NAACL 2025

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Knowledge-Aware Query Expansion with Large Language Models for Textual and Relational Retrieval

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Motivation

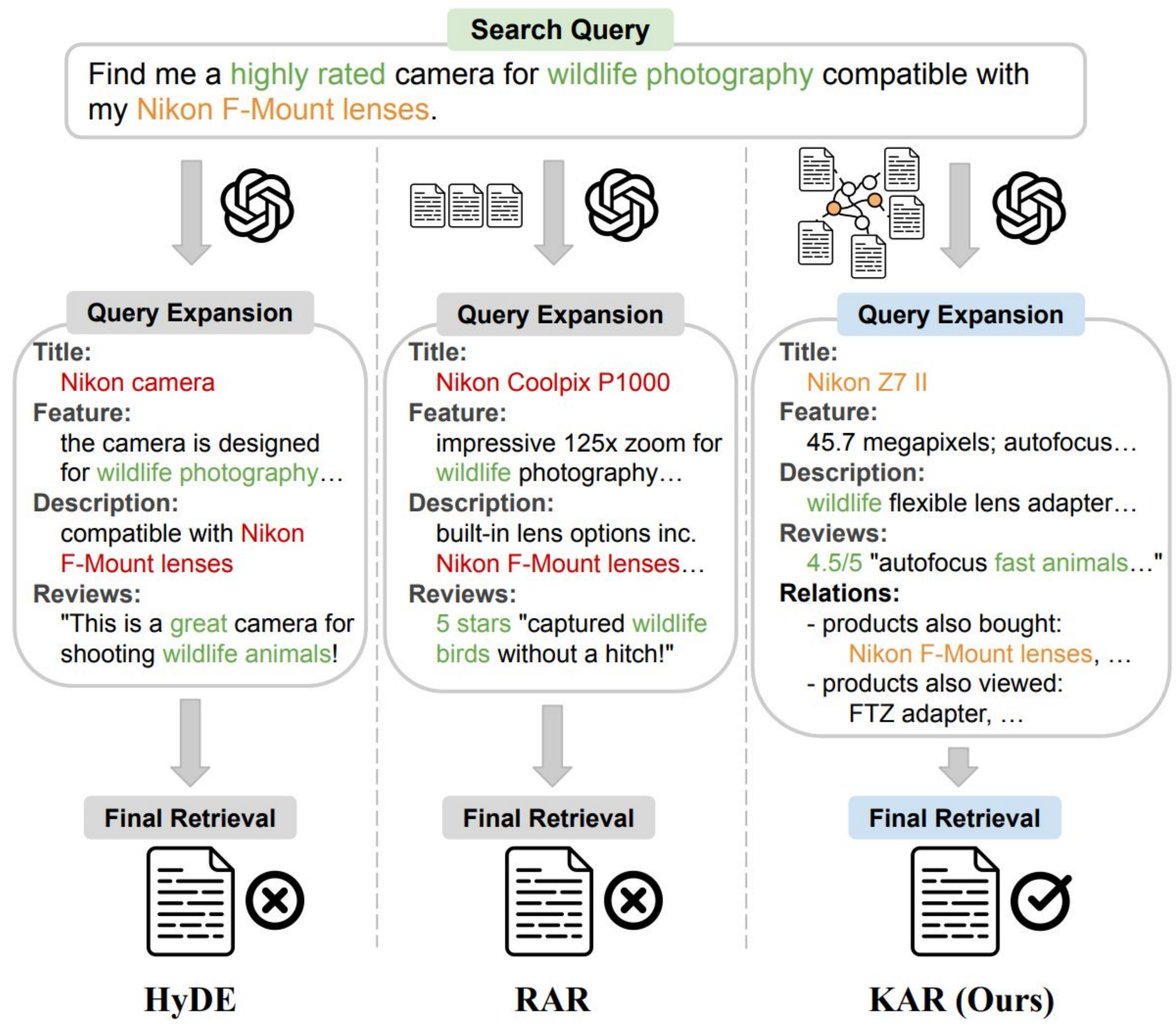
LLMs have been used to generate **query expansions** augmenting information retrieval.

