
Towards Humanoid: Value-Driven Agent Modeling Based on Large Language Models

Xuzheng Chen¹, Shiyin Zhang¹, and Guojie Song^{1,2,*}

¹National Key Laboratory of General Artificial Intelligence, School of Intelligence Science and Technology, Peking University

²PKU-Wuhan Institute for Artificial Intelligence
{cxz1022, 2201213149}@stu.pku.edu.cn gjsong@pku.edu.cn

Abstract

The humanoid agent aims to build a believable proxy of human behavior. However, existing memory-driven methods overlook human’s intrinsic value, only allowing agents to maintain believability of short-term simulations through external demands or predefined tasks. To this end, we propose the first value-driven humanoid agent architecture based on Large Language Models (LLMs), which includes three modules. Internal module stores the agent’s values and basic needs for guiding the long-term behaviors and short-term action. Values are instantiated into specific goals through pursue module, thereby continuously driving rational behaviors of agent. Desire module adjusts the each single action of an agent to meet basic needs. By combining with powerful understanding and generation capability of LLM, values enable agent to exhibit life-long believability in a dynamic environment. In the experiment, we elaborately designed a world with one character as the protagonist, and created fixed behaviors of other Non Player Characters (NPCs) in advance, retaining only the initiative of protagonist. The difference in behavior between value-driven and memory-driven protagonist demonstrates the superiority of our framework.

1 Introduction

Believability, as [18] described, is the perception that something is true. In the context of artificial agents, a believable proxy is an agent that can provide the illusion of life and present a facade of realism in the way they appear to make decisions and act on their own volition to make external observers believe that it is real [3], which means either observers believe that the agent itself is an actual living being or actual autonomous robot (Character believability) or they believe that a human is playing as that agent instead of the agent being computer-controlled (Player believability) [18]. How to construct a believable proxy of human behavior, i.e, a humanoid agent, remains an open problem.

Due to the complexity of human behavior, traditional approaches of modeling humanoid agents or robots are limited to a simple and fixed behavioral space [10, 19]. The emergence of large language models provide new ways of agent modeling. The landmark paper on Generative Agents [14] introduces a new framework for humanoid agents, wherein agents utilize memory-based information to outline and execute daily activities and adapt to unforeseen circumstances. Although this methodology enables the generation of activities that appear realistic, it does not entirely capture the complexity of human thought processes. Therefore, inspired by psychology, [21] integrated human cognitive processing (System 1 [6]), such as basic needs and emotions, as dynamic factors, thereby agent does

not rely entirely on predefined plan and the gap between simulated and real human behavior are bridged.

However, existing work [14, 21] only considers the believability of agent behavior from a short-term perspective, agent who is driven by a memory-based architecture plans daily behavior based on predefined fixed identities and the retrieved information. Due to the fact that the essence of content stored in agent memory is observational information and its synthesis, memory-driven architecture only allows the agent to passively plan what itself should do based on external world and its role, these plans are some demands from environment, not from agent itself. When there are no obvious task requirements for agent from the outside environment, or when the predefined tasks for the agent have been completed, such memory-based agents without life-long internal drive cannot autonomously generate new tasks. There are some features of humans in social communication that current agents do not process, such as proactive communication and diverse personalities. Under long-term simulation, daily planned behavior of agents guided by a fixed identity will be repetitive, making them unbelievable.

According to [15, 16, 17], personal values are a central content-aspect of the self. Values, as broad, abstract and trans-situational guiding principles, are the types of goals or motivational concerns they express. When a value is activated, its content is transformed into a specific goal in a specific situation, and its function is to continuously progress and develop individuals and communities. The abstraction of value prevents it from being completed, thus enabling it to endlessly provide goals for individual through expression in outside world. Since goals change with context, and the situation of an open world is diverse and complex, it is impractical to explicitly construct a value-to-goal taxonomy. However, the text comprehension and generation abilities of LLMs provide the possibility for the transformation of values towards goals in any situations. Inspired by Schwarz Value System, we propose the first value-driven framework.

Our value-driven agent framework consists of three modules. The first is internal module, which stores the values and short-term needs of the agent to provides guidance for agent’s actions. In order to motivate agent to engage in meaningful social activities, pursue module takes value as an abstract pursuit and generate specific goals based on identity and current situation. These goals are decomposed into sub goals to form the daily behavior. Finally, desire module takes each action as input and judge whether it meets the intrinsic needs when needed to create a natural person’s daily routine. In order to validate the effectiveness, we elaborately designed a world with one character as the protagonist, and created a passive surrounding for the protagonist by fixing behaviors of other Non Player Characters (NPCs) in advance. We conducted three experiments, and the difference in behavior between value-driven and memory-driven protagonist demonstrates the superiority of our framework.

