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PhraseMap: Attention-based Keyphrases Recommendation for Information Seeking


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Phrases in Scientific Papers

We propose InSituNet, a deep learning based surrogate model to support parameter space exploration for ensemble simulations that are visualized in situ.

Phrases **capture concise and precise** information compared to sentence-level and word-level information.

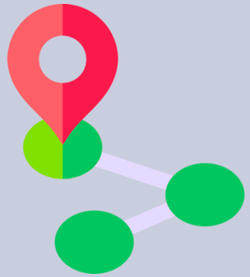
Phrases recommendation can help users to **locate information of interest** during information seeking process.

Challenges of Phrase-based Retrieval

- **Challenge1**: Modeling relationships among phrases.
  - Encode relationships as the distance between the phrase embeddings fail to link phrases that are highly relevant but dissimilar in semantics, e.g., volume rendering & transfer function.
- **Challenge2**: Human-in-the-loop retrieval is crucial but challenging.
  - The information of corpus can be large and complex.
- **Goal**: An intuitive visualization interface with an intelligent phrase-recommending system that can communicate with users.

Approach Overview

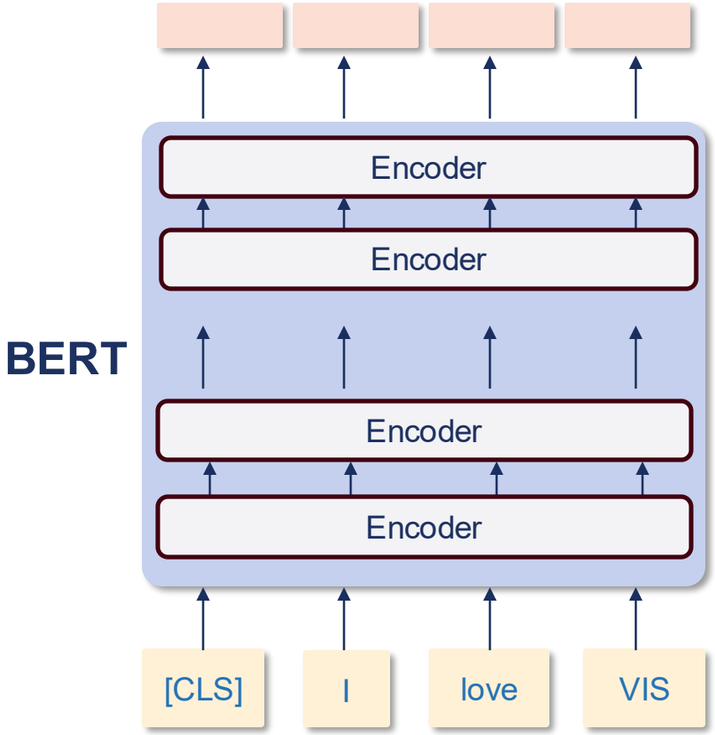
Construction



Navigation

Visualization

Self-Attention Mechanism



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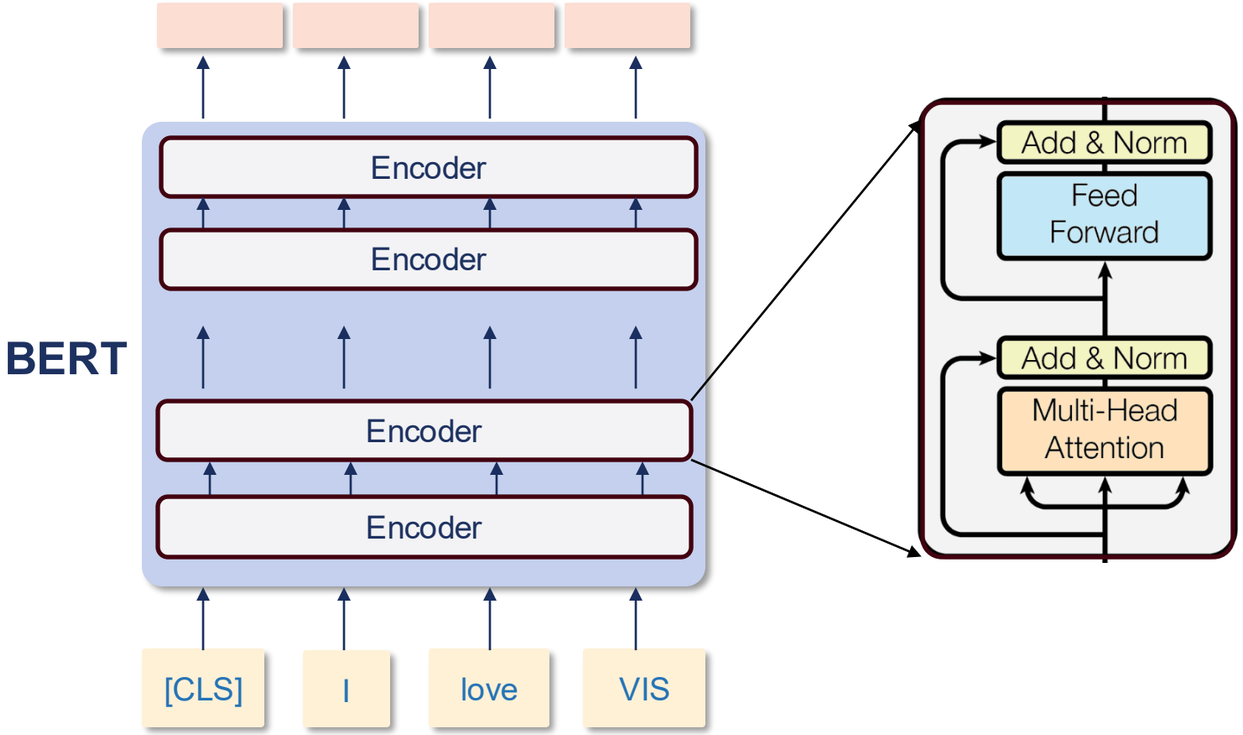

