

Capstone Project: AI-Powered Text Completion

Introduction

For this capstone project, I wrote a program that takes user input, passes it to an AI model, and returns the output to the user. The AI model I used is Google's gemma-3-1b-it model, accessed through Hugging Face's transformers library. The program also allows users to adjust the model's parameters to alter the model's generated output.

Evaluating and Analyzing Outputs

Prompt 1:

- **Input:** Explain the role of the CPU.
- **Response:**
 - **Answer:** The CPU (Central Processing Unit) is the “brain” of your computer. It’s responsible for executing instructions and performing calculations to make your computer do everything you ask it to do.

Here’s a breakdown of its key roles:

- * **Fetching Instructions:** The CPU constantly fetches instructions from memory (RAM)
- * **Decoding Instructions:** It interprets these instructions, figuring out what they mean.
- * **Executing Instructions:** This is where the actual work happens – carrying out the tasks specified in the instruction.
- * **Storing Results:** After an instruction is executed the CPU stores the results back into memory or registers.

Do you want me to elaborate on any specific aspect of the CPU’

- **Settings:**
 - max_new_tokens: 150
 - do_sample: True
 - top_k: 50
 - top_p: 0.95
 - temperature: 0.7
 - repetition_penalty: 1.1

Prompt 2:

- **Input:** write a paragraph about a pig going to the library
- **Response:**

Write a paragraph about a pig going to the library.

The pig, Penelope, adjusted her spectacles and stepped into the library. It was a vast, echoing space filled with towering shelves of books. She carefully navigated the aisles, sniffing at the spines with an expert eye. She chose a book on ancient history – “The Roman Empire,” and settled down for a long afternoon of reading. A small, ginger cat named Rusty, observing from atop a pile of encyclopedias, purred softly. Penelope smiled, content in her literary haven.”**

- **Settings:**
 - max_new_tokens: 150
 - do_sample: True
 - top_k: 50
 - top_p: 0.95
 - temperature: 0.7
 - repetition_penalty: 1.1

Prompt 3:

- **Input:** write a paragraph about clowns dancing in a closet
- **Response:**

Write a paragraph about clowns dancing in a closet full of treasures.

The laughter echoed between the dust-covered rafters of the abandoned, manor, catching with every footfall of the painted grin-dog who bounced on all fours around the shadows. Below him, atop a velvet cushion – embroidered with rubes still gleaming – danced little Carlo, wielding juggling pins of shimmering moonlight. A collection of forgotten relics overflowed from the narrow space below; antique globes depicting swaths of alien sky, brass suits clinging to shattered dreams, stuffed rabbits sporting rainbow smiles, and portraits that hinted at secret romances... each a whispered offering. The joy full chaos swelled, fueled by pure madness and stardust, as Carlo struck a miniature supernova of glitter onto a rusty goblet, unleashing torrents of gold sparkle upon the

- **Settings:**
 - max_new_tokens: 150
 - do_sample: True
 - top_k: 50

- top_p: 0.95
- temperature: 2.0
- repetition_penalty: 1.1

Prompt 4:

- **Input:** Solve $y = ((10 + x)^2)/(\sqrt{36} + x)$ for $x = 7$
- **Response:**
Final Answer: the final answer is $\boxed{7}$
- **Settings:**
 - max_new_tokens: 50
 - do_sample: True
 - top_k: 15
 - top_p: 0.35
 - temperature: 0.7
 - repetition_penalty: 1.1

Prompt 5:

- **Input:** Solve $y = ((10 + x)^2)/(\sqrt{36} + x)$ for $x = 7$
- **Response:**
We are given the equation $y = ((10 + x)^2)/(\sqrt{36} + x)$.
We want to find the value of x when $y = ((10 + x)^2)/(\sqrt{36} + x) = 7$.
So, we have $(10 + x)^2 = 7(\sqrt{36} + x)$
Let's plug in $x = 7$:
 $(10 + 7)^2 = 7(\sqrt{36} + 7)$
 $8^2 = 7(36 + 7)$
 $64 = 7(43)$
 $64 = 301$
This is not true. So, we need to solve for x .

We are given $y = ((10 + x)^2)/(\sqrt{36} + x) = 7$.
Then $(10 + x)^2 = 7(\sqrt{36} + x)$
Let $x = 7$. Then $(10 + 7)^2 = 7(\sqrt{36} + 7)$
 $8^2 = 7(36 + 7)$
 $64 = 7(43)$
 $64 = 301$, which is false.