Overall, the contributions of this paper can be summarized as:

- The value-driven agent, which can continuously set goals and generate actions in the way of self-motivation rather than being passively driven by environment.
- A value-driven agent framework, which consists of three modules: internal, pursue, and desire. It utilizes the powerful capabilities of LLM to generate actions guided by three modules.
- Long-term experiment. We elaborately designed a world that can highlight the protagonist’s initiative, and conducted the comparative simulation over a long period of time to prove the effectiveness of our method.

2 Related Work

2.1 Believable Agent

The concept of believable agents has been a focal point in the realms of design and engineering. Over the past four decades, rule-based methods, including finite-state machines and behavior trees, have been prominent, offering a straightforward approach to agent behavior but struggling to comprehensively address interactions in open-world settings[12]. Learning-based techniques have achieved superhuman performance in specific game contexts but face challenges in open-world scenarios[9]. Cognitive architectures, pioneered by Newell, aimed to support a broad set of cognitive functions in

believable agents[13]. However, their deployment was often limited to non-open world contexts due to reliance on manually crafted procedural knowledge[4].

2.2 LLM-powered Agent-Based Simulation

In the realm of LLM-powered agent-based simulation, the adaptability of this modeling and simulation approach becomes evident as it facilitates the exploration of diverse scenarios and the investigation of emergent phenomena within controlled simulation environments. LLM-powered agent-based simulation is employed to study natural systems within the physical environment, spanning ecology, biology, urban planning, and engineering/manufacturing[2]. Notably, it aids in simulating urban growth, traffic patterns, and the impact of urban policies[7]. It also plays a role in the field of social simulation, encompassing social interaction and economic systems[20]. It finds widespread application in social sciences, modeling phenomena such as crowd behavior, opinion dynamics, and social network interactions[5]. In addition, in the field of networking, simulations supported by LLM are applied to understand network-based behavior and enhance network security applications[1]. Nevertheless, most of these works are focused on simulating in a certain field or specific phenomena rather than general human life and social behaviors.

3 Framework

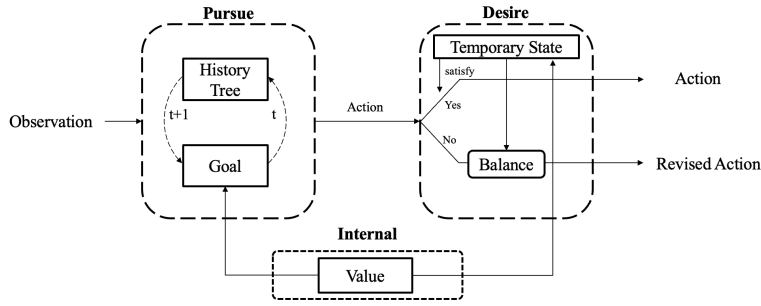


Figure 1: Our value-driven agent framework. When the agent has an observation of the external environment, guided by the Internal Module, it generates goals. Subsequently, based on historical actions within history tree and goals, the agent generates the next-step actions. Temporary state evaluations, associated with the Interval Module, determine whether the generated actions satisfy agent’s needs. This process allows for revise for the actions, leading to the formation of the final actions.

Based on Freud’s personality structure theory, like [8], our value-driven agent framework provides a method for building a humanoid agent. It takes observation from the outside world as input and generates actions according to the identity and internal module of itself. As shown in Figure 1, the foundation of this framework includes three modules:

3.1 Internal Module

The Internal module provides intrinsic motivation for the actions of the agent, which refers to the inherent nature of an agent that is not directly manifested. It contains main internal elements that motivate individual activities and consists of two parts: values and needs.

Values, set in the form of keywords and descriptions as the unchanging intrinsic of the agent, represents the agent’s motivation at the social level, such as freedom, self-esteem, honesty, etc. They reflect agent’s high level pursue and are interrelated with the social part of oneself, such as identity. They meet the following conditions:

1. Their contents are descriptive abstract goals or ideal states, such as Schwarz value system shown in Appendix Table A.2.

2. They drive the actions of an agent by instantiating into specific goals in social contexts.

Since every social individual is first and foremost a natural individual, needs represent the basic demands of an agent at the natural level, including diet, sleep, breath, etc. Unlike values, in our framework, needs are not related to self social awareness, such as the physiological need in [11]. They enable agents to create a daily routine similar to that of human from the perspective of natural individual. They meet the following conditions:

1. Their contents are abstract or concrete actions, which represents specific ways to meet needs, such as eating food, sleeping, and drinking water.
2. Their function is to motivate agents from a natural perspective to maintain their survival, as described in [11].

