Generative Agents (LoRA)

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Introduction

In recent years, the field of generative agents has garnered significant attention due to its potential in creating virtual simulation worlds that resemble reality. Notably, a groundbreaking paper published by Google a few weeks ago, titled "Generative Agents," showcased the creation of a simulation world reminiscent of the popular game SIMs using Large Language Models (LLMs). The authors demonstrated remarkable results, albeit at a substantial cost, raising concerns about the accessibility and scalability of such simulations for researchers and developers.

The objective of this research paper is to present LoRA (Low Rank Adaptation), a modified implementation of the "Generative Agents" paper. The LoRA method aims to address the cost and time limitations associated with the original method, enabling researchers to create simulation worlds in a more cost-effective and efficient manner. While compromises in accuracy may arise, the potential gain in affordability and scalability holds promise for fostering widespread contributions in the emerging field of generative agents.

The "Generative Agents" paper by Google outlined an elaborate process involving LLMs to generate rich character-driven simulations akin to real-world scenarios. However, the authors noted that the implementation costs for their method ran into thousands of dollars, posing a barrier for researchers with limited resources. LoRA aims to bridge this gap by presenting a methodology that reduces the cost of creating simulations while maintaining a satisfactory level of realism.

By analyzing the original "Generative Agents" paper, we identify key areas where optimizations can be made without compromising the overall integrity of the simulation. Our modifications aim to streamline resource consumption, reduce complexity, and leverage cost-effective alternatives. Through a series of carefully designed adjustments, LoRA empowers researchers to create a simulated day in the virtual world for less than $2, making simulation experiments more accessible and encouraging wider participation in the field.

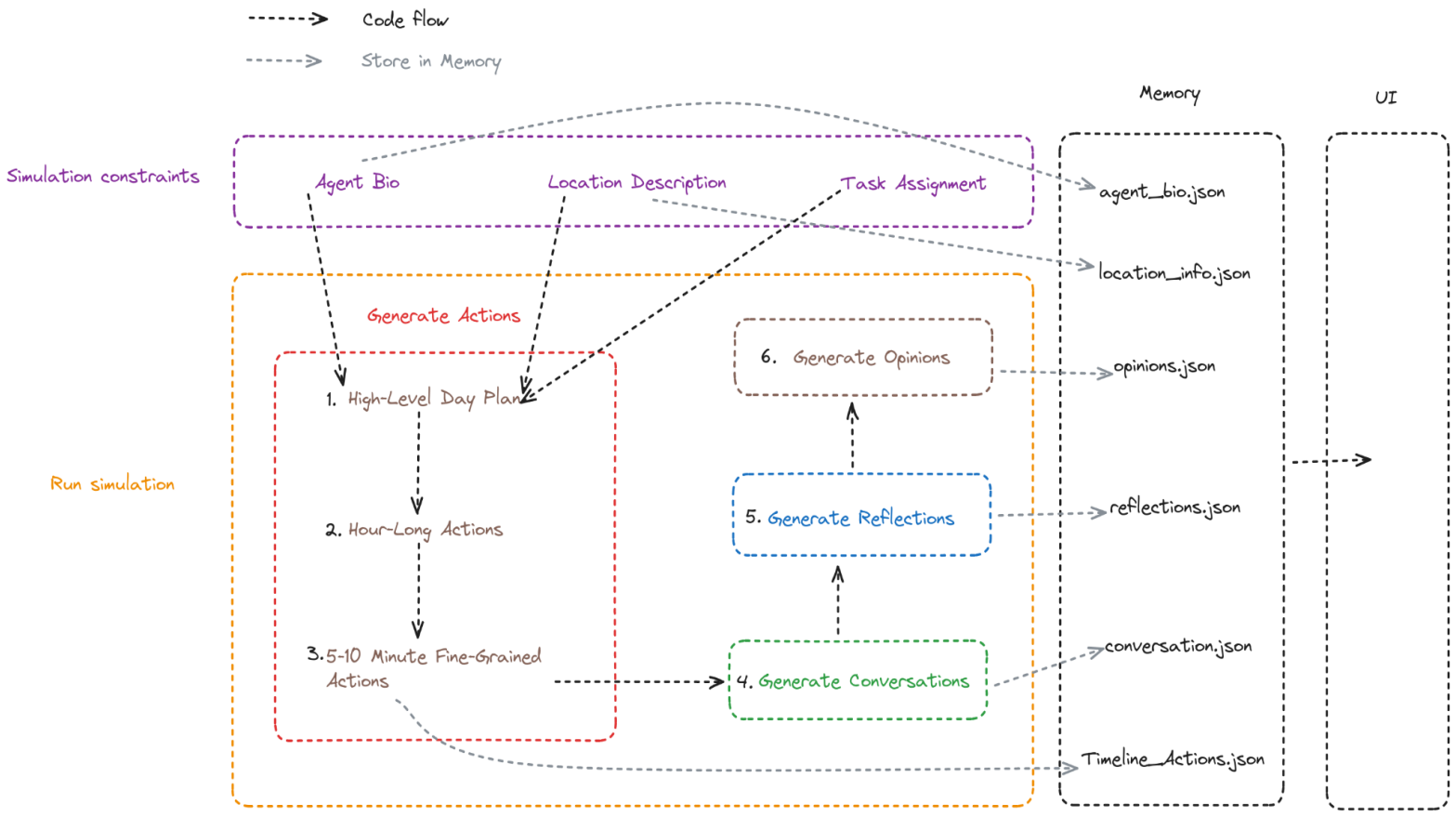
It is crucial to note that the intent of this research paper is not to present a superior or more accurate method than the original "Generative Agents" approach. Rather, our primary objective is to propose a more cost-effective and efficient alternative, enabling researchers with limited resources to explore and contribute to the exciting realm of generative agents. The potential for