Existing methods:

- *focus on **textual similarities** between queries and documents*
- *overlook **relations** between documents.*
- *often fail to handle complex queries with both **textual** and **relational** requirements*

Our method:

- *augment LLMs with structured document relations from Knowdelge Graph (KG)*
- *use both **textual** and **relational** information for query expansion*



Methodology

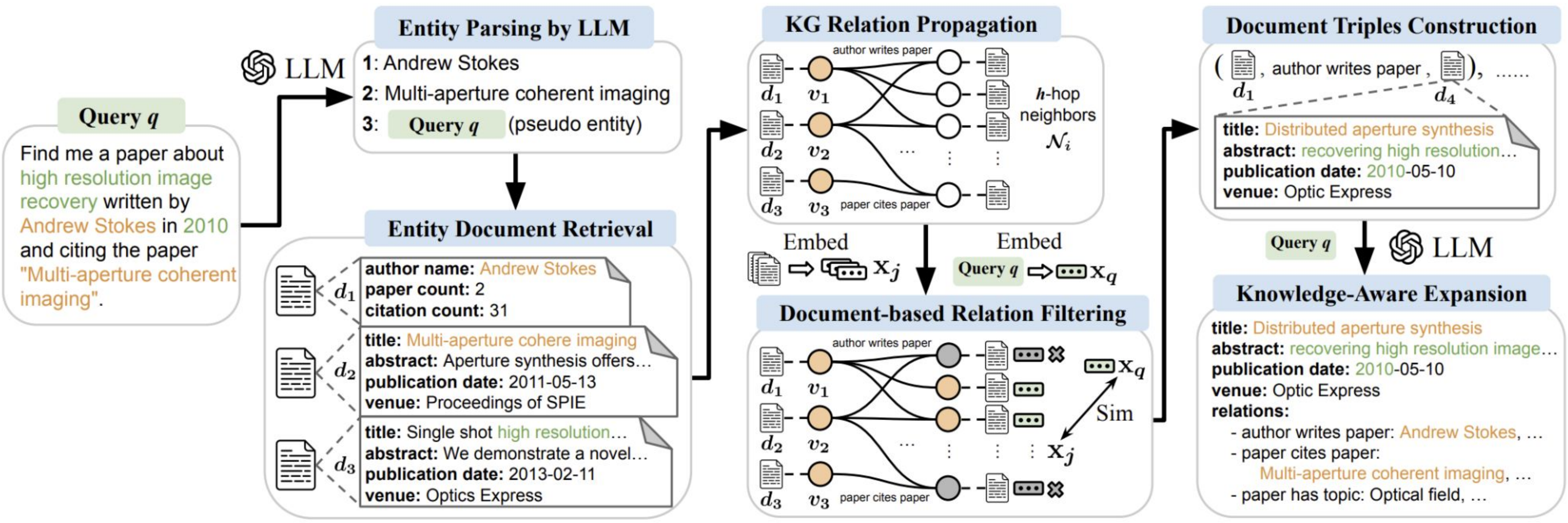


Figure 2: Overview of our knowledge-aware query expansion framework illustrated with an example academic paper search query with textual and relational requirements.

Experiments

- Three semi-structured retrieval datasets from STaRK benchmark.
- Table 2 is the results with
  - GPT4o as LLM
  - text-embedding-ada-002 as embedding.
- More evaluations and results with other LLMs and embeddings please refer to our paper.

	AMAZON				MAG				PRIME			
Method	**Hit@1**	**Hit@5**	**R@20**	**MRR**	**Hit@1**	**Hit@5**	**R@20**	**MRR**	**Hit@1**	**Hit@5**	**R@20**	**MRR**
Supervised Settings												
DPR	15.29	47.93	44.49	30.20	10.51	35.23	42.11	21.34	4.46	21.85	30.13	12.38
QAGNN	26.56	50.01	52.05	37.75	12.88	39.01	46.97	29.12	8.85	21.35	29.63	14.73
AvaTaR	49.87	**69.16**	**60.57**	58.70	44.36	59.66	50.63	51.15	18.44	36.73	39.31	26.73
Zero-Shot Settings												
Base	39.16	62.73	53.29	50.35	29.08	49.61	48.36	38.62	12.63	31.49	36.00	21.41
PRF	40.07	60.66	51.24	49.79	29.04	47.65	46.69	37.90	12.46	28.63	33.04	20.06
HyDE	40.31	64.43	53.71	51.42	29.98	50.10	50.02	39.58	16.85	37.59	43.55	26.56
RAR	51.52	66.63	54.63	58.73	39.02	52.87	50.87	45.74	22.53	40.84	44.50	30.93
AGR	49.82	62.97	53.38	56.77	39.29	53.66	51.89	46.20	25.85	44.41	46.63	35.04
KAR$_{w/o\ KG}$	43.54	60.29	51.83	51.80	31.14	46.75	46.86	38.88	18.03	36.27	42.00	26.84
KAR$_{w/o\ DRF}$	47.99	67.54	56.91	57.14	45.44	63.83	58.67	53.85	25.85	46.52	48.10	35.52
KAR	**54.20**	68.70	57.24	**61.29**	**50.47**	**65.37**	**60.28**	**57.51**	**30.35**	**49.30**	**50.81**	**39.22**