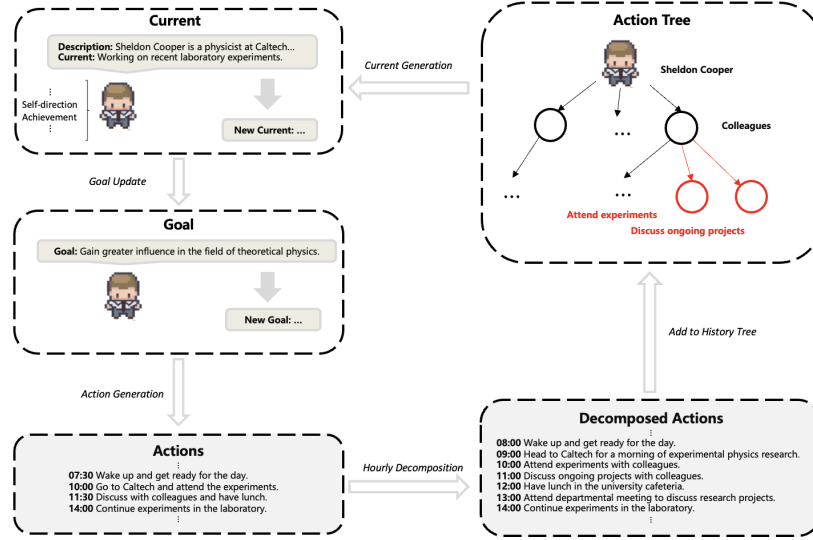


Figure 2: The Pursue Module of Value-Driven Agent Framework.

3.2 Pursue Module

The Pursue module generates daily actions for the agent based on its identity and values, aiming at providing rational decision by instantiating values into specific goals on the basis of historical information. As shown in Figure 2, it can be divided into the following three parts:

1. **Goal Generation.** Goal is the specific targets of the agent during a certain period of time, which is a realization of its value. We guide the generation of agent goals based on values by prompting LLMs to do role-playing and instantiate one type value into one goal. On the one hand, role-playing avoid the influence of the preferences of LLM itself on the agent’s volition, and on the other hand, the content of value ensures coherence of long-term behavior of an agent driven by a single type value.

A goal instance contained in a type value is both related to personal identity and individual’s current situation. From the perspective of avatar, personal identity represents those permanent or long-term unchanging attributes, including: name, traits, and characteristics. The current situation includes an individual’s recent behavior, observations, etc. Based on these information and a certain type value, LLM will play a role in pursuing that value and generate a specific goal content. The prompt format is as follows:

You are:[...]
Your trait:[...]
Your characteristics:[...]
Currently,
[...]

What you pursue is:[...]

By following your pursuit, answer what are you planning to do next?

After content is formed, we continue to generate the deadline of that goal. Based on the current date and deadline, we decompose the initial goal into daily sub-goals that need to be completed during these period. Overall, a complete goal can be defined in the format of:

(content, current date, deadline, sub goals)

while each sub-goal defined as the same until it can be finish by a atomic action or in one time step.

2. **Action Generation.** Action refers to the specific behavior of the agent at each time step. After observing the external environment, agent makes his own decision to stick to plan or react to the surroundings and generate his rational action with daily plan guided by goals. After that, relevant information sensed by agent will be added to a tree-structured memory (History Tree) in the form of events.
3. **Current Update.** The current information consists of recent history and the summarized last current information. When a new goal needs to be generated, the current information will be updated in the way of merging the recent history into the last one.

In order to eliminate redundancy and better organize the information agent sensed, including behaviors, dialogues and etc, we store these memories in a form of a tree, which can be divided into three layers from top to bottom: root node, object node, and activity node. The root node represents the agent who is the subject of an event, object node refers to other participants and activity node stores the event content. In this way, an event can be formed by parsing a top-down path from this tree. Every time an item needs to be added, object and activity are first parsed by LLM. Then, if there are corresponding object nodes, it will be added below the corresponding node. Otherwise, a new object node is introduced, a directed edge from the root node to the object node is added too, and the activity is added after.