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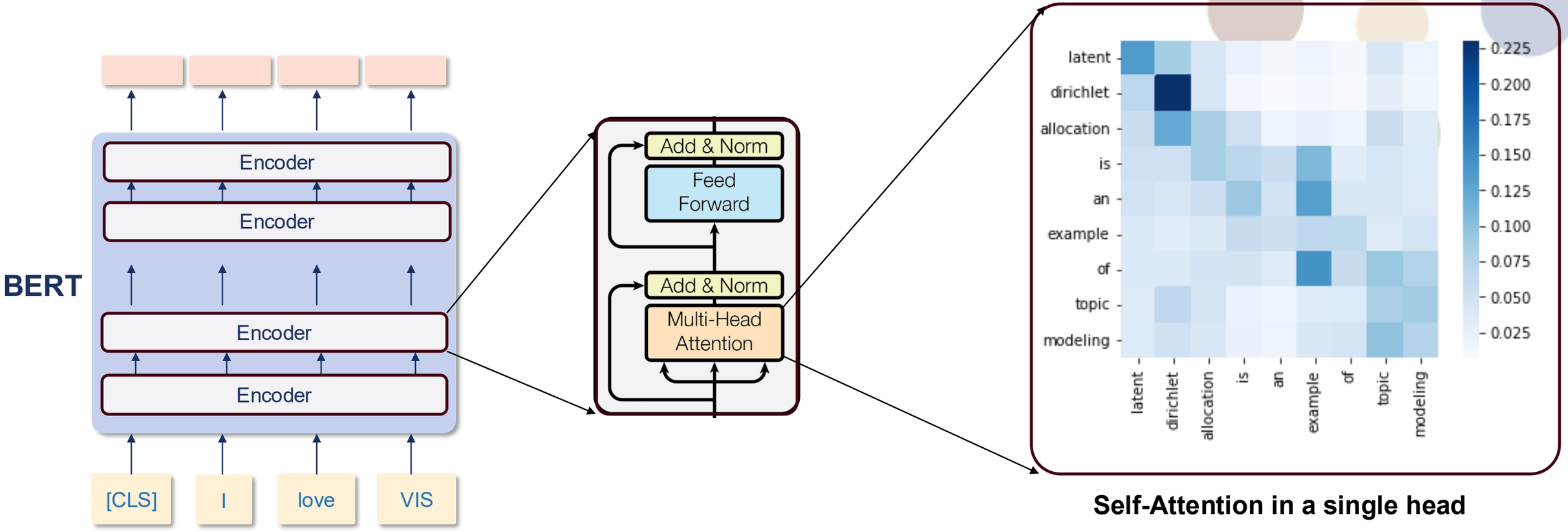

Self-Attention in a single head

What is PhraseMap?

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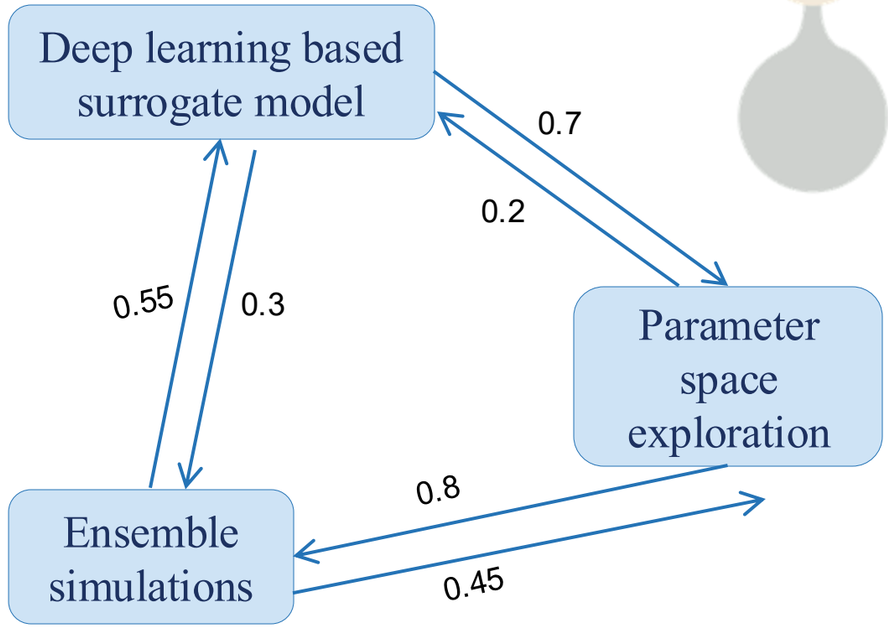
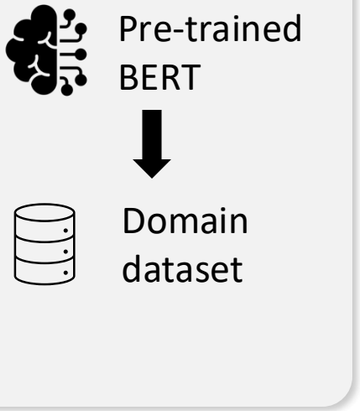


