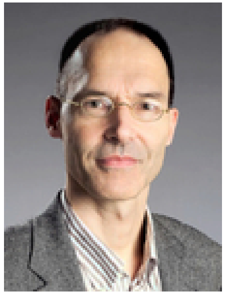
Language Models as Context-sensitive Word Search Engines



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[1]Bauhaus-Universität Weimar [2]Leipzig University

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Language Models as Context-sensitive Word Search Engines

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Context-sensitive word search engines retrieve words that match a given context.

- Trivially: Thesauri, idiom collections, ...

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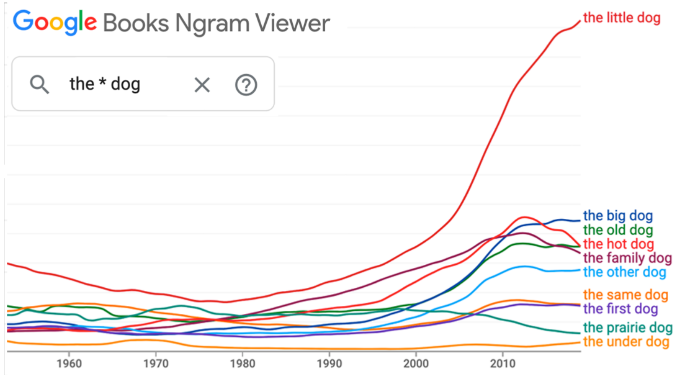

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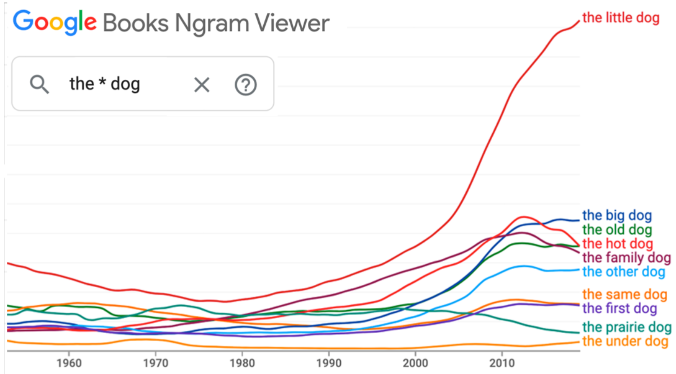

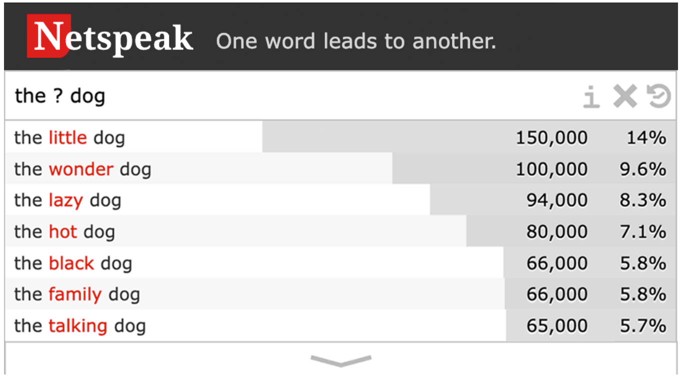

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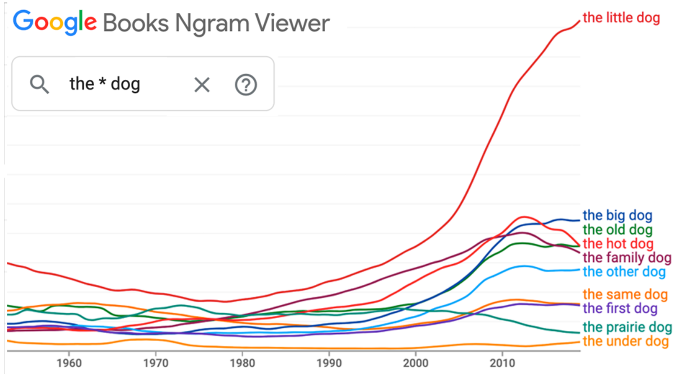