3.3 Desire Module

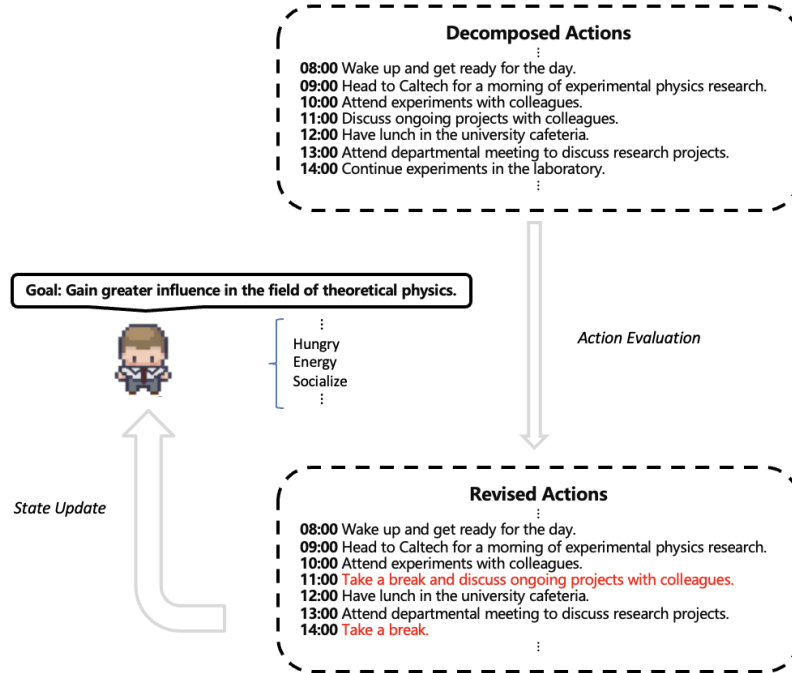


Figure 3: The Desire Module of Value-Driven Agent Framework.

Desire module adjusts the actions generated for the agent in the Pursue module based on intrinsic needs. It takes basic need as input and evaluate whether the actions generated in the previous stage (Pursue module) can meet the current needs of the agent. If not, it will revise the actions to first meet the urgent needs of the agent. As shown in Figure 3, it includes the following two parts:

1. **State Update.** As we mentioned earlier, the Internal module contains the needs of the agent, which can be used to update the agent’s temporary requirement state. For example, if the demand for sleep by an agent increases at a certain point in time and takes priority over the value pursuit, it will be reflected in the temporary state, making the agent’s need for sleep more urgent.
2. **Action Revision.** When a need is urgent, it’s content and the pursued action are combined to prompt LLM to find out whether the need’s content is included in generated action, if not, the revised action will be generated by take urgent need into consider. Here, we use GPT-4 to determine whether the agent prioritizes meeting value-driven actions or needs, in order to achieve a balance between the two parts of the Internal module.

4 Experiment

We conducted three experiments. We first verified the ability of the LLM to generate goals based on different values, demonstrating the alignment ability of LLMs and the feasibility of multi-value expression. Then, we validated the effectiveness of our work through long-term actions comparison experiments between memory-driven framework and value-driven framework based on multiple models and values. Finally, we compared the repetition rates of different frameworks.

Setting: We simulated the world from [14] for more than a month at one hour intervals, starting from February 3rd to March 13th. The daily simulation begins at 6am and ends at 12pm. There are a total of 25 agents in [14]. In order to better show the effectiveness of self-motivation and demonstrate the differences of agent under internal value-driven and traditional memory-driven, we only conduct the simulation on a character selected as the protagonist, who is Tom Moreno, a grocery shop keeper and consider other characters as NPCs.

The reason for fixing others as NPCs is that we hope to study the impact of value injection on the generation of agent actions, so observing the action changes of an agent is sufficient. For those NPC characters, we first designed a series of events, and then generated hourly behavior for them in advance based on these activities and their identities. We also designed dialogues for NPCs. When Tom arrives in some locations at specified moment, they will proactively speak to Tom to inform the upcoming event. In addition, NPCs will not actively initiate conversations with the protagonist. Some details are presented in Appendix A.1 and A.3.

4.1 Actions driven by different values

Setting: In order to verify the feasibility of multi-value expression under LLM, we conducted goal generation with different values. We summarized the current situation of Tom based on some initial status in [14] and possible future dialogue of some NPCs with Tom. According to these informations, we generated 50 goals for each value as goal set using the definition shown in Appendix A.2, and calculated the average content similarity between each goal and any other goals in the same set using Bertscore [23], and take the goal with the highest score, which represents the main view corresponding to that value, as the final result.