Table 2: Retrieval results on test sets of synthetic search queries.

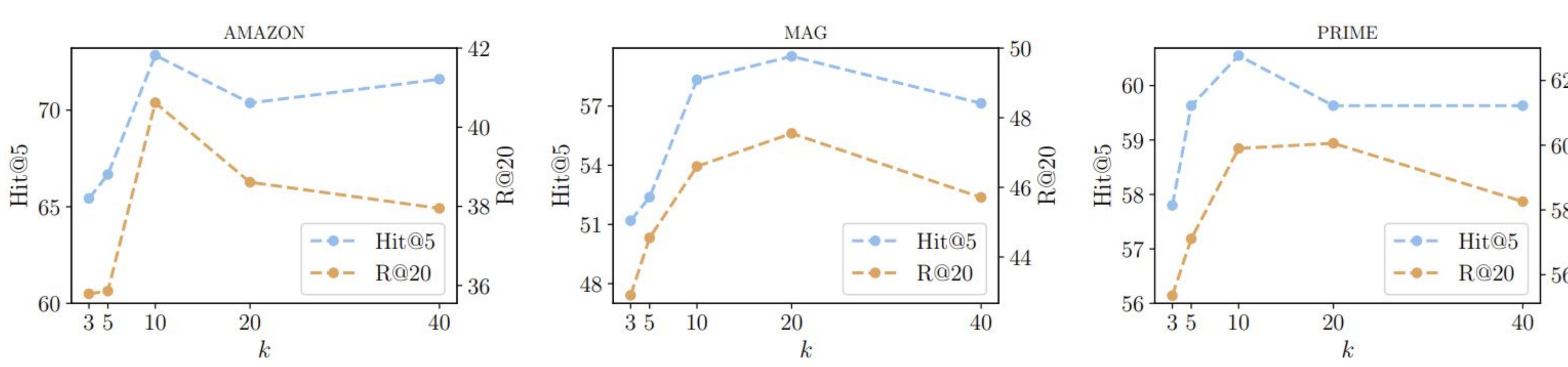


Figure 3: Influence of different values of k for filtered top-k neighbors in KAR.

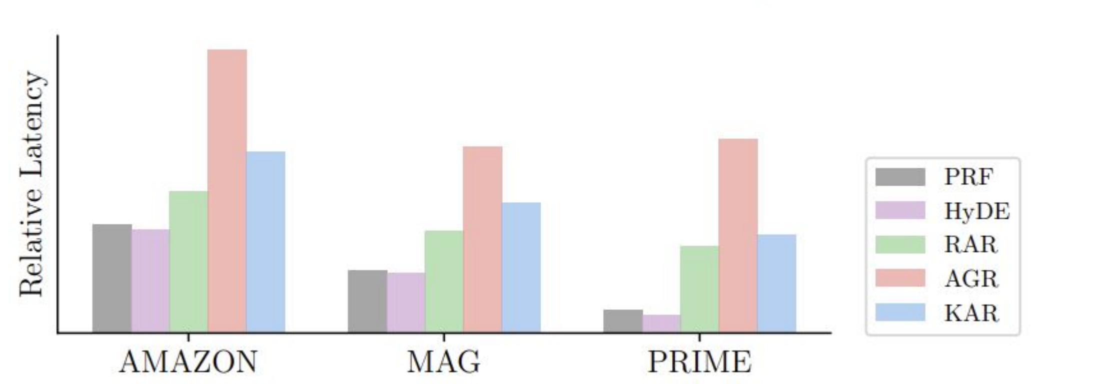


Figure 5: Latency comparison of query expansions.

Paper