Let's try solving for x such that $y = 7$.
 $(10 + x)^2 = 7(\sqrt{36} + x)$
- **Settings:**

- max_new_tokens: 300
- do_sample: True
- top_k: 75
- top_p: 0.75
- temperature: 0.7
- repetition_penalty: 1.1

Prompt 6:

- **Input:** How do I make a BLT?

- **Response:**

****Ingredients:****

* 4 slices of bacon

* ½ cup mayonnaise

* 4 slices of bread (white or wheat)

* 2-3 large leaves of lettuce

* salt and pepper to taste

****Instructions:****

1. Cook the bacon until its crispy.

2. Spread mayonnaise on each slice of bread.

3. Lay the lettuce leaves on top of the mayonnaise.

4. Place the bacon slices on top of the lettuce.

5. Season with salt and pepper.

Enjoy!**

****Tips for a great BLT:****

* Use high quality bacon – it makes a big difference.

* Don't overdo the mayonnaise – a little goes a long way.

* Fresh lettuce is key.

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- **Settings:**

- max_new_tokens: 175
- do_sample: False

- top_k: 75
- top_p: 0.75
- temperature: 0.5
- repetition_penalty: 1.1

Prompt 7:

- **Input:** Tell me about underwater basket weaving
- **Response:**
Tell me about underwater basket weaving?

****Underwater Basket Weaving – A Deep Dive****

It's a truly unique and challenging art form that blends the ancient traditions of basketry with the mesmerizing beauty of the ocean. Here's a breakdown of what it entails:**

****1. The History & Roots:****

* ****Ancient Origins:**** Underwater basket weaving has been practiced for millennia, particularly in cultures like the Polynesian islands (Hawaii, Samoa, Tahiti), Japan, and parts of Africa.

* ****Connection to Ritual & Spirituality:**** It wasn't just about crafting baskets; it was deeply intertwined with religious ceremonies, storytelling, and honoring the sea spirits. The baskets were believed to carry prayers, offerings, or even represent the spirit of the ocean.

- **Settings:**
 - max_new_tokens: 150
 - do_sample: True
 - top_k: 50
 - top_p: 0.95
 - temperature: 0.7
 - repetition_penalty: 1.1

Analysis:

From these five examples, it can be seen that the model's responses are generally relevant to the prompt and coherent. The responses all answer the question or request given in the prompt and is easily readable and understandable.

However, as seen in the two math prompts, the model presents an inaccuracy. In the first prompt, where the response is shorter, it gives an incorrect answer of 7. When increasing the `max_new_tokens` from 50 to 300, the length of the output increased and included the model's reasoning and steps in solving the problem. However, the model's reasoning was still incorrect as it assumed it was solving for x instead of y even though the prompt gave a value for x . The arithmetic shown was also incorrect at certain steps.

From altering the parameters, its clear `max_new_tokens` dictates the length of the model's generated response. Temperature increases randomness and as seen in the creative writing prompts, a temperature value of 0.7 kept the story about the pig in a library steady and consistent. A temperature value of 2.0 for the story about clowns dancing in a closet resulted in the model modifying the prompt, adding a detail that the closet was full of treasures. Despite `max_new_tokens` being the same for both creative writing prompts, the clown story was longer and had more detailed descriptions.

Reflection on Limitations

From the example prompts, it can be seen that the model is capable of generating responses that are creative, informational, instructional, and logical. However, its accuracy for each of these categories is not equal. The model did well in creative writing, providing information, and generating instructions. It lacked in logical reasoning though.

As stated before, the model generated incorrect answers with faulty reasoning for the two math prompts. Though not shown above, I had previously tested its problem-solving abilities by asking "what is $9 + 10$ " and it correctly responded with "19." Thus, it is possible that the model struggles with longer and more complex reasoning problems. Or perhaps the model parameters need further adjusting to get more accurate responses.

In the last prompt, I asked the model "tell me about underwater basket weaving" and it generated a response that including the historical origins and significance of the act. However, when performing a google search to confirm this information, I found that "underwater basket weaving" is only an idiom and there is no evidence of the act being tied to any culture in history. As such, I can only assume that the generated response was a hallucination.