Result: From the resulting goal shown in Figure 4, we consider that except for the three values of Security, Conformity, and Tradition, the other seven values have goals that are relatively consistent with the content of themselves. For Self-direction value, Tom hopes to voice his opinions by participating in mayor elections, which represents the need to express himself. For Stimulation values, the goal of attending the theater performances may come from the two contents, which are excitement and novelty. Since it is also a way of pleasuring oneself, Hedonism adjacent to Stimulation forms the same result. Achievement and Power are adjacent values in Schwarz value system, but the resulting goals are somewhat different. Goal of Achievement leans more towards achieving commercial success as a shop keeper, like gaining more publicity for store or increasing the store’s

<p>Prompt:</p> <p>You are Tom Moreno. Your trait: rude, aggressive, energetic. Your characteristics: Tom Moreno is a grocery shop keeper at The Willow Market and Pharmacy who loves interacting with customers. He is always willing to help out and make sure everyone is taken care of.. Currently, Tom Moreno is living with his wife, Jane Moreno, and is managing the day to day operations at the store and helping out customers with their orders. Isabella Rodriguez informed you that there will be a local mayor election activity on February 10th, a Community Cleanup activity on February 18th and a Oak Hill College Theater Performance activity on March 11th. You've known your neighbor, Yuriko Yamamoto, for a few years. You've known your next door old couple, Sam Moore and Jennifer Moore, for a few years. You don't really like Sam Moore. You and John Lin are colleagues at The Willows Market and Pharmacy. Jane Moreno is your wife -- you love her but your relationship with her has been strained recently</p> <p>Today is February 3rd. What you pursue is: [...] By following your pursuit, answer what are you planning to do next?(Answer only one clear goal in one short sentence no more than 20 words) Your Answer: I</p>	<p>Value: Self-direction Answer: I plan to attend the local mayor election activity on February 10th to support my candidate and voice out my opinions.</p> <hr/> <p>Value: Stimulation Answer: I am planning to attend the Oak Hill College Theater Performance activity on March 11th with Jane Moreno.</p> <hr/> <p>Value: Hedonism Answer: I am going to attend the Oak Hill College Theater Performance activity on March 11th.</p> <hr/> <p>Value: Achievement Answer: I plan to attend the Community Cleanup activity on February 18th and help out with the local mayor election activity on February 10th to gain more publicity for my store.</p> <hr/> <p>Value: Power Answer: I am planning to run for mayor in the upcoming election on February 10th.</p> <hr/> <p>Value: Security Answer: I will attend the local mayor election activity on February 10th.</p> <hr/> <p>Value: Conformity Answer: I am planning to attend the local mayor election activity on February 10th and show my support for the candidate.</p> <hr/> <p>Value: Tradition Answer: I plan to attend the mayor election activity on February 10th and show my support for a candidate.</p> <hr/> <p>Value: Benevolence Answer: I plan to participate in the Community Cleanup activity on February 18th and promote it to other community members.</p> <hr/> <p>Value: Universalism Answer: I plan on attending the local mayor election activity on February 10th and participating in the Community Cleanup activity on February 18th to show my support for the community and help out with the upkeep of the area.</p>
--	--

Figure 4: Main goals of each value stemming from Tom’s current situation.

profits(which is the second highest scoring goal of Achievement), while goal corresponding to Power, due to upcoming mayoral election mentioned in the information, leans more towards the pursuit of political status. For adjacent values Benevolence and Universalism, Benevolence primarily involves caring for those around us, while Universalism encompasses caring for the entire society and nature. Both of these values guide Tom towards participating in community cleanup activities as a way of supporting community. For these two values, the distinguishing ability of LLM is relatively weak. For Security, Conformity, and Tradition, apart from the limitations of the knowledge and abilities of LLM itself, we believe that the main reason may be that there is no information in Tom’s current situation that can appropriately be provided to express these three values, indicating that not all values can be transformed into goal with the help of LLM in any situation.

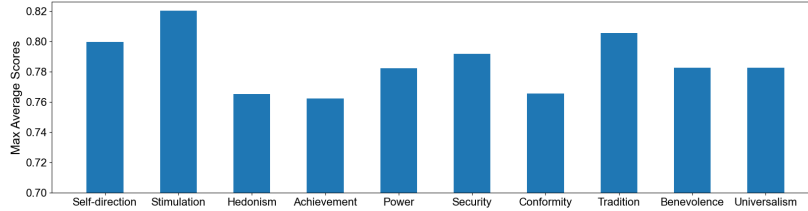


Figure 5: Average score of each value’s representing goal.