a more affordable implementation opens doors for novel research, creative experimentation, and the democratization of simulation-based studies.

In the subsequent sections of this paper, we will delve into the methodology behind LoRA, outlining the specific tweaks and optimizations made to the original "Generative Agents" framework. We will discuss the impact of these modifications on cost-effectiveness and time efficiency, while acknowledging the compromises in accuracy. Through our research, we hope to inspire and encourage further advancements in the field, fostering a diverse range of perspectives and contributions.

Overall, LoRA represents a significant step towards democratizing generative agents, allowing researchers to harness the power of simulation worlds without being hampered by exorbitant costs. By making simulation experiments more accessible, we anticipate a surge of innovative approaches and novel discoveries in this evolving field.

System Architecture



1. Define simulation constraints

Simulation constraints play a vital role in ensuring accurate representation and meaningful results within the simulation world. By guiding the random generation of GPT (Generative Pre-trained Transformer) models, these constraints establish the boundaries and rules for the simulation. They strike a balance between adhering to defined descriptions and allowing the creative imagination of the GPT models.

The simulation constraints primarily consist of three key components: character definitions/bios, key locations with brief descriptions, and assigned tasks to specific agents. Together, these components foster consistency and enable effective simulation outcomes. The constraints direct the simulation generation to focus on the provided characters and locations, incorporating the relevant descriptions. Additionally, task assignment allows control over the daily activities of the simulated agents.

- **Character Definitions:**
  Creating characters within the simulation world begins with providing a small bio for each individual. These character bios typically include fundamental details such as name, gender, age, occupation, and other pertinent attributes. Furthermore, defining the relationships between the agents mentioned in the simulation world enhances the depth and interconnectivity of the simulated environment. In certain cases, it may also be essential to specify significant relationships with characters outside the simulation world when their influence impacts the simulation's objectives. Examples of character bio used in experimentation are mentioned in **annexure-1**.

- **Key Locations with Descriptions:**
  To ensure a comprehensive understanding of the simulated environment, it is crucial to define key locations within the simulation world. These locations can include an agent's house, their locality, workplace, or any other relevant setting. By providing concise descriptions of these locations, the simulation model gains a better grasp of the simulated environment. This understanding facilitates the generation of more contextually relevant and meaningful results throughout the simulation. Examples of location descriptions used in experimentation are mentioned in **annexure-2**.

- **Task Assignment:**
  In scenarios where a specific narrative or imaginary play is desired, task assignment comes into play. By assigning particular tasks to agents within the simulation, the simulation box generates events and actions in accordance with these assigned tasks. Task assignment enables control over the progression of the simulation and ensures the simulation aligns with predetermined objectives

or scenarios. It allows for the development of interactive storylines and facilitates the exploration of various agent behaviors.

2. Run simulation

The process of running the simulation is divided into four distinct parts, each serving a specific purpose in generating a dynamic and realistic simulation world. These components include generating actions, conversations, reflections, and opinions, collectively contributing to the depth and complexity of the simulated environment.

a. Generate Actions:

The generation of actions forms the foundation of the simulation, driving the behavior and activities of the simulated agents. This component can be further divided into three levels of action generation: high-level day planning, hour-long actions, and fine-grained actions spanning 5-10 minutes.

