LENR-GPT: An Experimental Chatbot Specialized for Low Energy Nuclear Reactions (LENR)

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February 16, 2025

Abstract

One of the greatest challenges we face today is the relentless growth in population and the subsequent gradual deterioration of resources. Slowly but surely humanity will seemingly reach a stage where we will require a new source of clean energy. This is where the over three decades of research on LENR becomes significant. LENR or Low-Energy Nuclear Reactions differ from traditional nuclear reactions given the fact that LENR occurs at low energies and temperatures, thus being a potentially sustainable and clean source of energy. With the renewed focus towards LENR research, it is important for all the scattered and unorganized prior work to be accessible; and easy to study as well as investigate. With this objective in mind, we leveraged the capabilities of LLMs to produce a Chatbot capable of conversing and answering questions about LENR literature.

Keywords: Low Energy Nuclear Reactions, LENR, Large Language Models, Chatbot, Artificial Intelligence.

1 Introduction

Periodically, humanity encounters innovations that redefine existence, reshaping perspectives, and lifestyles. Examples like smartphones, airplanes, and even vaccines illustrate this paradigm shift. The impact and scale of these innovations may vary but they undoubtedly become a crucial part of our daily lives and also the world at large. This work covers a relatively recent, but widely transformative breakthrough: Language Models.

2 Literature Review

2.1 Large Language Models (LLMs)

Large Language Models (LLMs) are Transformer based AI models designed to comprehend and generate human-like text based on vast amounts of diverse data. These models are trained through unsupervised learning on massive datasets, learning the intricacies of language structure, semantics, and context.

2.2 Advancements in Conversational Agents

The evolution of conversational agents has paralleled advancements in Large Language Models (LLMs), offering unprecedented capabilities in natural language understanding and generation. State-of-the-art LMs such as GPT-3 and BERT have shown a great ability to understand language and generate unseen text.

3 Data and Processing

3.1 LENR Data Stats

This research delves into the exploration of Low Energy Nuclear Reaction (LENR), a vast field with many years of research efforts. Our primary data source was Jed Rothwell's extensive LENR bibliography, available at `https://lenr-canr.org/` (LENR-CANR), comprising more than 4,743 entries.

3.2 Data Processing

We utilized GROBID (GeneRation Of BIbliographic Data), an open-source machine learning library, to parse PDFs into TEI XML files. The XML format generated by GROBID is clearly divided into sections, making it easier to extract specific sections like the abstract.

4 Methodology

4.1 Retrieval-Augmented Generation (RAG)

We applied Retrieval-Augmented Generation (RAG), a method that combines information retrieval with the generative capabilities of Large Language Models. This helps mitigate hallucination, especially when dealing with domain-specific knowledge.

4.2 Semantic Search for Document Retrieval

For our application of answering questions regarding existing LENR documents, we utilized semantic search, which retrieves relevant documents based on the true meaning of the input query.

5 Results

5.1 Web Application

The LLM chatbot was deployed as a web application to make it universally accessible. It uses CSS-Bootstrap to ensure the deployed application is responsive across multiple devices.

5.2 Testing

The performance of our chatbot was tested using expert questions in the LENR field. The chatbot demonstrated strong grounding to its knowledge base, providing more accurate and contextually relevant responses than other chatbots like ChatGPT.

6 Conclusion

The importance of LENR cannot be overstated. A breakthrough in cold fusion could change the world, providing a sustainable and clean energy source. This paper introduces a chatbot specialized in over 30 years of LENR research, offering utilities such as finding papers, summarization, comparisons, and more.

7 References

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