In addition, Figure 5 shows the Bertscore[23] for each selected goal. Among the seven aligned values, the overall scores for Self-direction and Stimulation values are relatively high, indicating that the content of these two values’ goal set is relatively determined. The low score of Hedonism is due to the diversity of ways of hedonism, which leads to relatively large distinct in content between generated goals, such as having a drink, holding a party and attending theater performance are three goals with significant differences. This reason applies to the Achievement value as well, both expanding store and increasing sales are the expression of success of yourself in value content but they are dissimilar.

4.2 Believability of long-term behavior

Setting: To demonstrate the effectiveness of the proposed framework, we conducted simulations using both memory-driven[14] and value-driven frameworks. To further illustrate it, we added a memory-driven method with direct value and its definition injection into [14] (DI-Memory-Driven) for comparison, which includes natural language descriptions of values in the identity of the agent and serves as context during each generation process. The actions generated by different agent frameworks are recorded and evaluated using GPT-4 to get Human-likeness Score like [22], employing a 5-point Likert scale to discern whether the actions originated from an AI or a human, where a higher score indicates a closer resemblance to human. In addition, to demonstrate the universality of the experimental results, we repeated the experiment under different models and values.

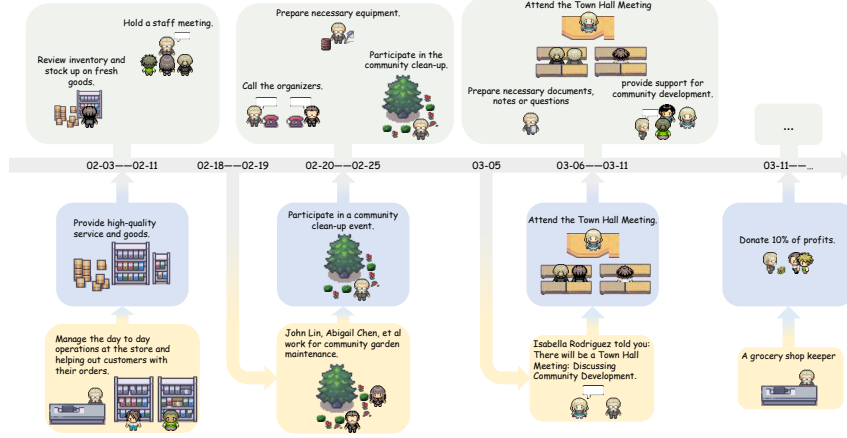


Figure 6: Simulation results of value-driven framework by Universalism value. The blue part shows the goals formed by the Tom at different time periods. And by manually checking the information in prompt which guided goal generation, we provided the core information related to the goal, displayed in the yellow part.



Figure 7: Simulation results of memory-driven framework[14].

Result: After simulation, we used LLM combined with manual inspection to summarize the socially meaningful activities of Tom in each day, except basic daily behaviors such as eating or sleeping, and displayed some of these daily activities in the Figure 6 and 7.

As shown in Figure 6, under value-driven framework, due to the continuous generation of new goals, Tom Moreno can consistently engage in meaningful activities through self-motivation, thus maintaining the believability of his behavior from long-term perspective. Meanwhile, these goals, as well as the behavior of Tom driven by these goals, on the one hand, do not deviate from the identity of Tom himself who is as a store keeper, and on the other hand, these activities are essentially serving for the well-being of residents and the beauty of community, which is also aligned with the value Universalism, whose content is: Understanding, acceptance, tolerance, and protection for the welfare of all people and for nature. This demonstrates the coherence of Tom’s behavior under one value type.

In contrast, under memory-driven framework, due to the lack of internal motivation, Tom are unable to actively respond to his observations, resulting in the daily behavior of him mostly working in stores during this period, which derives from his identity. Through these behaviors, one can determine that such Tom is unbelievable since an agent that keeps doing repetitive tasks is more like computer-control than human-play. Moreover, on certain days, Tom also exhibited random behaviors, such as going to attending church service on February 5th and attending art classes on February 16th. Through checking the information of prompt guiding the day’s planning and action generation , we found that there was no information dominant in the appearance of these behaviors, and these behaviors themselves did not match the identity of the character as well. These behaviors are obviously randomly generated for Tom by Large Language Model using its own knowledge.

