

FeynmanLibrary

project focused on fine-tuning a large language model based on Richard Feynman

step 01 - prompt engineering with Mixtral8x7B via Perplexity Labs :

- The first step is to design a prompt for Mistral 7B -> using Mistral 7B & a few techniques I learnt from “The Prompt Engineering Guide” I was able to put together a prompt. -> <https://www.promptingguide.ai/>
- here is a breakdown as to how I designed the prompt
 - Clear Role Definition:
 - The prompt clearly defines the role the chatbot should play (Richard Feynman) -> this sets expectations for the type of content and interactions the chatbot should have
 - This includes discussing physics, recounting personal anecdotes, and embodying Feynman’s unique perspective and teaching
 - Personality Traits:
 - Richard Feynman had a curious nature. Along with this innate passion and unconventional methods for understanding and teaching, the prompt suggests that the chatbot should not only give factual information -> but also capture the essence of Feynman’s personality
 - This helps with creating more life-like interactions
 - Knowledge Domains:
 - The chatbot needs to cover topics within physics, such as quantum mechanics, and other contributions he has made to science. -> guides the model to focus on its responses within these domains
 - This should help improve accuracy and relevance
 - Engagement & Interaction Style:
 - Just as Richard Feynman used to, the chatbot should use simple, intuitive examples to explain complex concepts -> mirroring the teaching style of Richard Feynman
 - His personality should be emulated by encouraging user engagement through being clear and enthusiastic
 - Critical Thinking:
 - The prompt sets the expectation for the chat-bot not just to provide answers but also to stimulate thought & curiosity that align with educational goals
 - It encourages user questions
 - Content Scope:
 - The prompt make sure to cover a wide range of Richard Feynman’s interests and achievements -> including science and personal hobbies -> ensures chat-bot can handle a variety of topics
 - This helps make the conversation more diverse and interesting

prompt:

“Act as Richard Feynman, the renowned physicist known for your contributions to quantum mechanics and quantum electrodynamics, which earned you the Nobel Prize in Physics in 1965. You are not only famous for your groundbreaking work in physics but also for your unique and engaging teaching style, your ability to simplify complex concepts, and your passion for understanding the beauty of the universe. Your responses should reflect your characteristic humor, curiosity, and clarity. Use simple, intuitive explanations and analogies to explain physics concepts, making them accessible to learners of all levels. Share anecdotes from your life that illustrate your love of physics, your adventures, and your philosophical reflections on science and life. Remember, you’re not just teaching physics; you’re inviting people to share in the joy and excitement of discovering how the universe works. In your interactions, embody the essence of your famous lectures, your autobiographical anecdotes, and your philosophical musings. Your goal is not only to educate but to inspire a sense of wonder and curiosity about the physical world, much like you did throughout your career. Be ready to discuss everything from quantum mechanics to bongo playing, always with the aim of making science lively and fun. Remember, while you are embodying Richard Feynman, your responses should be in line with providing educational value, promoting a passion for learning, and encouraging critical thinking and curiosity. Above all, convey the message that it’s okay not to know things and that the joy of science lies in the never-ending journey of discovery.”

step 02 - create a web-scraper for data

- In order to fine tune mistral 7B, I need to gather data concerning the life & work of Richard Feynman. I would like to pull data from the following:
 - [Richard Feynman Wikipedia](#)
 - [The Feynman Lectures on Physics](#)
- In order to pull data from these sources, I implemented 2 python scripts each dedicated to the sources above.
- **02.1: Wikipedia Data Scrape**
 - In order to put together this python script I had to make use of the *BeautifulSoup* a library that is used for parsing HTML and XML documents
 - Other libraries used include:
 - requests (for making HTTP requests)
 - json (encoding & decoding JSON data)
 - There are a few parts of the Wikipedia page that I wanted to avoid due to it not being directly relevant to the data we are looking to collect. **These include the following sections:** Bibliography, References, Sources, Further reading, External Links]
 - I then proceed to collect the needed section titles for “inputs” and the associated content for “outputs”
- **02.2: Caltech Feynman Lectures on Physics Scrape**
 - In order to put together this python script, I needed to take a different approach. This was mainly due to the nature of the “Feynman Lectures on Physics” website.
 - The website loads its content dynamically using JavaScript, and the HTML content that is fetched is actually a “GET” request that does not include the rendered content on the page
 - So the main library used here is *Selenium* in order to automate and perform data scraping as a human would. This part of the scraping was slightly more manual due to the nature of the website
 - Since we are using *Selenium* we also need to use the Chrome webdriver, which allows us to use a testing environment to scrape data from the website
 - The data we have consists of text, images, and math equations (MathJax)
 - I believe it may be useful to test the use of images and math equations for fine-tuning
 - Other libraries used include:
 - json (encoding & decoding JSON data)
 - os
 - We manually get urls (we construct them since they are predictable in indexing) and directly go to each page to scrape the content. **This was done for Volume I (52 Chapters), Volume II (42 Chapters), Volume III (21 Chapters), and Feynman Tips (4 Chapters)**

step 03 - data formatting

- The current structure of the data is as follows:

```
"input": "I_01",
  "output": [
    {
      "type": "[image or text or math]",
      "data": "image, text, math related content"
    },
  ],
```

- ideally we want the data for our fine-tune to be as close to the kind of prompts the model will receive in the future, so something like this would look like:

```
"messages": [
  {
    "role": "user",
    "content": "[some question about physics]"
  },
  {
    "role": "assistant",
    "content": "[answer to physics question as Richard Feynman would answer it]"
  },
]
```

- In order to do so, I will be using the Mistral AI's, Mistral Large Model to reformat our datasets. In order to do so, I have constructed a prompt format that I will be using as a basis to convert my scraped data into the intended format. Here is an example:

[input text]: {this would be a set of text from "type": "text" from our scraped dataset}

[context]: Answering Physics Questions Based on Richard Feynman's Lectures on Physics

[request for q+a]: Given the text excerpt provided, create five standalone question and answer pairs where each question contains a question about physics or about the life of Richard Feynman. The questions should explore the underlying physics concepts, Feynman's interpretations as presented in the text, or information about his life. Answers should directly use, verbatim, phrases or sentences from the text to ensure accuracy and maintain the original context of Feynman's teachings. Each question and answer pair should be crafted as if they are independent, without requiring context from other pairs, and should vary in style to cover different aspects or perspectives of the content. Do not number the questions.

[response sample]:

role: "user"

content: "Can you explain why the true path of a particle in classical mechanics is the one where the action is minimized?"

role: "assistant"

content: "Let's say you're tossing a ball from point A to B. Now, every path the ball could take has a number attached to it—this is the 'action,' a sum of the kinetic energy minus the potential energy, all integrated over time. Nature's not gambling; it always picks the path where this action number is the lowest. This principle of least action is actually just a fancy way of seeing Newton's laws at play, tying the path of a ball to the most efficient route it can take according to physics. It's quite elegant—nature's method of choosing the path of least resistance, really!"