LARGE LANGUAGE MODELS (LLMS) AND CHATGPT FOR BIOMEDICINE

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Large Language Models (LLMs) are a type of artificial intelligence that has been revolutionizing various fields, including biomedicine. They have the capability to process and analyze large amounts of data, understand natural language, and generate new content, making them highly desirable in many biomedical applications and beyond. In this workshop, we aim to introduce the attendees to an in-depth understanding of the rise of LLMs in biomedicine, and how they are being used to drive innovation and improve outcomes in the field, along with associated challenges and pitfalls.

Keywords: ChatGPT; large language model; LLM; generative AI; biomedicine and health; education; ethics.

1. Background

A language model (LM) is a machine learning technique for natural language processing tasks. LMs typically predict the probability of a word appearing in a text sequence based on the previous word, modeling linguistic intuition (like completing a missing word in a sentence). One of the key advances in LM was the introduction of the transformer architecture [1], which became the cornerstone for many of the large language models (LLMs) that followed. In brief, the transformer architecture includes two modules, namely, an encoder of bidirectional attention blocks and a decoder of unidirectional attention blocks. Based on which modules are used, the LLMs are classified as encoder-only (e.g., BERT, Bidirectional Encoder Representations from Transformers [2]), encoder-decoder (e.g., T5 , Text-to-Text Transfer Transformer [3]), or decoder-only (e.g.,

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GPT, Generative Pre-trained Transformer, series [4]–[6]). The latter class are able to use billions (or even trillions) of parameters and trained on massive amounts of unlabeled text, providing the ability to generate human-like text [7]. In addition to capturing the language, these models can "memorize" facts during training. Thus, LLMs have the capacity to efficiently handle and analyze extensive text data and generate fresh content, demonstrating significant promise in diverse applications.

The launch of ChatGPT, the LLM-based chatbot developed by OpenAI [8], to the public in late 2022 has sparked a number of exciting opportunities, but also some challenges and ethical concerns. It was recently reported that a keyword search for "large language models" OR "ChatGPT" in PubMed returned 582 articles by the end of May 2023 [9]. The same search conducted at the end of September 2023 returned 1,495 articles, more than doubled in a short period. Publications include research and review articles as well as relevant commentaries on how LLMs are reshaping biomedicine, healthcare and education [9]–[16]. The extent of LLM applications goes beyond language, with active research in the field of protein annotation [17], [18], function [19], and structure prediction [20]. While LLMs offer substantial benefits, it is important to acknowledge its limitations such as hallucinations and key ethical challenges including: perpetuating biases present in the training data, thus efforts are needed to ensure fairness and equity in their applications; privacy issues when handling sensitive data; transparency and plagiarism, among others.

2. *LLM and ChatGPT in Biomedicine Workshop*

Given the rapid evolution and dissemination of the LLMs, and more specifically ChatGPT, the proposed workshop aims at introducing and discussing latest developments in the first year surrounding this new technology in biomedicine. The workshop will consist of talks spanning the following topics:

- Introduction to LLM Technology: This talk will provide an overview of LLMs, including their architecture, training process, and how they work. It will help attendees understand the basics of this technology and why it is relevant to biomedicine.

- Use of Standard LLMs in Scientific Research: This talk will focus on the use of standard LLMs in research, and how they can support researchers in various ways, including helping design and analyze experiments, writing code, brainstorming, and writing papers.

- Use of LLMs in the Education and Academic Writing: This talk will discuss the use of LLMs in the classroom, both for teachers and students. Highlighting the benefits of using LLMs in teaching and learning and provide examples (e.g., as a writing assistant) of how they are being used to enhance the educational experience.

- Applications of LLMs in Healthcare: This talk will showcase the use of LLM technologies in custom methods development for existing/new problems in clinical informatics research and healthcare.

- Ethics of using LLMs: This talk will feature topics surrounding the use of such a chatbot technology in medical care and scientific research, including but not limited to privacy and ethical concerns, AI bias, and legal liabilities.

3. Conclusion

We envision that similarly to previous new technology disruptions in society (e.g., calculator, computer or the internet), LLMs will become integral part of our lives, and the discussions in this workshop will help to shape the landscape ahead.

4. Acknowledgments

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