

Homework 5: Let's Play LLM

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Part 1: Designing a Task for LLM and Explore the Capability of LLM (70%)

Task Description (10%)

- Describe the task you want to solve
The task is that i will give a sequence of actions and finally let the ChatGPT to recognize the color of fruit.
- Describe the format of the input prompt
"Imagine we have an apple, we put the apple into the blue color paint, and then we clean the apple and then put it into orange colored paint. What is the finally color of the apple ? "
- Describe the ideal output
"The color of the apple is Orange."

Motivation (10%)

- Describe the reason why you choose this task
Because sometimes we may get some response from ChatGPT which are very insane or illogical. As result, I want to find the ability of logic thinking in ChatGPT.
- Describe the capability of LLM you want to explore
We want to explore the ability of ChatGPT's logic thinking.

Describe your Initial Attempt (15%)

- Input
We give the sequence of actions that try what response we will get.

Imagine we have an apple, an orange and a banana, we put the apple into the white-colored paint and put the orange into red-colored paint. And then we clean the orange and put the banana into brown-colored paint. We clean the banana and put the orange into blue-colored paint. And then, we put the banana into black-colored paint.

What is the finally color of the apple, orange and banana ?

- Output

The correct output would be "Apple: red, Orange: Blue, Banana: Black.". However, the output is wrong.



Let's break it down step by step|

1. **Apple:** Initially white-colored, but no further actions mentioned, so it remains white.
2. **Orange:** Starts as orange, then turns red, then blue. Finally, it's put into black paint. Since black is a dominant color, it overrides the previous colors. Therefore, the orange will end up black.
3. **Banana:** Starts yellow, then turns brown, and finally black. Again, black overrides the previous colors, so the banana ends up black as well.

So, the final colors are:

- **Apple:** White
- **Orange:** Black
- **Banana:** Black



- Analysis

By analyzing the response, we can find out that the ChatGPT can basic to judge the step of the sequence of actions, but ChatGPT cannot handle the whole actions. We observed the ChatGPT has the limited to understand amounts of actions. As a result, we proposed to provide the actions step by step, which is chunk the query into small parts.

Describe Improvements (35%)

Describe the methods you tried and compare them

- Input

Imagine we have an apple, an orange and a banana.

first step, we put the apple into the white-colored paint and put the orange into red-colored paint.

And then we clean the orange and put the banana into brown-colored paint.

We clean the banana and put the orange into blue-colored paint.

And then, we put the banana into black-colored paint.

What is the finally color of the apple, orange and banana ?

We used the same prompt, but we chunk the query into small parts and many steps to make ChatGPT to understand the problem.

- Output

Imagine we have an apple, an orange and a banana.



Got it, we have an apple, an orange, and a banana. What do you need to do with these fruits? Are you looking to perform some specific actions or tasks with them?

first step, we put the apple into the white-colored paint and put the orange into red-colored paint.



Okay, so the first step is to put the apple into white-colored paint and the orange into red-colored paint. Got it. What's the next step in the sequence?

And then we clean the orange and put the banana into brown-colored paint.



Got it. So, the second step is to clean the orange, and then put the banana into brown-colored paint. What's the next action in the sequence?



We clean the banana and put the orange into blue-colored paint.



Great, so the next step is to clean the banana and then put the orange into blue-colored paint. What's the next action after that?



And then, we put the banana into black-colored paint.



Alright, so after putting the orange into blue-colored paint, the next step is to put the banana into black-colored paint. What's the final action in the sequence?

What is the finally color of the apple, orange and banana ?



Let's recap the sequence of actions:

1. Put the apple into white-colored paint and the orange into red-colored paint.
2. Clean the orange and put the banana into brown-colored paint.
3. Clean the banana and put the orange into blue-colored paint.
4. Put the banana into black-colored paint.

Given these actions, let's determine the final color of each fruit:

- **Apple:** It was initially put into white-colored paint and there are no further steps involving it. So, the final color of the apple remains white.
- **Orange:** Initially put into red-colored paint, then cleaned, and finally put into blue-colored paint. So, the final color of the orange is blue.
- **Banana:** Initially put into brown-colored paint, then cleaned, and finally put into black-colored paint. So, the final color of the banana is black.

So, the final colors are:

- Apple: White
- Orange: Blue
- Banana: Black



After we separate the query into many steps, let the ChatGPT understand the actions of each step. Finally, we get the correct answer.

- Analysis

Breaking down complex queries into smaller, manageable parts can help the ChatGPT provide more accurate responses. Each part can be addressed individually and then combined to form the final answer.

- Reference

Here are the Chat I've tested in ChatGPT 3.5. TAs can open the link to check.

