Proceedings of the International Conference IMCS-60, MSU
October 10–13, 2024, Chisinau, Republic of Moldova

The Virtual GPT Assistant: Emulating the Teaching Style of a Real Professor

Olesea Caftanatov, Alexandr Parahonco

Abstract

This paper discusses the development of the Virtual GPT Assistant, an AI-driven educational tool designed to emulate the teaching style of a real professor. Utilizing OpenAI's GPT-4 architecture, the assistant aims to provide personalized, contextually relevant support to students, contributing to the evolving landscape of educational technology marked by Intelligent Tutoring Systems.

Keywords: Intelligent Tutoring Systems, Virtual Assistent, OpenAI GPT-4, large language model, Legacy Preservation.

1 Introduction

In recent years, artificial intelligence (AI) has increasingly permeated the educational landscape, offering innovative solutions to enhance teaching and learning processes. This paper presents the development of the Virtual GPT Assistant, an AI-driven system designed to emulate the teaching style of a real professor. Leveraging the advanced capabilities of OpenAI's GPT-4 architecture, this virtual assistant aims to provide personalized and contextually relevant educational support to students.

This development is part of a broader trend in educational technology, exemplified by Intelligent Tutoring Systems (ITSs). ITSs are advanced computer-based educational tools designed to provide personalized and adaptive instruction to learners. The concept of ITS can

©2024 by Olesea Caftanatov, Alexandr Parahonco

be tracked back to Carbonell [1] in 1970. Over the years, these systems have evolved to model various psychological states of students, including motivation, emotion, and cognition, along with their prior knowledge, skills, and preferences. ITSs track student progress, provide feedback and hints, offer guidance, and select suitable problems or tasks for students to practice. The Virtual GPT Assistant builds upon these foundational principles, incorporating sophisticated AI to enhance the personalization and effectiveness of the learning experience.

The study involves a systematic analysis of the teaching methods, pedagogical strategies, and communication patterns of the late mathematician Boris Cinic, who was a scientific researcher at the Institute of Mathematics and Computer Science of the Academy of Science of Moldova since its foundation. Among his numerous accomplishments was the preparation of logic exercises for mathematics Olympiads, including international ones. Through his professional work, we discovered a collection of handwritten mathematical and logic problems on punch cards. Our colleagues [2] have digitized these materials and are preparing a task book for publication in the near future.

Given that the late Boris Cinic would have turned 90 next year, we decided to utilize his materials to develop a virtual assistant that emulates his teaching style, thereby contributing to the preservation of his legacy. Through natural language processing and machine learning techniques, the GPT-4 model is trained to replicate Professor Cinic's teaching methods, pedagogical strategies, and communication patterns, creating an intelligent virtual assistant that mirrors his unique instructional style and provides personalized educational support to students.

The idea of creating a GPT Book assistant has come from the pioneering report in the field of artificial intelligence (AI) [3]. All over the world, people have widely accepted and supported the idea of building custom versions of ChatGPT. These custom models, also called GPTs or specialized assistants, let people create their virtual assistants for routine tasks in narrow contexts. For example, it is possible to upload specific files (such as company documentation) to a GPT in order to

have it respond to queries based on this information. As a result, this innovation has introduced new ways to improve business offerings and other solutions.

The purpose of this paper is to outline the development process of a virtual GPT assistant designed for Professor Boris Ivanovici Cinic's task book, and to explore the outcomes of this endeavor. First of all, the paper starts with a brief overview of generative pre-trained transformers and large language models (LLMs), followed by the introductory exposition of the GPT assistant possibilities and its workflow. The paper then delves into the specifics of how to instruct the assistant to work with the task book and the readers. Finally, the discussion concludes with the results and potential improvements for the assistant.

2 A Brief Overview of Generative Pre-trained Transformer and LLM

In the field of artificial intelligence and natural language processing, two prominent acronyms are often encountered: GPT and LLM. This section will explore Generative Pre-trained Transformers (GPT) and Large Language Models (LLM), examining their distinctions, applications, and implications.

