AI For Research and Education
Live Demos!

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ChatGPT (GPT3.5)

- Fast
- Can hallucinate
- Can generate URLs, citations
  - often fake information
- Best for information discussions on issues prior to Nov. 2021
GPT-4

- Debut in March 2023
- Still the best ChatBot in September 2023 (not for long)
- Can provide accurate citations
- Better capabilities overall
- More reliable than GPT-3 overall
  - Plugins
  - Advanced Data Analytics
  - (one or the other, but not both)
Create a table that includes all capitals of the world, their longitude and latitude, and their population. Create and display a scattergram of population (displayed as a circle with a radius proportional to the log(population), as a function of longitude and latitude.

Analytics cannot be shared

Actual conversation
Klein-Gordon Equation in Polar Coordinates

- Write the Fermi-Dirac equations in a standalone Latex file. Add explanations for all symbols used.
- How about a file for the Klein-Gordon equation, expressed in spherical coordinates?
- Propose appropriate latex/tex macros to simplify the Latex expression of the Klein-Gordon equations just generated. Rewrite the macros and simplify the equations. Produce a new standalone latex file.
Klein-Gordon Equation in Spherical Coordinates (Simplified)

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1 Introduction
The Klein-Gordon equation is a relativistic quantum mechanical wave equation that describes scalar particles. When expressed in spherical coordinates, it accounts for the symmetry and properties inherent to spherical systems. This document presents a simplified notation using LaTeX macros.

2 Equation
Using the defined macros, the time-dependent Klein-Gordon equation in spherical coordinates \((r, \theta, \phi)\) is:

\[
\frac{1}{c^2} \frac{\partial^2 \psi}{\partial t^2} - \frac{1}{r^2} \frac{\partial}{\partial r} \left( r^2 \frac{\partial \psi}{\partial r} \right) - \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} \left( \sin \theta \frac{\partial \psi}{\partial \theta} \right) - \frac{1}{r^2 \sin^2 \theta} \frac{\partial^2 \psi}{\partial \phi^2} + \frac{m^2 c^2}{\hbar^2} \psi = 0
\]

Where:
- \(\psi(r, \theta, \phi)\) is the scalar field.
- \(c\) is the speed of light.
- \(m\) is the rest mass of the scalar particle.
- \(\hbar\) is the reduced Planck's constant.
- \(r, \theta, \phi\) are the radial, polar, and azimuthal coordinates, respectively.

3 Conclusion
Using LaTeX macros can significantly simplify the notation and readability of complex equations like the Klein-Gordon equation. This is especially useful for documents with repeated use of similar terms or structures.
Role Playing

- Professor of Computer Science
  - (use roles that are well known on the web)
- Astrophysicist, playwright, high-school student, doctoral student
- A Linux terminal
- Shakespeare explains function overloading in C++ (link)
- Julia Childs explains how to make a french baguette
Chat Interruptions

- In GPT, you can interrupt a conversation that goes on and on …
- Beware: the context has been cut off.
  - GPT has no memory except the context
  - The reply to the next question *cannot* take into account anything that was not stated
Quiz generation

- Students can create their own quizzes on any topic
- Keep in mind that the chatbot is sometimes wrong.
  - good thing: keeps students on their toes
- Quizzes can be generated in multiple languages, at any level of difficulty
- Quiz types:
  - True/False
  - Multiple Choice
  - Free format
  - auto grading might then be an issue
Lesson Plans

- Develop course materials on any topic
- At any level of difficulty
- With illustration provided by the AI or the user
- With or without code examples
- Have the Chatbot generate synthetic data
- Using DataAnalytics, the chatbot can plot results
  - However: DataAnalytics must be enabled before starting the chat session
Writing Code

❖ Write a Code in C++
❖ Translate it to Javascript
❖ Create a simple Website
❖ Have GPT write code to create a client / server
❖ Analyze stack traces generated by code errors
❖ To try: translate assembler code (i.e., decompile) to readable code
Writing

- Fix grammatical errors
- Change the tone of text
- Completely rewrite text
- Write letters of recommendation
- Write speeches, blogs, reports
- Extract information from text (Abbreviations, links, definitions)