One document

Corresponding PhraseMap

PhraseMap Construction

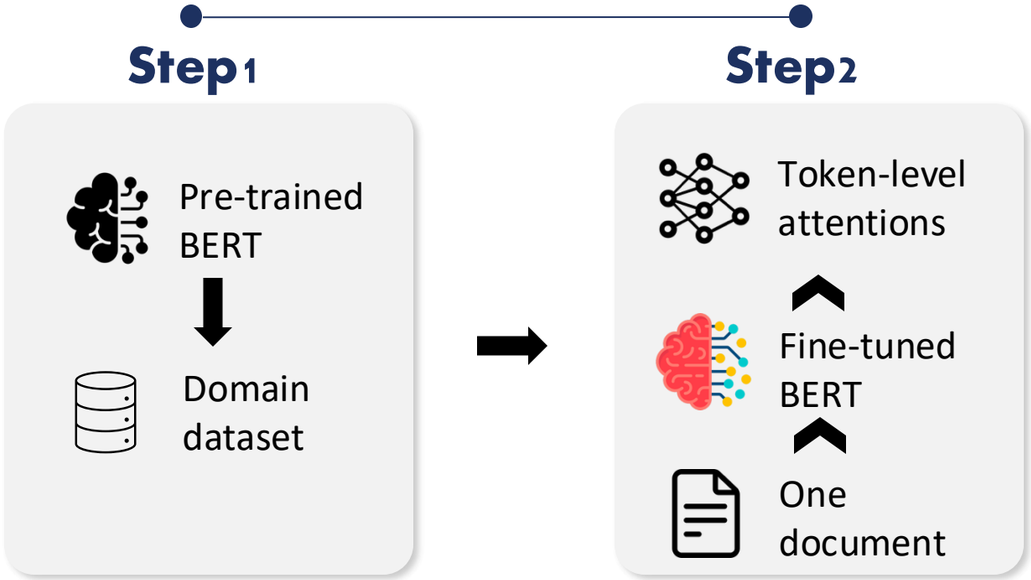
Step 1



Attention Tuning

Fine-tuned on domain datasets to capture the relationships of domain-specific words better.

PhraseMap Construction



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For each document, average over the attention heads in the last layer to obtain the token relationships

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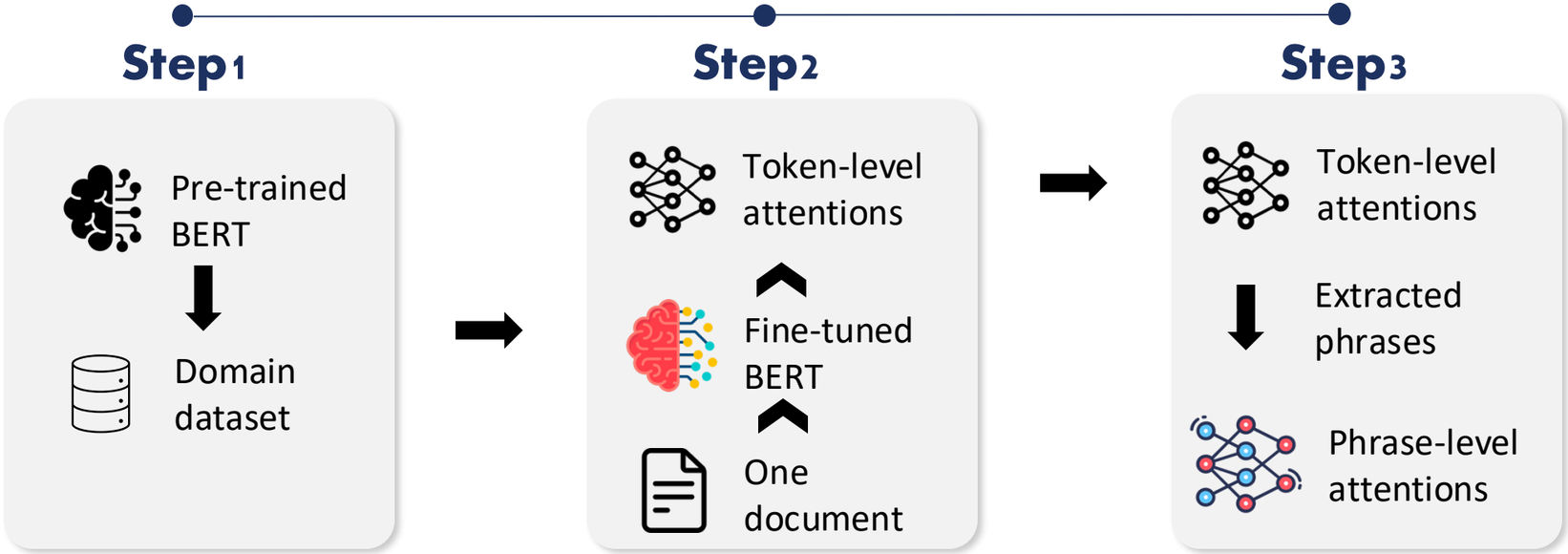