- **Generate High-Level Day Plan:**

  At the highest level, the simulation generates a day plan that outlines the general activities and objectives for each agent within the simulated world. This plan provides a broad structure for the agents' daily routines and sets the stage for subsequent action generation.

- **Generate Hour-Long Actions:**

  Building upon the day plan, the simulation generates hour-long actions that detail the specific activities agents undertake during each hour. These actions may include work-related tasks, social interactions, leisure activities, or any other relevant behaviors. Hour-long actions contribute to the realism and coherence of the simulation, simulating the progression of time within the virtual world.

- **Generate 5-10 Minute Fine-Grained Actions:**

  To add granularity and detail to the simulation, fine-grained actions are generated, capturing the short-term behaviors of the agents. These actions occur within specific time windows of 5-10 minutes and encompass more specific activities such as conversations, small tasks, or interactions with the environment.

b. Generate Conversations:

Conversations play a crucial role in simulating realistic social interactions within the simulation world. This component focuses on generating meaningful dialogues between the simulated agents, enabling them to engage in conversations that align with their attributes, relationships, and objectives. By considering context, personality traits, and social dynamics, the simulation produces dialogues that reflect the nuances and intricacies of human communication.

c. Generate Reflections:

The ability to reflect on past experiences and actions adds depth and realism to the simulated agents. This component focuses on generating reflections, where agents recall and contemplate their previous interactions, events, and decisions. Reflections contribute to the agents' evolving behaviors and help shape their future actions, making the simulation more dynamic and responsive.

d. Generate Opinions:

Opinions are an integral aspect of human behavior, influencing decision-making processes and social dynamics. In this component, the simulation generates opinions held by the agents, which can encompass a wide range of topics, including preferences, beliefs, attitudes, and judgments. These opinions influence the agents' interactions, choices, and overall behavior, enhancing the authenticity and complexity of the simulated world.

By integrating these four components into the simulation process, researchers can create a comprehensive and immersive simulation experience. The generation of actions, conversations, reflections, and opinions allows for the emergence of realistic behaviors, social dynamics, and decision-making patterns within the simulated world. As a result, the simulation becomes a valuable tool for studying and analyzing various aspects of human behavior and societal interactions.

Annexure-1

Following are the examples of character bio, used in experimentation.

Jerry
age : 50,
bio : He is a Gujarati businessman. His age is 50. He has a business of Electric goods (TV, Washing machine, mobile phones etc.).
He has got a son named Tom, his father's name is Father_Bob and his wife's name is Daisy. He loves eating Guajarati food, especially Fafda jalebi
He got two employees at his business named Nolan uncle and Bilal. He is also very angry about Nolan uncle and Bilal for being lazy at their work,
although he respects Nolan uncle because of his age. He is also very irritated that why did such a fair skin woman called Belena married to Black skin guy named Adam. He has a big crush on Belena and he never misses a chance of healthy flirting with Belena. Jerry is a very funny person.

Daisy
age : 47,
bio : She is the wife of Jerry. She is a housewife. She is known for her helping nature and she cooks amazing Gujarati dishes. She lives her life with Gujarati cultural values.

Belena
age : 40,
bio : She is a pretty white Bangoli woman. She is very fair skinned. She lives a western culture life. She is a housewife. She lives with her husband Adam, in Gulab society. She is very fitness-found and diet conscious.

Adam
age : 45,
bio : he is a dark skin south indian guy. he lives with his wife Belena. he is a space scientist at ISRO center. He knows Jerry always flirts with his wife, so he doesn't like Jerry.

Annexure-2

Following are the examples of location description, used in experimentation.

jerry's house
It's a typical Gujarati house. with a julah (swing). It is located in Gulab society.

Belena & Adam's house
It's a modern English house, as Belena & Adam are quite fond of western culture. It is located in Gulab society.

general park
It is a general park of Gulab society. It is right in the center of the society and the rest of every house is located in its periphery.

Jerry's shop
Jerry's shop is located in the town, which is a bit far from his residence. Jerry doesn't own a car, so he often travels by taxi. Nolan uncle and Bilal work as support staff at this shop. They sell Electronic goods like TVs, Washing machines, mobile phones, etc.

Adam's office
Adam works as a Space scientist, in ISRO (an Indian government space body). It is located in the town,which is a bit far from his residence. He doesn't own a car so he often commutes to the office using Taxi service.

References

Generative Agents: Interactive Simulacra of Human Behavior
https://arxiv.org/pdf/2304.03442.pdf