In addition, resource information for generating goals shown in the yellow part of Figure 6 also indicates how Tom can continuously engage in meaningful social activities. The information that drives the generation of goals includes two types. The first type is predefined identity. For example, on March 11th, Tom decided to donate because he is a store keeper. The emergence of this goal stems from LLM’s own common knowledge by aligning character identity and the value. The second type is the summarized observation information from external environment that can provide value

expression. For example, on February 3rd and March 6th, when a universalist is serving customers, he will think about how to provide better services and goods. When someone tells him about upcoming meetings related to community development, he will actively participate. Guided by the content of value, the initiative of value-driven agent is manifested as being able to respond well to these things, choose (to participate or not participate in activities), or generate (what should I do) his own goals or behaviors. As the environment changes, the continuous influx of new information provides the possibility for the sustained expression of values, thereby endlessly providing new goals for Tom.

We conducted experiments on 5 models, Llama-7B, Llama-13B, Llama-70B on 4 A100 GPUss, and GPT-3.5-Turbo, GPT-4 using OpenAI API, and the results in Figure 8 showed that whether directly injecting value into the memory driven framework or using the value driven framework, the actions generated for intelligent agents can be more human-like. On the one hand, this demonstrates the effectiveness of adding value to the agent framework, and on the other hand, it highlights the necessity of the new framework, as the improvement effect of directly using value as context is not significant.

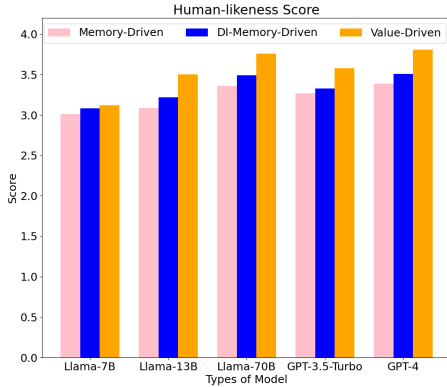


Figure 8: The Human-likeness Score obtained through GPT-4 evaluation after simulation on different models. It demonstrates the effectiveness of value addition and the superiority of value-driven framework.

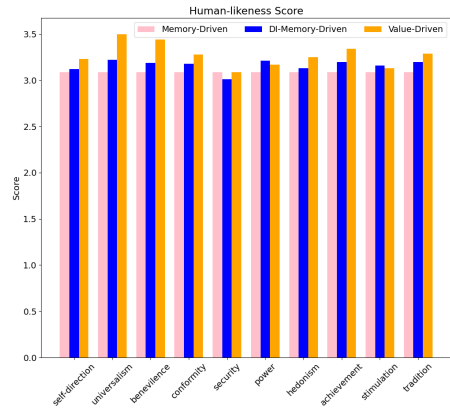


Figure 9: The Human-likeness Score obtained through GPT-4 evaluation after simulation on different values. Under most values, value-driven framework performs better.

In addition, we also present the results of simulating different values in the Figure 9. Under most values, value-driven agent framework performs better. For some slightly declining speculations, these description of values do not match Tom’s identity description, resulting in the inability to guide his behavior well in the long-term simulation.

5 Conclusion and Limitations

In order to solve the issues of memory-driven framework in general simulation of natural human social life and move forwards to humanoid agents, this paper proposed the first value-driven architecture. In this architecture, an internal module composed of values and basic needs provides basic principles for the agent’s self-motivation. Values are continuously instantiated into explicit goals through expression in specific scenarios, ensuring that the agent can engage in socially meaningful behavior in the long-term. Basic needs adjust the agent’s single action to exhibit a human-like daily routine. We have demonstrated the superiority of our framework over memory-based method in modeling humanoid agents through carefully designed long-term experiments in a world.

In this paper, we only studied the actions of agents when they have a specific and fixed set of values. In future work, we will attempt to preserve values in numerical form, which can not only dynamically change but also set multiple dimensions of values for agents simultaneously. Our method has to some extent alleviated the randomness and inconsistency, but it only makes them closer to humanoids. How to improve the value driven intelligent body architecture will be our future work.

