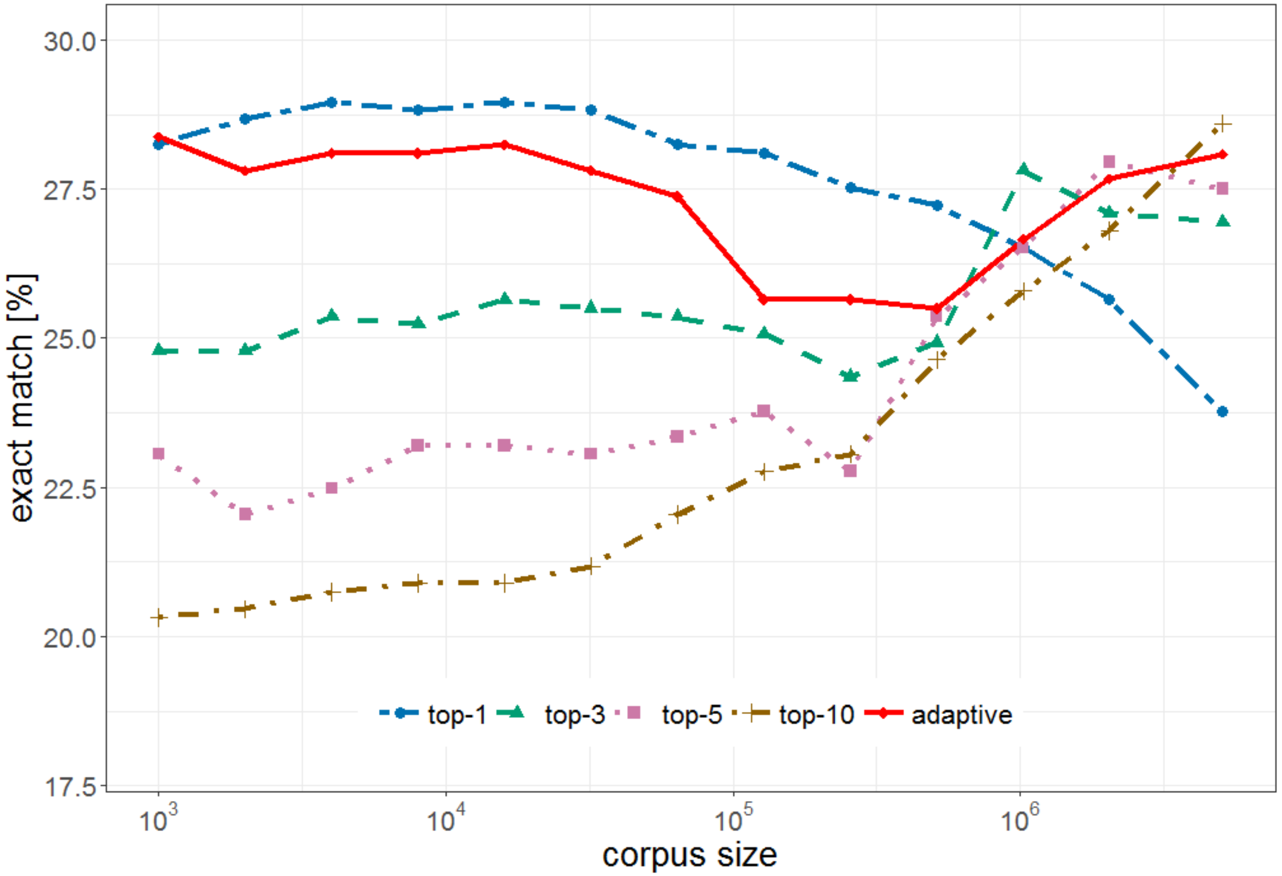
Experiment

- Paragraph system #2
- Corpus: Full Wikipedia

	SQuAD	TREC	WebQuestions	WikiMovies
Top-50 System	27.0	23.5	15.1	24.4
Top-80 System	27.2	25.9	14.9	26.0
Threshold-based ($\theta = 0.75, \tau = 100$)	27.2	**27.1**	15.4	26.3
Ordinal regression ($b = 3, \tau = 250$)	**27.3**	**27.1**	**16.7**	**26.5**

Chen, Danqi, et al. "Reading Wikipedia to Answer Open-Domain Questions." *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics* (2017)
Wang, Shuohang, et al. "R3: Reinforced Reader-Ranker for Open-Domain Question Answering.“ *Conference on Artificial Intelligence AAAI* (2018).

Results under varying corporas



The adaptive approach remains the most **robust**

It's the 'safest' bet in terms of regret
→ i.e. when the corpus grows/shrinks over time

Experiments based on DrQA System:
Chen, Danqi, et al. "Reading Wikipedia to Answer Open-Domain Questions." *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics* (2017)

Thank you very much!

Questions?

Feel free to reach out to us: bkratzwald@ethz.ch

Slides and more background:
https://github.com/bernhard2202/adaptive-ir-for-qa