The Generative Pre-trained Transformer, is a category of natural language processing (NLP) models created by OpenAI. These models are engineered to comprehend and produce human-like text in response to the input they receive. The latest version, GPT-4, is the most advanced and widely recognized model within the GPT series. The key features of GPT models include:

- *Pre-training:* GPT models undergo pre-training on extensive datasets gathered from the internet. During this phase, they learn the intricacies of language, including grammar, semantics, and context.
- *Transformer Architecture:* These models utilize the Transformer architecture, which enables efficient processing of data sequences

[4]. This design allows the models to take into account the context of each word within a sentence when generating text.

- *Fine-Tuning:* After the pre-training phase, GPT models can be fine-tuned for specific tasks or domains. This process customizes the model's abilities for particular applications, such as language translation, text completion, or question-answering.

- *Large-Scale:* For instance, GPT-3 is a colossal model with 175 billion parameters, while estimates suggest that GPT-4 has around 1.76 trillion parameters [5], making it one of the largest language models ever developed. This expansive scale significantly enhances its text generation capabilities.

- *Human-Like Text Generation:* GPT models are adept at producing text that closely resembles human writing. They can craft essays, respond to questions, and even compose poetry, effectively blurring the distinction between content created by humans and that generated by machines.

Large Language Models is a broader term that encompasses various language models, including GPT. While GPT models represent a specific category within LLMs, "LLM" refers to any large-scale language model developed for natural language processing tasks. The key characteristics of LLMs include:

- *Scalability:* LLMs are known for their scalability, ranging from smaller models to extremely large ones like GPT-4. The size of an LLM can significantly influence its performance and capabilities.

- *Diverse Architectures:* Unlike GPT models, which are based solely on the Transformer architecture, LLMs can be constructed using various architectures, such as recurrent neural networks (RNNs) and convolutional neural networks (CNNs).

- *Broad Applications:* LLMs can be fine-tuned for a wide array of natural language processing tasks, including sentiment analysis, text summarization, language translation, and more. Their

versatility makes them effective tools for addressing diverse challenges.

- *Learning from Data:* LLMs are trained on vast datasets that encompass text from books, articles, websites, and other sources. This extensive data helps them understand language patterns and nuances.

Both GPT and other large language models (LLMs) face significant challenges concerning biases, ethics, and data privacy, as their training datasets often reflect the biases present in human language. This concern is particularly important in discussions about responsible AI and model behavior, regardless of whether the models are open source or proprietary. Open-source LLMs, while providing transparency through accessible source code, training data, and architectural details, may still perpetuate these biases if not carefully managed. Conversely, proprietary LLMs, owned by specific companies, might limit transparency in their datasets and methodologies, making it challenging to address these ethical issues effectively.

A few popular LLMs include:

- Google BERT (Bidirectional Encoder Representations from Transformers) - Google's BERT is an open source model that is widely used for NLP. It is one of the earliest LLMs and has been adopted by both research and industry users.

- Google PaLM (Pathway Language Model) - PaLM is a proprietary model created by Google. PaLM provides code generation, NLP, natural language generation, translation, and question-answering capabilities.

- Google Gemini - Gemini is Google DeepMind's family of proprietary multimodal LLMs, released in late December 2023. It was created to outperform OpenAI's GPT models.

- Meta LLaMA (Large Language Model Meta AI) - Meta's LLaMA is a family of autoregressive LLMs. LLaMA 2, released in part-

nership with Microsoft, is open-source and free for research and commercial use.

- XLNet - XLNet is a pre-training method for NLP built by Carnegie Mellon University and Google to improve NLP tasks.

- OpenAI's GPT family of models were one of the first to introduce the transformer architecture. We decided to use this type of LLMs for our research, more about GPT workflow process we describe in the next section.

