Applying ChatGPT to Extract Mind Maps For Resource Evaluation

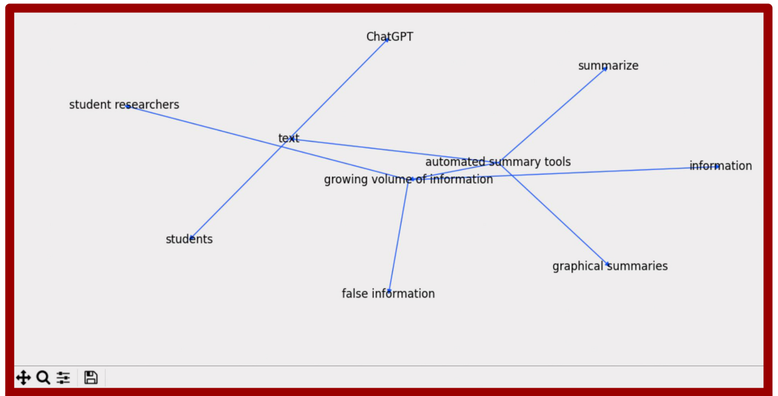
Joshua Tint, Computer Science
Mentor: Chitta Baral, Professor
School of Computing and Augmented Intelligence

Abstract

Student researchers are increasingly using automated summary tools such as ChatGPT in order to quickly analyze resources given the growing volume of information they have access to. However, ChatGPT has several known problems with hallucinating false information (Bang et al., 2023). Meanwhile, graphical summaries of information can be more effective at summarizing information for students than text. For instance, mind maps, which are maps of connected keywords in a text organized around a central point, are faster to process and have better recall than text (Morfidi et al., 2018). For this research, I created an algorithm that automatically generates mind maps to summarize research papers, using filtered output from GPT3 to minimize hallucination. I then asked a group of students to use it as well as ChatGPT and compare the two methods of summarizing research.

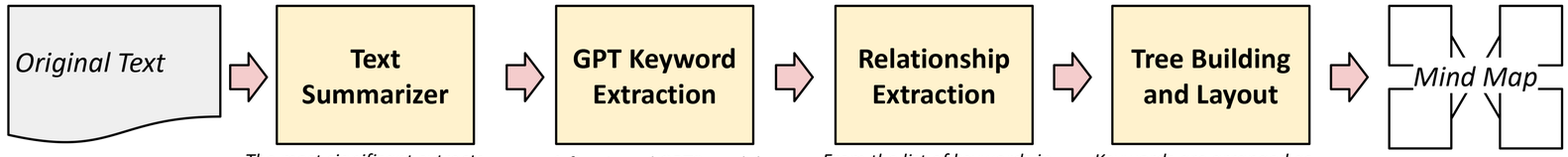
Problem Statement

Would GPT3-generated mind maps be more useful and accurate summaries of research articles to student researchers than GPT3-generated textual summaries?



A mind map generated from this poster's abstract

The Process of Generating Mind Maps



The most significant extracts of the text are collected with a PageRank algorithm. This reduces risk of hallucination or over-response from GPT and reduces the token count for the API call.

A fine-tuned GPT3 model for keyword extraction is used to pull a list of keywords and key phrases from the text, ranked in descending order of significance.

From the list of keywords in the text, the set of relationships between keywords is determined using a transformer to determine each keyword pair's similarity.

Keywords are arranged as nodes in a mind map to keep significant keywords towards the center while connecting relevant nodes.

The full code for the application can be found at github.com/jtint24/mind_map_builder

State of Art: Literature Review

The process of generating mind maps has been automated using artificial intelligence (Wei 2019). However, none of these tools have yet integrated a large language model comparable to GPT3. Automated mind map generation has been suggested as a tool for resource evaluation in Zidek 2015. However, its efficacy was not tested with a group of students.

Methods

After the creation of an algorithm to automatically generate mind maps, a group of five volunteer ASU undergraduate students sourced from HON 171, HON 370, and HON 194 courses. They were asked to use the algorithm for evaluating resources for their class projects, and to use ChatGPT for the same purpose. After two weeks they were asked to complete an open-ended survey on their experiences with each and to compare their effectiveness.

Results

Three participants preferred the automated mind maps for quickly understanding the subjects covered in a paper and their interrelations. Multiple participants preferred textual summaries for understanding the arguments posed by papers, however. Multiple participants critiqued the layouts of the generated mind maps, suggesting that the efficacy of the maps as a tool is sensitive to the visual structure of the maps as well as their content.

Proposals for Future Work

- An investigation to how the layouts of mind maps affect their ability to be quickly processed and understood, and how effective layouts can be automatically generated
- Testing mind map generation algorithms with a larger and more diverse group of students to address the limitations of the small sample size of this research

References

Bang, Y., Cahyawijaya, S., Lee, N., et al. (2023). A multitask, multilingual, multimodal evaluation of ChatGPT on reasoning, hallucination, and interactivity. *arXiv preprint arXiv:2302.04023.*

Morfidi, E., Mikropoulos, A., & Rogdaki, A. (2018). Using concept mapping to improve poor readers' understanding of expository text. Education and Information Technologies, 23, 271-286.

Wei, Y., Guo, H., Wei, J. M., & Su, Z. (2019, August). Revealing semantic structures of texts: multi-grained framework for automatic mind-map generation. In IJCAI (pp. 5247-5254).

Zidek, A. (2015). Automatic Generation of Mind Maps from Essays. Master's Thesis, University of Cambridge

FURI

Ira A. Fulton Schools of Engineering
Arizona State University