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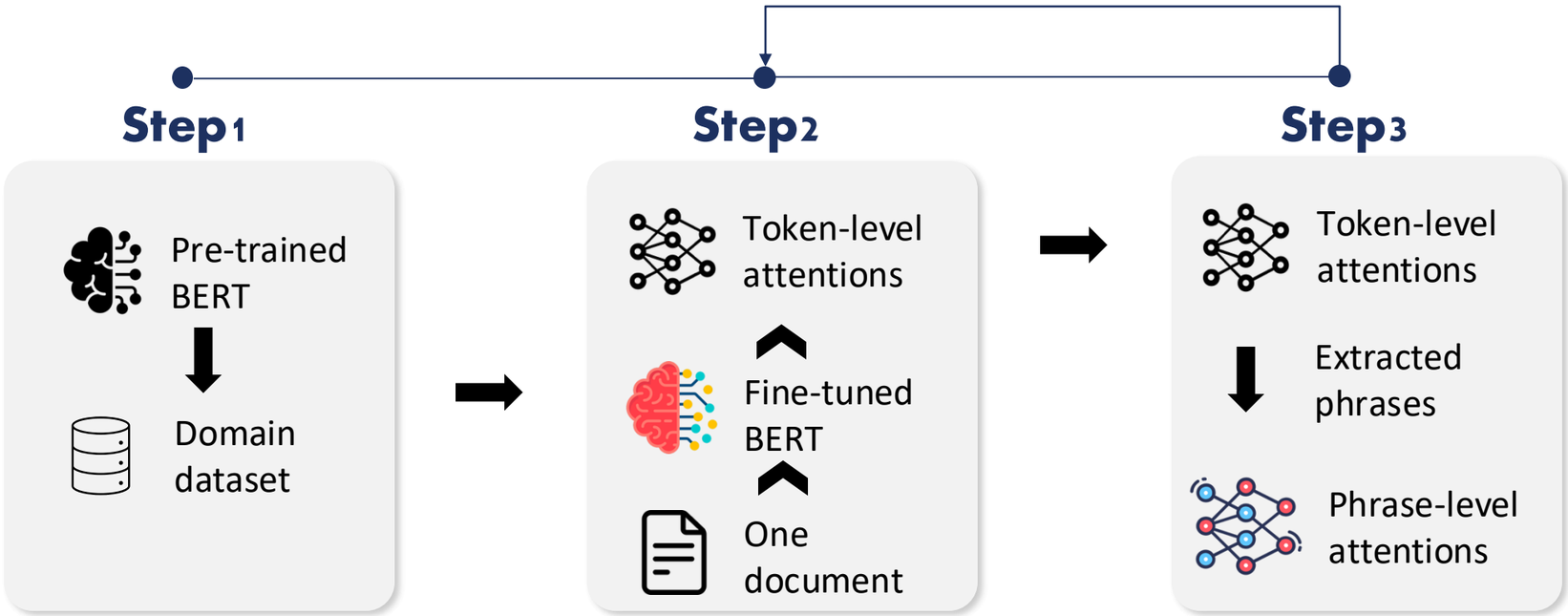

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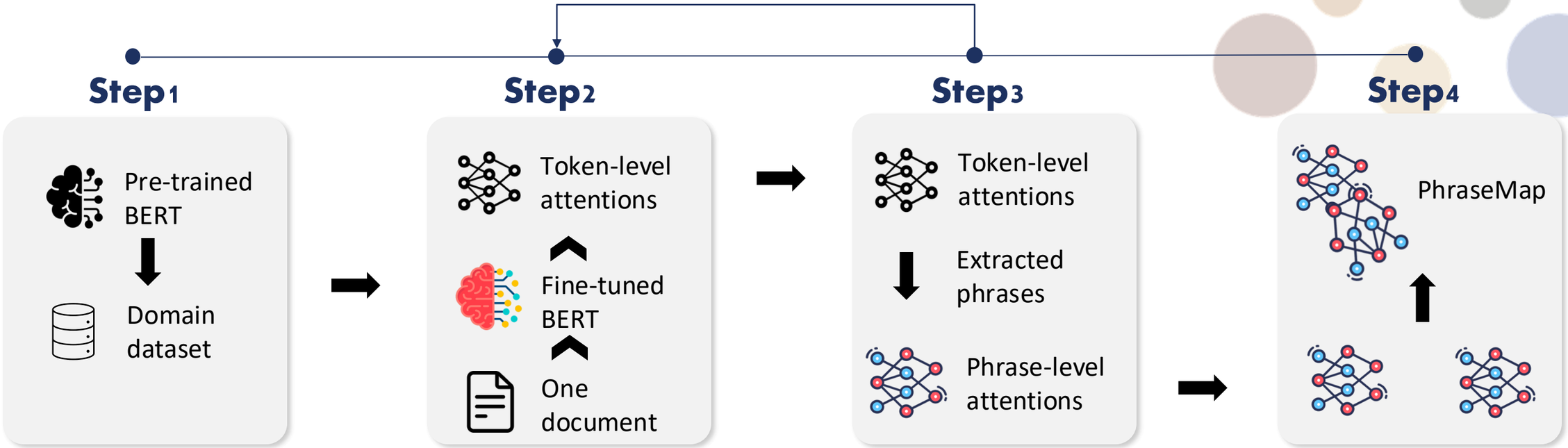

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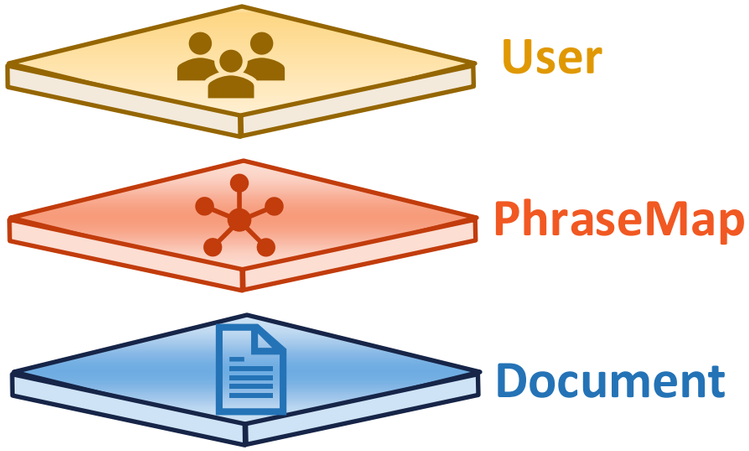
Attention Aggregation

We merge the graphs of all documents in a corpus to create the PhraseMap in an iterative manner.

PhraseMap Navigation Algorithm

How to enable efficient query over the PhraseMap?