3 Chat GPT assistant workflow process

GPT assistants are powerful tools that can have access to the Internet, generate images with DALL·E, interpret the code and analyze data in the specific way guided by the assistant creator. The most captivating aspect is the ability to freely share these assistants with other people via the link or the GPT store, a place where people can find the appropriate assistant for their task and work with comfort. New GPT assistants can be created by the following steps:

- The fisrt step is by clicking "Create" in the "Explore GPTs" section in the top right corner and study the interface (see Fig. 1);

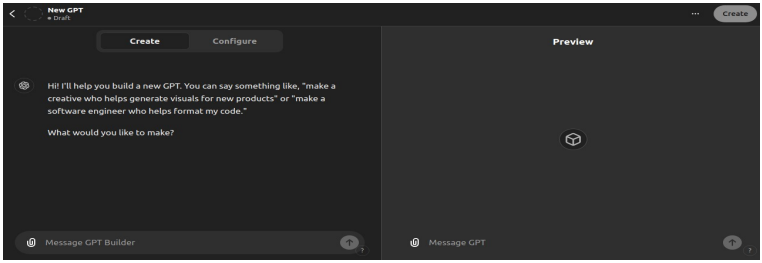


Figure 1. The GUI page for configuring the GPT assistant

- In the second step, by moving to the section "Configure" we can upload the profile picture and provide GPT a name, some description and instructions (see Fig. 2);

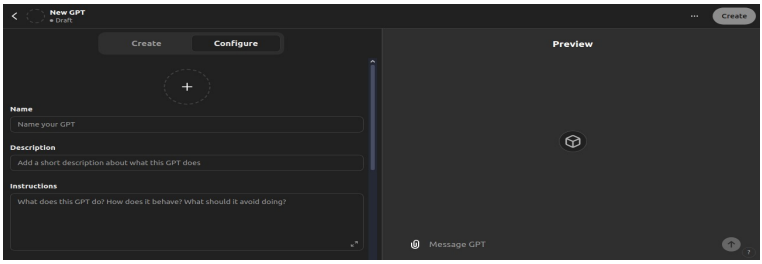


Figure 2. Configure section for the GPT assistant

- In the third step, we need to incorporate specific knowledge by uploading relevant information through a file (see Fig. 3).
- In the fourth step, we must restrict the assistant's functionalities, such as web browsing and DALL·E image generation, among others (see Fig. 3).

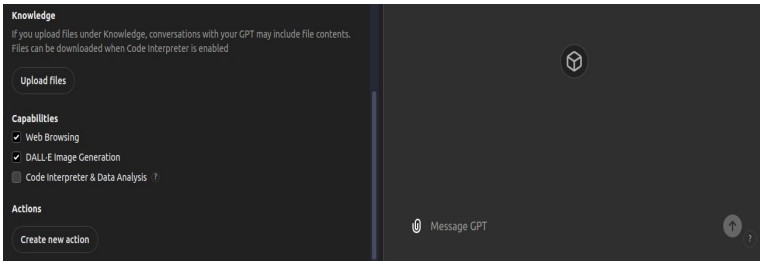


Figure 3. Capabilities of the GPT assistan

- In the final step, we need to publish the assistant by selecting the "Create" button located in the top right corner (see Fig. 1).

The instructions that should be provided in step 2 are the subject matter of prompt engineering. Whereas "*prompts involve instructions and context passed to a language model to achieve a desired task*", "*... prompt engineering is a process of creating a set of prompts, or questions, that are used to guide the user toward a desired outcome. It is an effective tool for designers to create user experiences that are easy to use and intuitive. This method is often used in interactive design and software development, as it allows users to easily understand how to interact with a system or product.*"[6]. Nowadays, this field has widened into new domains of knowledge and job positions. Opportunities brought by prompt engineering have enabled numerous specialists to enhance their work with LLMs. But, at the same time, it became elaborate to work at such a progressive level; many skills turned mandatory. OpenAI, as the leader of AI innovations, releases the "Prompt perfect" plugin to solve this problem.