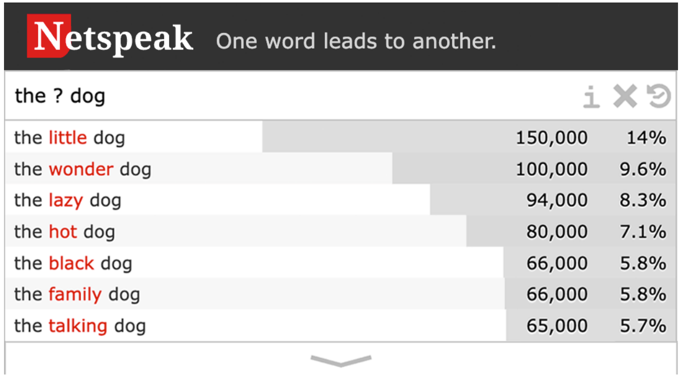

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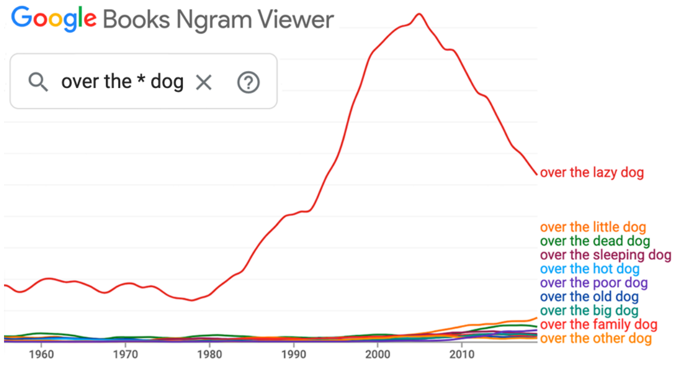
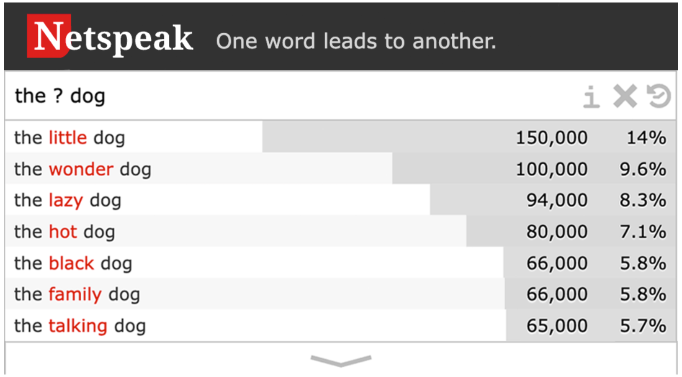
$\rightarrow$ Context-sensitive word search engines are build on n-gram collections.





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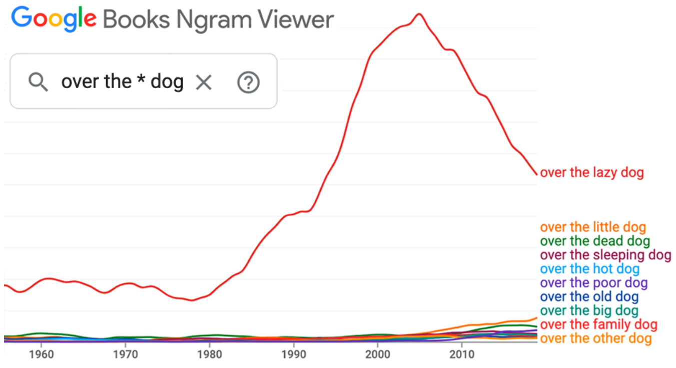
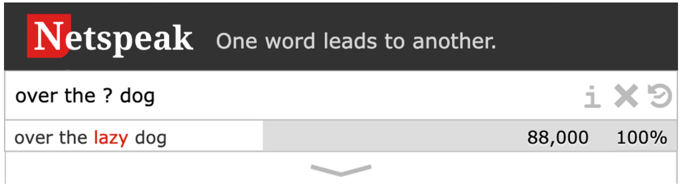
Problem: Increasing n requires exponential observations; We're limited to $n <= 5$.
$\rightarrow$ Infer the answers to wildcard queries and their probabilities from a (large) language model.