Key: Relevance score of each phrase to users' interests.



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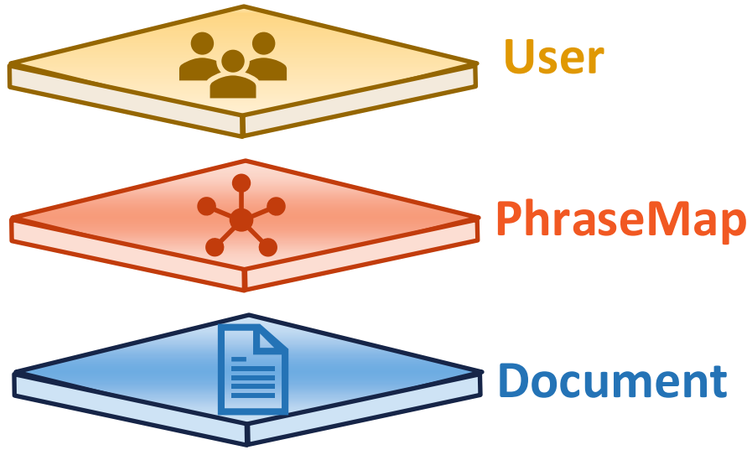
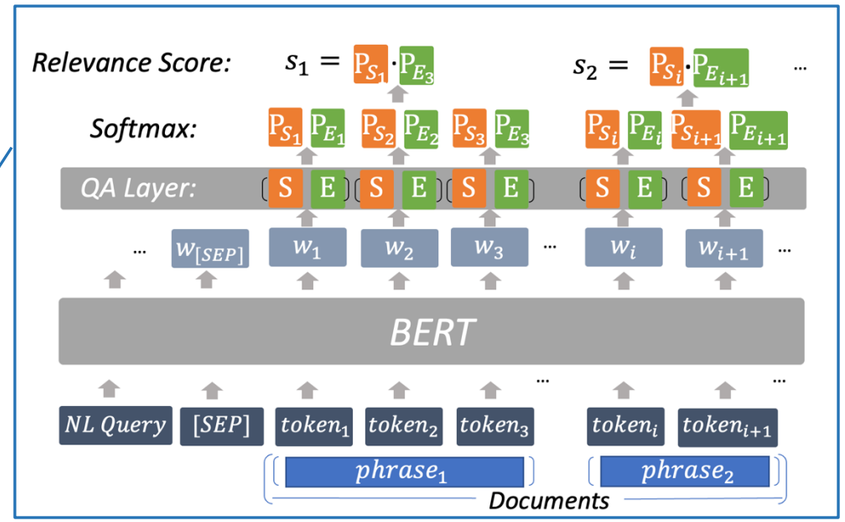


NL question

BERT-QA model



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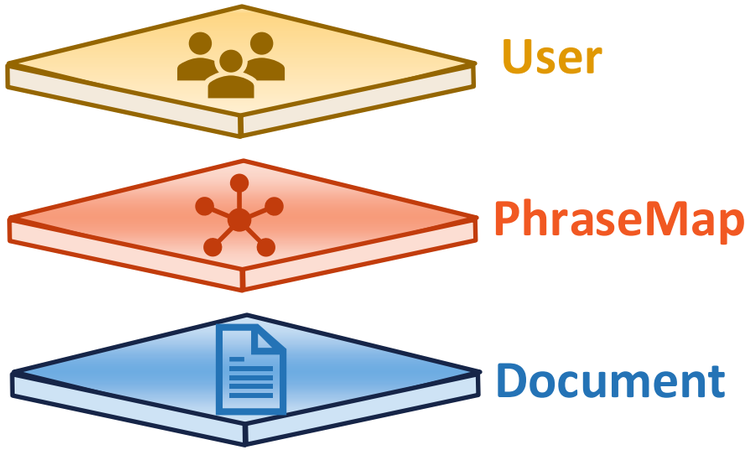
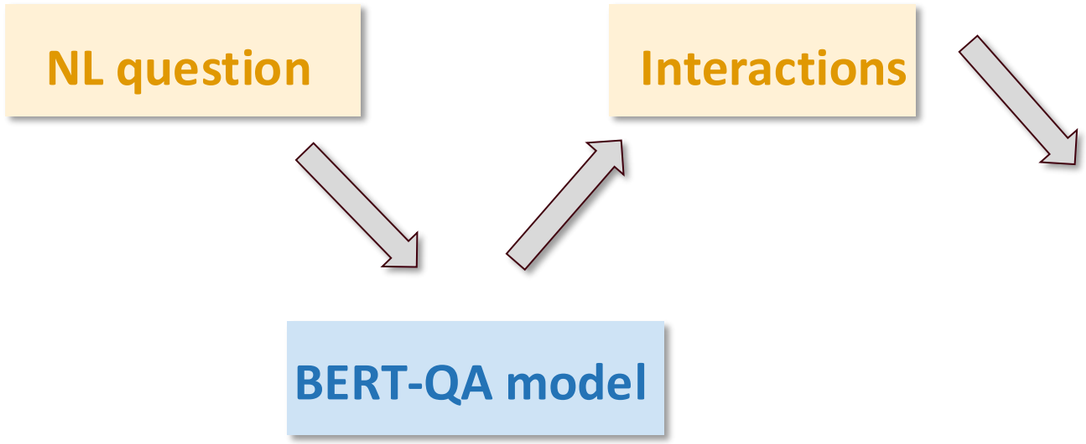
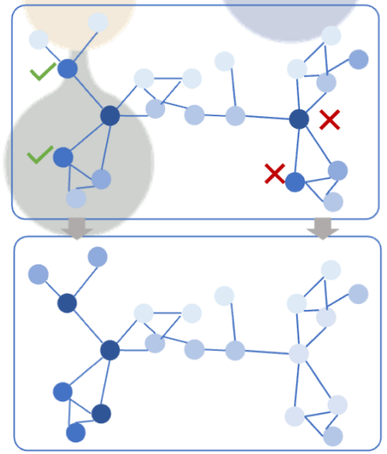


