Retrieval-based Question Answering with Passage Expansion using a Knowledge Graph

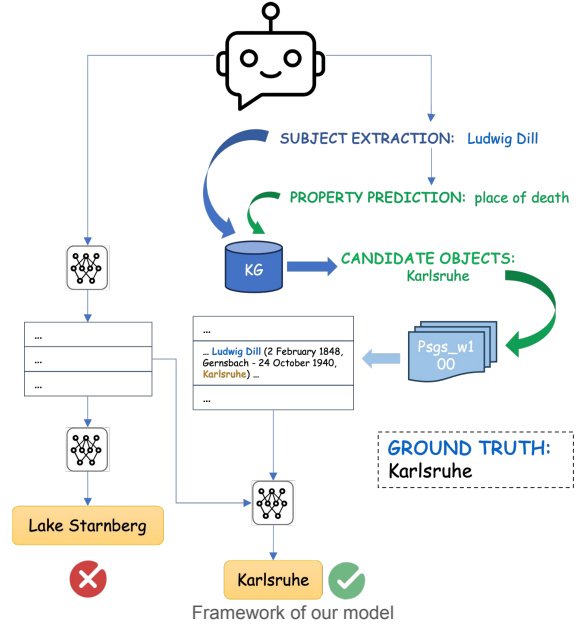Yiming Xu[1,2], Jan-Christoph Kalo[2], and Benno Kruit[1]

Motivation

- The QA model, combining dense retrieval and LM, has achieved success but faces issues with data quality and non-common entities.
- Introducing precise retrieval in knowledge graphs will help improve the performance of QA models on non-common entity problems.

Design

- Subject Extraction
- Property Prediction
- Candidate Object Retrieval
  - WAT: Retrieve passages with candidate object as the title in the text library.
  - WHy: Retrieve the passages containing the most candidate objects, subjects, and properties in the text library.
- Combain passages with DPR
- Reading Comprehension (FiD)
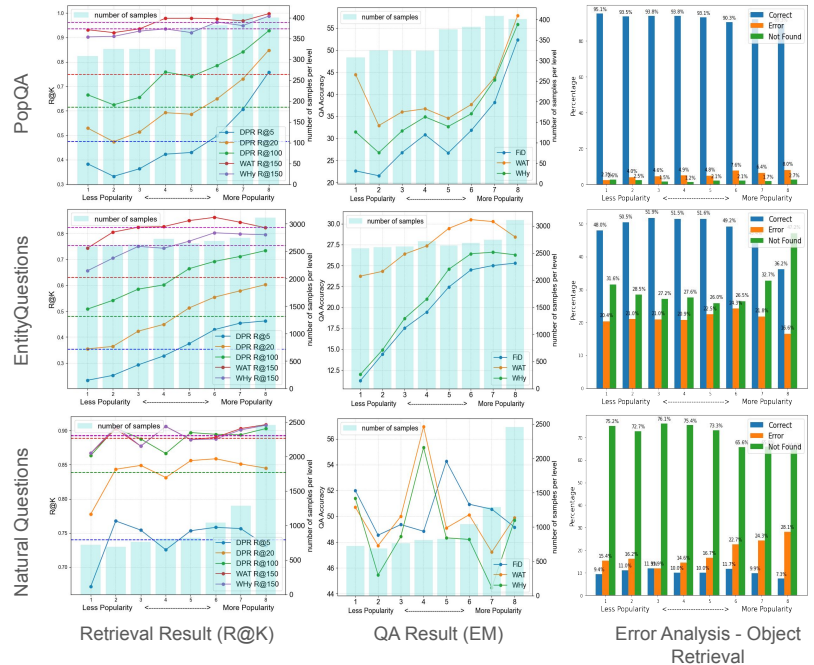
Experimental Setup

- Datasets
  - PopQA (entity-centric, artificial)
  - EntityQuestions (e.-c., artificial)
  - Natural Questions (from Google)
- Metrics
  - Top-k retrieval accuracy(R@K, ↑)
  - Exact match (EM, ↑)

Error Analysis

- Impact of Property Prediction Model
- Impact of Object Retrieval model

Conclusion

- Introduced a multimodal information retrieval model that combines text and knowledge graphs to retrieve relevant passages.
- Assessed the QA model's performance on three standard benchmarks, notably enhancing its performance for rare entities.
- Analyzed the model's limitations in handling complex natural language problems and presented plans for future improvements.

QUESTION: Where did Ludwig Dill die?

SUBJECT EXTRACTION: Ludwig Dill

PROPERTY PREDICTION: place of death

CANDIDATE OBJECTS: Karlsruhe

... Ludwig Dill (2 February 1848, Gernsbach - 24 October 1940, Karlsruhe) ...

GROUND TRUTH: Karlsruhe

Lake Starnberg ✗

Karlsruhe ✓

Framework of our model

Retrieval Result (R@K) | QA Result (EM) | Error Analysis - Object Retrieval

Question	Correct Answer	Baseline Answer	Triple	Our Answer	Error Type
What music label is You Got My Attention represented by?	Fervent Records	Fervent Records ✓	s: You Got My Attention p: record label o: Fervent Records ✓	eMusic ✗	noisy
Who is the author of Before?	Gael Baudino	Gael Baudino ✓	s: Before p: author o: Gael Baudino ✓	Franz Kafka ✗	noisy
Who is the author of Black Orchids?	Rex Stout Rex Todhunter Stout	Neil Gaiman ✗	s: Black Orchids p: author o: Rex Stout ✓	Neil Gaiman ✗	weak reader
Who sings I want to dance with you?	George Strait	Baby K ✗	s: I Just Want to Dance with You ✓ p: performer o: George Strait ✓	Baby K ✗	weak reader
Where did the battle of bonhomme richard take place ?	near Flamborough Head	the Isle of Wight ✗	s: Battle of Damme ✗ p: location o: Damme ✗	France ✗	wrong subject
Who sings love me tender in princess diaries 2?	Norah Jones Adam Levy	Julie Andrews ✗	s: Prince + Princess 2 ✗ p: cast member o: Dylan Kuo ✗	Julie Andrews ✗	wrong subject
When did i'm like a bird come out? (NaturalQuestions)	October 24, 2000	2001 ✗	s: I'm Like a Bird ✓ p: performer o: Nelly Furtado ✗	2001 ✗	wrong relation
Where is wake forest located in north carolina? (NaturalQuestions)	78.51889°W, in Franklin and Wake counties, 35.97333°N	Wake Forest, North Carolina ✗	s: Wake Forest, North Carolina p: located in the administrative territorial entity o: Wake County, North Carolina	Wake Forest ✗	complex answer
When was the first book made into a movie? (NaturalQuestions)	1924	1952 ✗	s: When Were You Born ✗ p: cast member ✗ o: Margaret Lindsay, Anna May Wong ✗	1952 ✗	general question

Correction Examples