- Original edition

<https://chatgpt.com/share/d8075455-e285-47fe-8ef6-c2e15eebb3d0>

- The improved edition

<https://chatgpt.com/share/20af6913-568e-41d9-977c-5cf494f1b38b>

Part 2: Problem Answering (30%)

Question 1

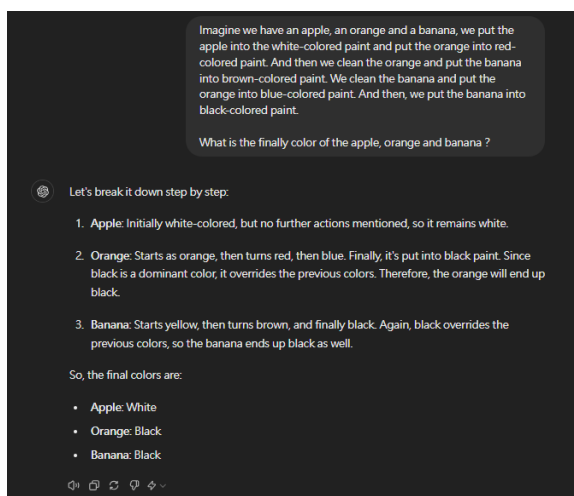
1. Besides providing a more detailed description of the question in the prompt, what other methods can be employed to improve the accuracy of the responses?

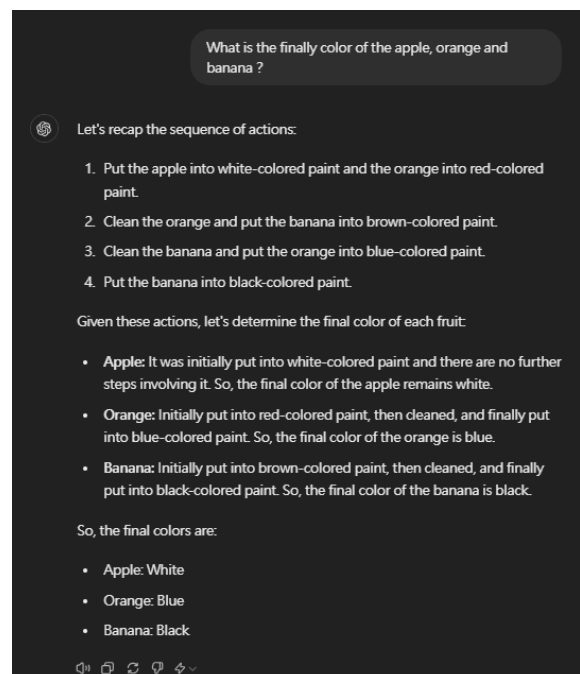
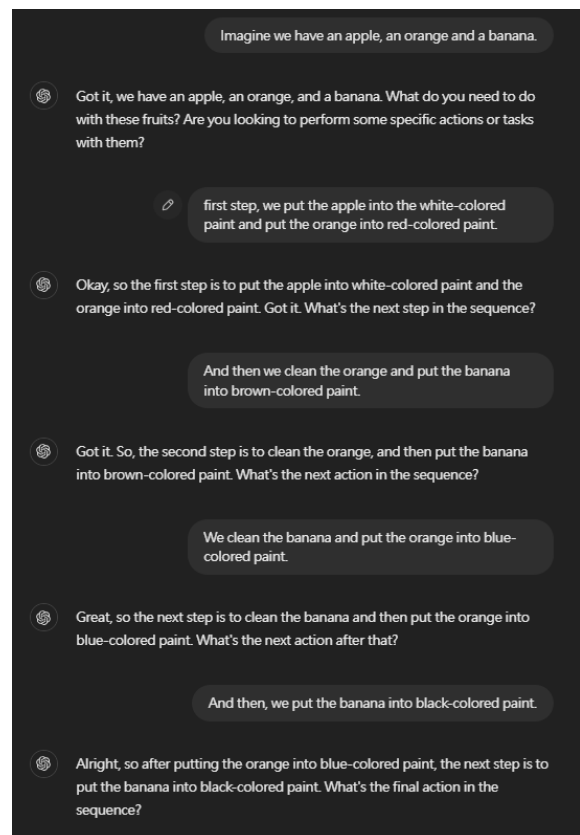
A : If we can only modify the prompt and context:

- Firstly, we chunk the query into small parts and let the ChatGPT generate the response in stages, reviewing and adjusting the prompt based on the output at each stage.

If we can modify not only about the prompt we type:

- Using "Fine-Tuning" on the domain data
 - Using "Retrieval Augmented Generation, RAG" makes the models to output better response.
2. Please provide an example demonstrating the impact of implementing the aforementioned methods on a prompt.
- The answer is wrong.
 - The answer is right.





We take the example of the part 1 we used, since we make the query into many steps, and the accuracy of the ChatGPT 3.5 response can give me the right answer.

Question 2

- Question: Scalability and Efficiency of the LLM
- Motivation: Since we know that the LLM like ChatGPT has the limit. So, we want to figure out that is there any possibility to manage the computational and resource demands of LLMs.
- Challenges: High computational cost, energy consumption, and long training times.
- Solution: Model pruning, quantization, knowledge distillation, and more efficient architectures like transformers for reducing unnecessary computations to enhance efficiency.
- Reference

<https://medium.com/@kaushikeva0026/overcoming-llm-challenges-in-big-data-analytics-with-google-cloud-f46fb73981d1>