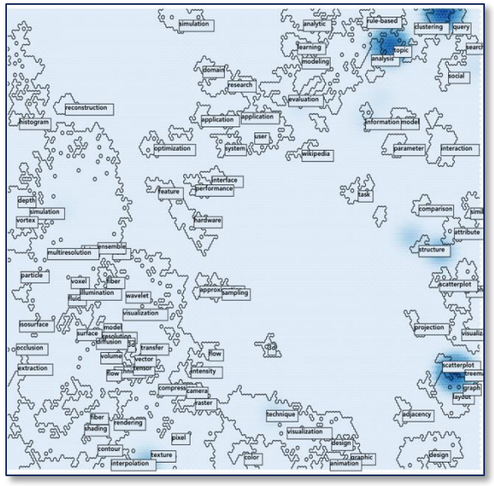




PhraseMap Visualization

- Requirements of mapping PhraseMap to 2D grids :
  1. Phrases with similar semantics should be assigned to neighboring grids.
  2. One-to-one mapping to avoid visual clutter.
- Method: Resource-controlled Self-Organizing Map (RC-SOM)

Default Coloring



Color based on users' interests.

Visual Analytics Framework

- We propose a ***visual analytics framework*** to enable interactive information seeking over the PhraseMap.

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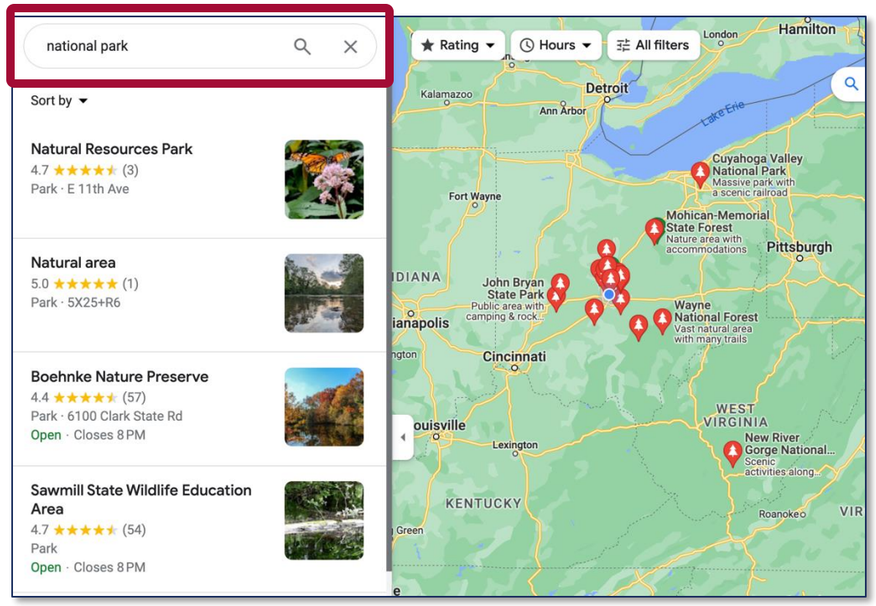

Query

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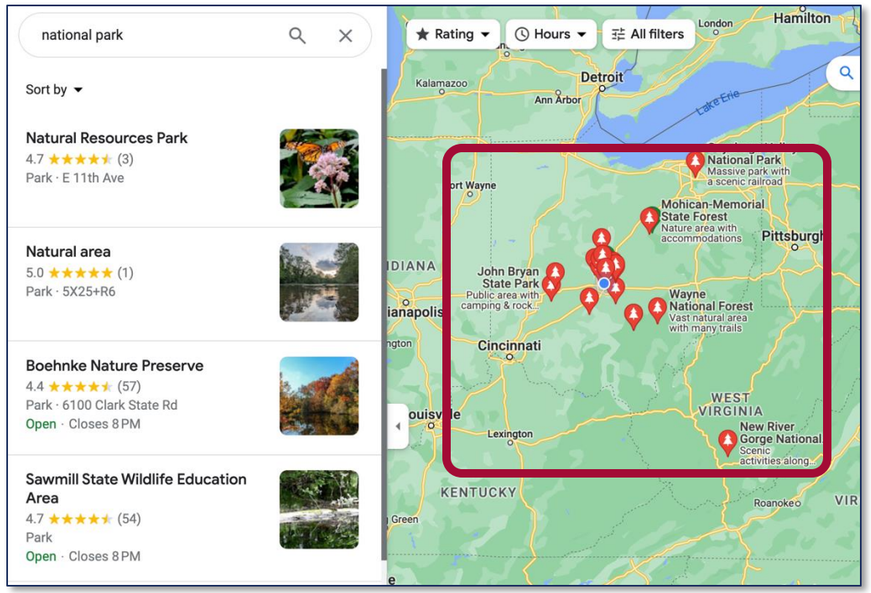