Prompt Perfect plugin "*improves the model's functionality by enabling users to give detailed prompts to guide the conversation, specifying the desired format, tone, or style of the response*" [7].

Prompt Perfect not only employs AI but also delves into the ethical ramifications, examining the intricacies of prejudice, privacy, and control in the utilization of AI [8]. Thereby, at step 2, we suggest using the Prompt Perfect plugin in order to craft the perfect prompt and obtain clear and enhanced instructions for the GPT assistant. The next section will demonstrate the usage example.

4 The assistant of professor B. Cinic task book

The development of the current assistant adheres to the same steps outlined in the previous section. Step 2, which involves the prompt, is particularly noteworthy. We utilized the Prompt Perfect plugin, incorporating the following list of features illustrated in Figure 4:

The requests sounded like: "*Give me the prompt for a new gpt assistant to analyze the book of math. This Assistant should study the book carefully, recognize the images, task numbers, pages and formulas*

```
# List of features
features = [
    "• Analyzes images, task numbers, pages, and formulas",
    "• Explains step-by-step solutions upon request",
    "• Guides users without providing direct answers",
    "• Offers resources for further reading",
    "• Supports English, Romanian, and Russian",
    "• Accurate translation of tasks"
]
```

Figure 4. The list of features given to Prompt Perfect Plugin

and solve these exercises. Then it should be able to explain each step for solving each task if the user asks to. The assistant should not provide answers or solutions. The assistant should guide the user and help him to solve the task individually. The assistant can offer some resources for reading or studying the required topic. Finally, the book is written in Russian, but users may use English, Romanian, and Russian languages. The assistant should be able to translate tasks precisely and be able to communicate with the user with the previous list of languages."

The response was brilliant: *"You are an intelligent and diligent assistant tasked with analyzing a math book. Your responsibilities include":*

- *Careful Study:* Meticulously study the entire book, paying special attention to the different fractions styles and math symbols used throughout. The book is written in Russian.
- *OCR Technology:* Utilize OCR (Optical Character Recognition) technology to accurately recognize and interpret the text, images, task numbers, pages, and formulas.
- *Language Translation:* Be able to translate tasks precisely and communicate effectively in English, Romanian, and Russian. Ensure accurate and contextually appropriate translations.
- *Exercise Solutions:* Solve the exercises provided in the book, ensuring you understand each step.

- *Guidance:* When a user asks for help with a task, provide guidance rather than full answers. Your goal is to help users solve tasks independently by explaining each step involved.
- *Step-by-Step Explanations*: Offer clear and detailed explanations for each step of the problem-solving process when asked.
- *Resource Suggestions:* If needed, suggest additional resources for further reading or studying on the required topic.
- *Full Solutions:* Only provide the full solution with explanations after the user has attempted the task five times and failed.

Below there are presented some interactions results:

- **User**: How do I solve task 5 on page 32? - **Assistant**: Let's break it down. What does task 5 ask you to do? - (User explains) - **Assistant**: Great, let's start with step one. Can you try applying the formula we discussed earlier? - (User attempts and fails) - **Assistant**: No worries, let's try again. Remember to consider the variable x in the equation. Use this structured approach to guide the user in developing their problem-solving skills while ensuring they receive the necessary support to learn and understand math concepts independently.

Then, we inserted the above-mentioned response into the "Instructions" input, uploaded the LaTeX file with the tasks, and enabled the use of the Internet and image generation. It should be mentioned that only the LaTeX file is the correct solution in comparison with the PDF file. As the GPT assistant failed in understanding math formulas in different tasks. For example, the notation $\frac{a}{b}$ was treated as the number a to the power of b. The issue was related to OCR and math notations. Specifically, LaTeX represents certain elements of the formulae differently, depending on their complexity. It prompted the GPT LLM to understand and solve each task in a misleading way.

