FRI Natural language processing course 2025
Project report

University *of Ljubljana*
Faculty *of Computer and Information Science*

Retrieval-Augmented Generation for Academic Research

Marko Medved, Sebastijan Trojer, and Matej Vrečar

Abstract

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Keywords

Keyword1, Keyword2, Keyword3 ...

Advisors: Aleš Žagar

Introduction

We are developing a conversational agent with Retrieval-Augmented Generation (RAG) to support academic research, focusing on the field of automatic re-identification. The system will leverage a pre-trained chatbot developed in [insert year], enhanced with a RAG mechanism to retrieve and incorporate the latest research papers from arXiv. To keep the model manageable and focused, we will limit the scope of retrieved papers to a specific recent time frame (e.g., one month). The retrieved papers will be processed and integrated into the chatbot's responses, allowing the agent to provide up-to-date and accurate answers about re-identification methods developed after the chatbot's original training. To evaluate our approach an option is to manually check if the answers were relevant for the chosen scientific area and if the papers used for the queries were relevant for the specific query. Another option would be to compare the answers of a chat-bot that was trained with more recent data. Possible pre-trained chatbots that we could use include Mistral 7B or Zephyr.

Related work

Large Language Models (LLMs) have demonstrated strong language understanding and generation capabilities, but they often struggle with hallucinations, outdated knowledge, and limited domain-specific accuracy, especially when handling specialized research queries [1]. Retrieval-Augmented Generation (RAG) addresses these challenges by enhancing LLMs with real-time information retrieval, improving factual accuracy and relevance [2]. Early RAG models followed a basic retrieve-then-generate structure, but more advanced approaches have introduced techniques like query rewriting, reranking, and adaptive retrieval to improve context relevance and coherence [2].

Recent research has shown the effectiveness of RAG-based systems for academic and domain-specific applications. For example, [3] implemented a RAG system using OpenAI Ada embeddings and GPT-3.5 to enhance information retrieval and synthesis for academic documents, demonstrating the importance of precise embedding strategies for research-based chatbots. Afzal et al. [4] focused on domain-specific data by creating the CurriculumQA dataset and optimizing retrieval with tailored evaluation metrics such as relevance, coherence, and faithfulness, highlighting the importance of fine-tuning for specific academic fields. Similarly, Yasin et al. [5] integrated advanced techniques—including fine-tuned embedding models, semantic chunking, and abstract-first retrieval—to improve the accuracy and relevance of scholarly content retrieval.

Evaluating RAG systems remains complex due to the nuanced nature of retrieval and generation quality. Chen et al. [6] introduced the Retrieval-Augmented Generation Benchmark (RGB) to measure RAG performance across four key dimensions: noise robustness, negative rejection, information integration, and counterfactual robustness. Their findings show that while RAG improves LLM accuracy, it still struggles with integrating long-distance information and handling noisy or uncertain evidence. Common evaluation methods

for RAG systems include retrieval-focused metrics like MRR (Mean Reciprocal Rank) and nDCG (Normalized Discounted Cumulative Gain), as well as generation-focused metrics like BLEU and ROUGE to measure the quality and relevance of generated responses [7].

In our project, we aim to address these issues by developing a RAG-based chatbot for academic research in automatic re-identification—the task of matching individuals across different cameras or settings, a complex problem in computer vision and machine learning. By focusing on recent research papers from arXiv, we seek to enhance the chatbot's ability to retrieve and generate accurate responses about the latest developments in automatic re-identification

Discussion

Use the Discussion section to objectively evaluate your work, do not just put praise on everything you did, be critical and exposes flaws and weaknesses of your solution. You can also explain what you would do differently if you would be able to start again and what upgrades could be done on the project in the future.

Acknowledgments

Here you can thank other persons (advisors, colleagues ...) that contributed to the successful completion of your project.

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