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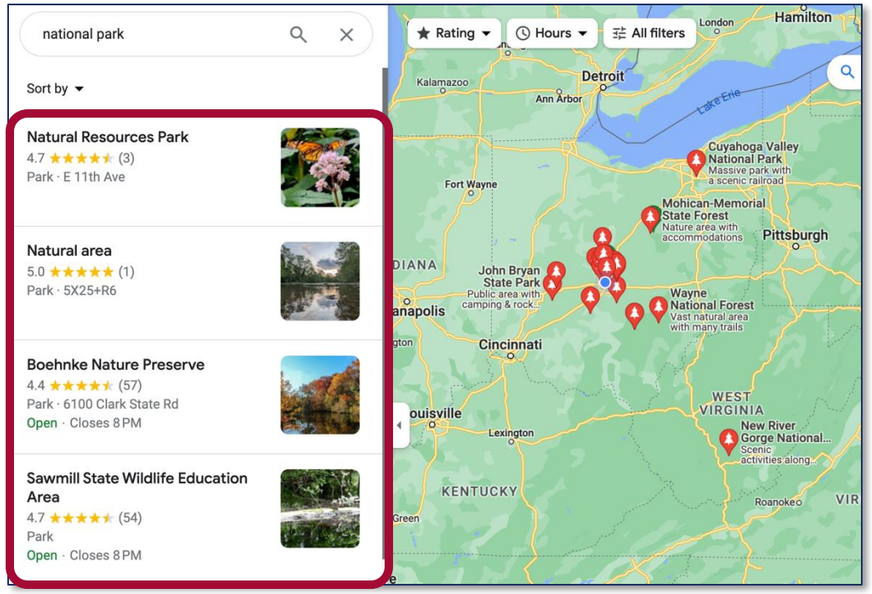

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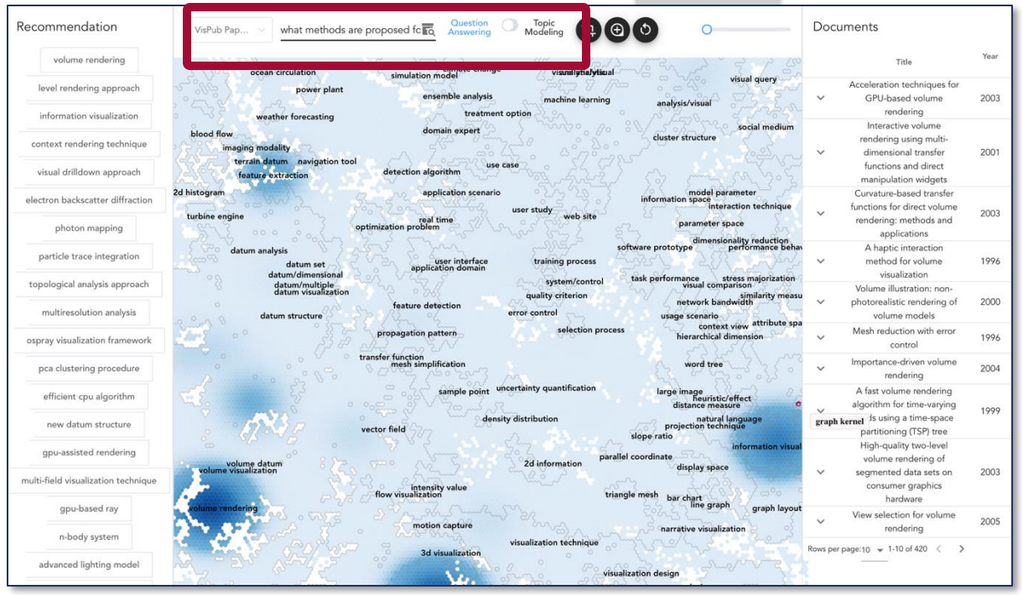
Explore



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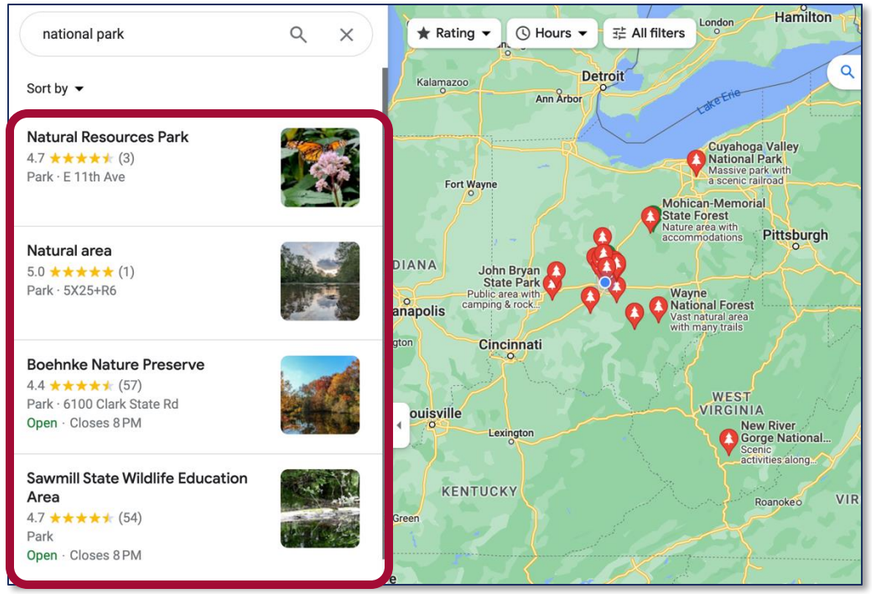