@MattiWiegmann, 2022

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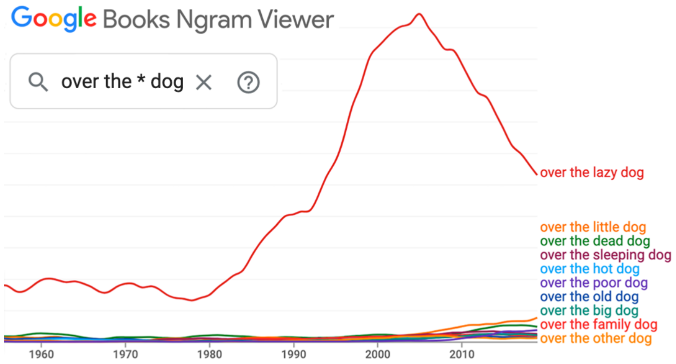
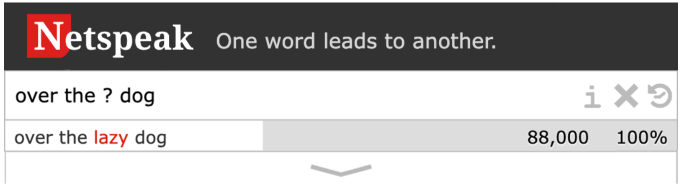
Contributions:

- Tune large language models to n-grams while preserving corpus characteristics and idioms.
- Predict the ranking with frequency.





Language Models as Context-sensitive Word Search Engines

Language Modeling for Word Search

Solving wildcard queries $q = q_l \; ? \; q_r$ with:

1. Masked Language Modeling

We used `DistillBERT`

2. Coditional Language Modeling

We used `BART`

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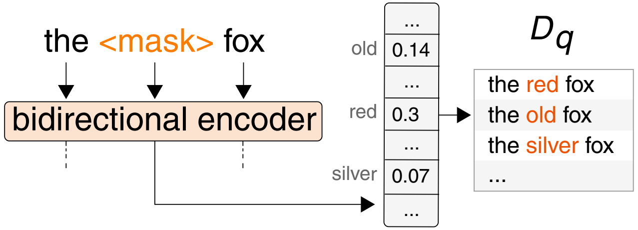

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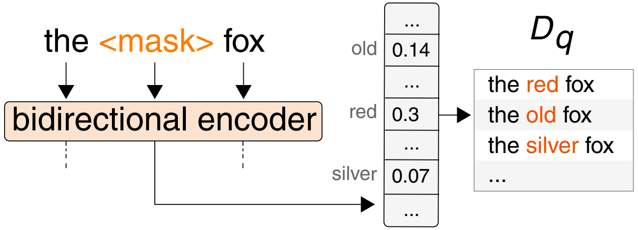

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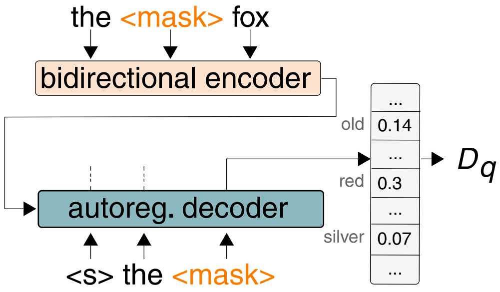

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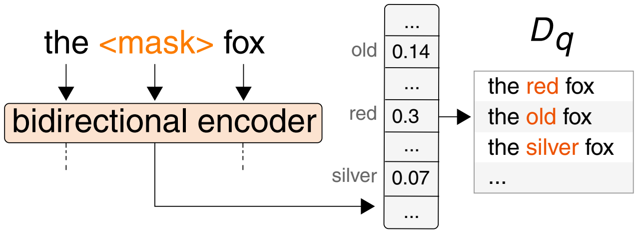