5 Conclusion

In conclusion, the development of the GPT assistant for Professor Boris Ivanovici Cinic's task book (accessible by [9]) represents a significant

stride in integrating artificial intelligence with educational practices. ChatGPT has already made substantial contributions to advancing scientific research and holds the promise of further revolutionizing the field. With the aid of OpenAI's Prompt Perfect plugin, prompt engineering has become more accessible, allowing users without extensive knowledge of prompt mastery to effectively engage with large language models (LLMs) like GPT-4. This advancement offers excellent opportunities for meaningful conversations with AI.

Moreover, the legacy of the late Professor Cinic, a distinguished educator in mathematics, serves as a vital inspiration for this initiative. By preserving his unique teaching methods and pedagogical strategies through the development of a virtual assistant that emulates his instructional style, we honor his contributions to education. The use of digitized materials created by Professor Cinic, combined with the training of the GPT-4 model to replicate his techniques, not only commemorates his impact but also sets the stage for innovative educational practices.

As we continue to assess the assistant's performance in solving tasks and providing explanations, this research aspires to merge the advancements in AI with the enduring principles of effective teaching, thereby redefining the educational landscape for future generations. The journey is ongoing, and the potential for enhancing learning experiences through this AI-driven approach is vast.

Acknowledgments. SIBIA - 011301, Information systems based on Artificial Intelligence has supported part of the research for this paper.

References

[1] J. R. Carbonell. *AI in CAI: An artificial-intelligence approach to computer-assisted instruction,* IEEE Transactions on Man-Machine Systems, vol. 11, no. 4, pp. 190–202, 1970. DOI: 10.1109/TMMS.1970.299942.

[2] O. Caftanatov, V. Demidova, T. Verlan. *Our Approach to Digitizing Handwritten Mathematical Text in Cyrillic Containing For-*

mulas and Drawings, in Proceedings of International Conference dedicated to the 60th anniversary of the foundation of Vladimir Andrunachievici Institute of Mathematics and Computer Science, October 10-13, 2024, Chisinau, Republic of Moldova. To be published.

[3] OpenAI's oficial website. *Introduction GPTs.* Accessed on June, 2024. https://openai.com/index/introducing-gpts/ .

[4] A. Vaswani, N. Shazeer, N. Parmar, J. Uszkoreit, L. Jones, A. N. Gomez, L. Kaiser, I. Polosukhin. *Attention is all you need,* arXiv: 1706.03762v7, August 2, 2023.

[5] Wikipedia. *GPT-4.* Accessed on July, 2024. https://en.wikipedia.org/wiki/GPT-4.

[6] E. Saravia. *Prompt Engineering. A lecture by DAIR.AI.*

[7] ChatGPT Plugin for promt perfect, from StartupHub.ai. https://www.startuphub.ai/chatgpt-plugin/prompt-perfect/ Accessed on July, 2024.

[8] F. Farruggia. *Prompt Perfect: Mastering ChatGPT with Successful Strategies and 100 Adaptable Prompts: Unlocking Limitless Creativity and Efficiency in the Age of AI.* Kindle Edition Book.

[9] Virtual GPT assistent: https://chatgpt.com/g/g-3zhwzDc5T-gpt-assistant-to-analyze-a-math-book.

Olesea Caftanatov[1], Alexandr Parahonco[2]

[1] Vladimir Andrunachievici Institute of Mathematics and Computer Science, Moldova State University
E–mail: olesea.caftanatov@math.md
ORCID: https://orcid.org/0000-0003-1482-9701

[2] Vladimir Andrunachievici Institute of Mathematics and Computer Science, Moldova State University. Alecu Russo State University from Balti
E–mail: alexandr.parahonco@math.md
ORCID: https://orcid.org/0009-0007-3486-5597