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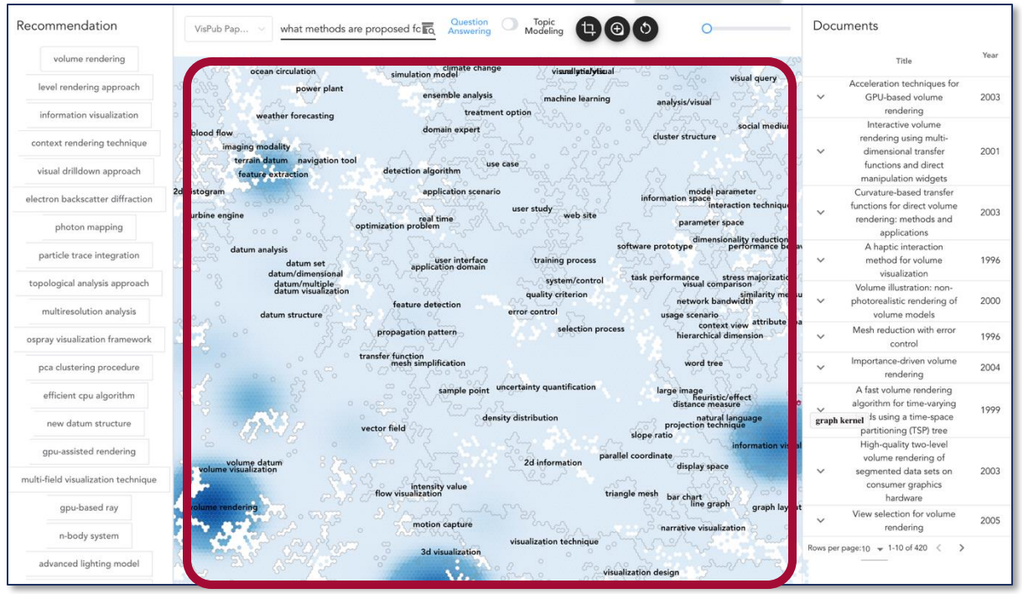

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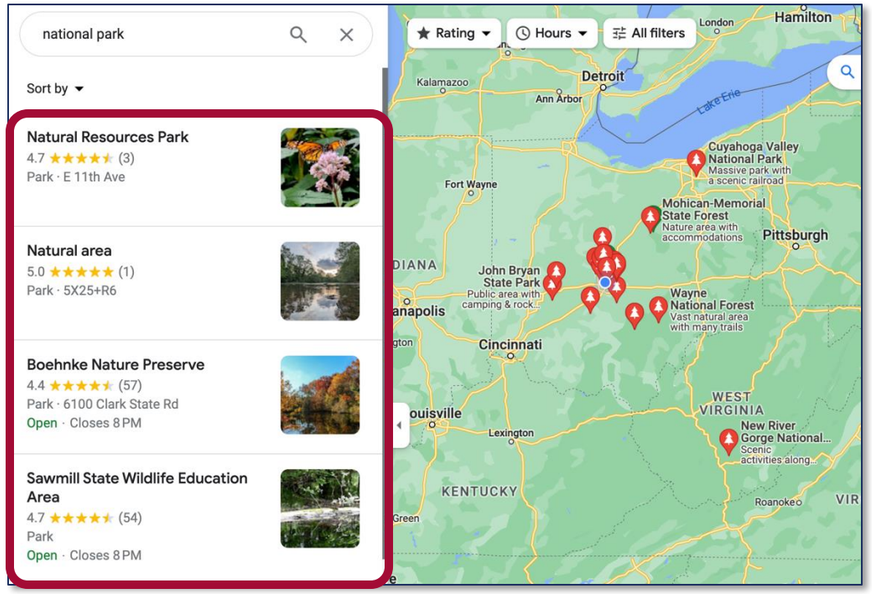

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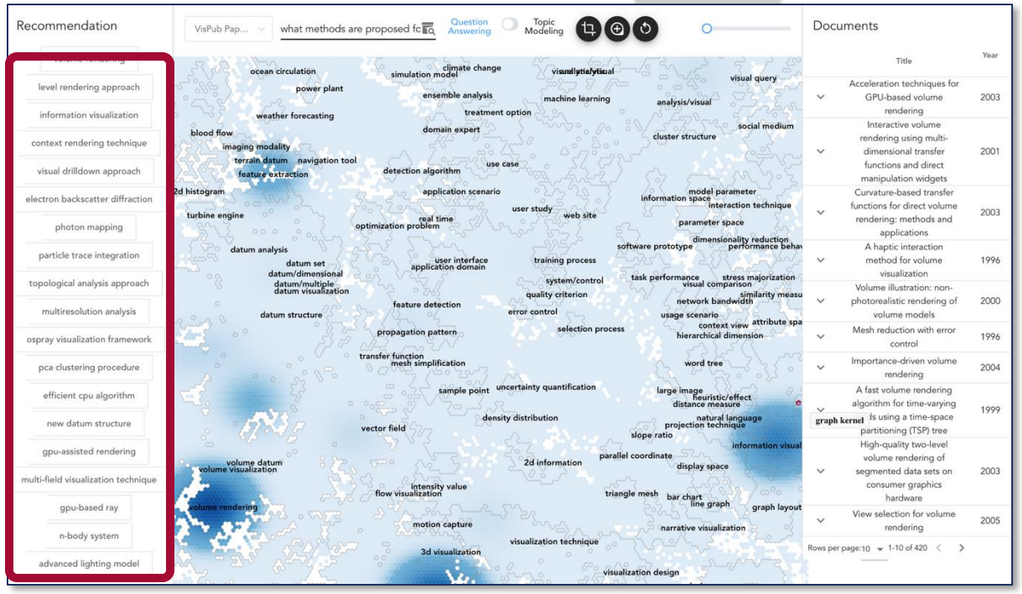

Case Study

Evaluation

- Usage Scenarios:
  - Information Seeking in the Visualization Field
  - Cross-domain Analysis of ML Literature
  - Interactive Retrieval of COVID-19 papers
- Comparison Analysis:
  - Contextual Attention vs. Semantic Similarity
  - Evaluation of Resource Controlled-SOM
    - T-SNE & RC-SOM
    - RC-SOM & SOM

Thank You !

Yamei Tu

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