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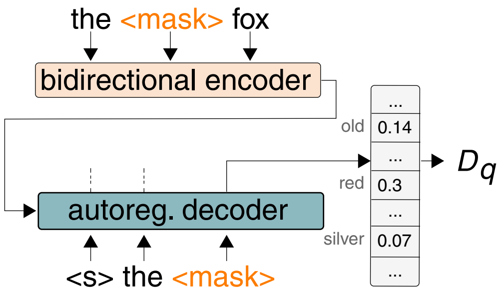

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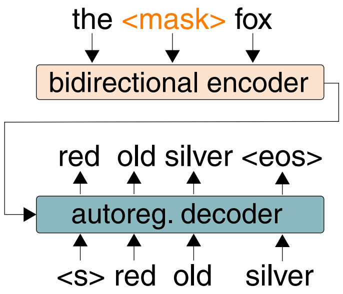

Finetune

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Experimental Evaluation

- **Data:** 3 and 5-grams from Wikitext and CLOTH.
- **Models:** DistillBERT, BART, DistillBERT$_{ft}$, BART$_{ft}$, Netspeak.
- Experiment 1: Predict masked word; Measure position in the result set via MRR.
- Experiment 2: Predict the observable ranking. Measure nDCG. High frequency results have a higher relevance.

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the lazy dog → the <mask> dog → the little dog / the lazy dog / the wonder dog → $\frac{1}{2}$

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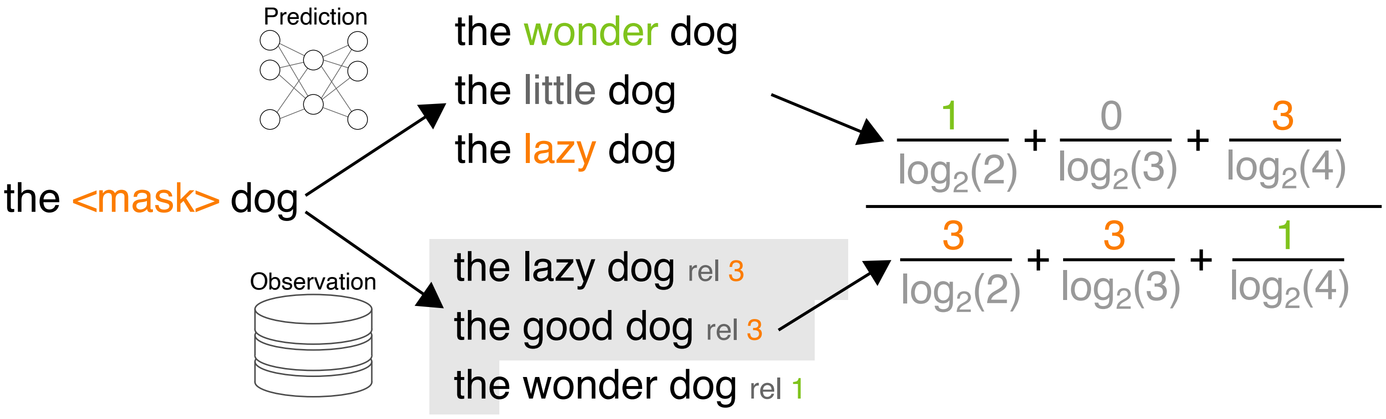

Language Models as Context-sensitive Word Search Engines

Results

Core Results:

- Finetuned models within 5 p.p. of Netspeak for queries with observable answers.
- Finetuning doubles MRR and nDCG, depending on word class and wildcard position. No substantial difference between model types.
- 80% of 5-gram queries have no obserable results:
  $\rightarrow$ Laguage models can answer, Netspeak can not;
  $\rightarrow$ Average MRR loss of 7 p.p.
- Runtime per Query: 5ms for `BERT` and `Netspeak`, 11 ms for `BART`

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`www.netspeak.org/demo`