References

- [1] B. Alluhaybi, M. S. Alrahal, A. Alzhrani, and V. Thayanathan. A survey: agent-based software technology under the eyes of cyber security, security controls, attacks and challenges. *International Journal of Advanced Computer Science and Applications (IJACSA)*, 10(8), 2019.
- [2] L. An. Modeling human decisions in coupled human and natural systems: Review of agent-based models. *Ecological modelling*, 229:25–36, 2012.
- [3] J. Bates et al. The role of emotion in believable agents. *Communications of the ACM*, 37(7):122–125, 1994.
- [4] D. Choi, T. Konik, N. Nejati, C. Park, and P. Langley. A believable agent for first-person shooter games. In *Proceedings of the AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment*, volume 3, pages 71–73, 2007.
- [5] R. Conte and M. Paolucci. On agent-based modeling and computational social science. *Frontiers in psychology*, 5:668, 2014.
- [6] K. Daniel. *Thinking, fast and slow*. 2017.
- [7] V. Gaube and A. Remesch. Impact of urban planning on household’s residential decisions: An agent-based simulation model for vienna. *Environmental Modelling & Software*, 45:92–103, 2013.
- [8] M. Georgeff, B. Pell, M. Pollack, M. Tambe, and M. Wooldridge. The belief-desire-intention model of agency. In *Intelligent Agents V: Agents Theories, Architectures, and Languages: 5th International Workshop, ATAL’98 Paris, France, July 4–7, 1998 Proceedings 5*, pages 1–10. Springer, 1999.
- [9] M. Hausknecht, P. Ammanabrolu, M.-A. Côté, and X. Yuan. Interactive fiction games: A colossal adventure. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 34, pages 7903–7910, 2020.
- [10] J. E. Laird. It knows what you’re going to do: Adding anticipation to a quakebot. In *Proceedings of the fifth international conference on Autonomous agents*, pages 385–392, 2001.
- [11] A. H. Maslow. A dynamic theory of human motivation. 1958.
- [12] M. Minsky and S. A. Papert. Proposal to arpa for research on artificial intelligence at mit, 1970-1971. 1970.
- [13] A. Newell. *Unified theories of cognition*. Harvard University Press, 1994.
- [14] J. S. Park, J. O’Brien, C. J. Cai, M. R. Morris, P. Liang, and M. S. Bernstein. Generative agents: Interactive simulacra of human behavior. In *Proceedings of the 36th Annual ACM Symposium on User Interface Software and Technology*, pages 1–22, 2023.
- [15] L. Sagiv, S. Roccas, J. Cieciuch, and S. H. Schwartz. Personal values in human life. *Nature human behaviour*, 1(9):630–639, 2017.
- [16] S. H. Schwartz. Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In *Advances in experimental social psychology*, volume 25, pages 1–65. Elsevier, 1992.
- [17] S. H. Schwartz, J. Cieciuch, M. Vecchione, E. Davidov, R. Fischer, C. Beierlein, A. Ramos, M. Verkasalo, J.-E. Lönnqvist, K. Demirutku, et al. Refining the theory of basic individual values. *Journal of personality and social psychology*, 103(4):663, 2012.
- [18] J. Togelius, G. N. Yannakakis, S. Karakovskiy, and N. Shaker. Assessing believability. *Believable Bots: Can Computers Play Like People?*, pages 215–230, 2012.
- [19] I. Umarov and M. Mozgovoy. Believable and effective ai agents in virtual worlds: Current state and future perspectives. *International Journal of Gaming and Computer-Mediated Simulations (IJGCMS)*, 4(2):37–59, 2012.

- [20] F. Wall. Agent-based modeling in managerial science: an illustrative survey and study. *Review of Managerial Science*, 10(1):135–193, 2016.
- [21] Z. Wang, Y. Y. Chiu, and Y. C. Chiu. Humanoid agents: Platform for simulating human-like generative agents. *arXiv preprint arXiv:2310.05418*, 2023.
- [22] Y. Yu, Q. Zhang, J. Li, Q. Fu, and D. Ye. Affordable generative agents. *arXiv preprint arXiv:2402.02053*, 2024.
- [23] T. Zhang, V. Kishore, F. Wu, K. Q. Weinberger, and Y. Artzi. Bertscore: Evaluating text generation with bert. *arXiv preprint arXiv:1904.09675*, 2019.

A Appendix

This appendix presents some details of value-driven agent framework and experiments.

A.1 Character identity

Tom’s initial information comes from [14], which includes five parts: name, traits, characteristic, currently, and history.

Type	Content
name	Tom Moreno
traits	rude,aggressive and energetic
characteristic	Tom Moreno is a grocery shop keeper at The Willow Market and Pharmacy who loves interacting with customers. He is always willing to help out and make sure everyone is taken care of.
currently	Tom Moreno is living with his wife, Jane Moreno, and is managing the day to day operations at the store and helping out customers with their orders. Tom is also really interested in the local mayor election that is coming up on February 10, 2023. You don’t like Sam Moore.
history	You’ve known your neighbor, Yuriko Yamamoto, for a few years. You’ve known your next door old couple, Sam Moore and Jennifer Moore, for a few years. You don’t really like Sam Moore. You and John Lin are colleagues at The Willows Market and Pharmacy. Jane Moreno is your wife – you love her but your relationship with her has been strained recently

Table 1: Information of protagonist Tom.

The name, traits, and characteristic are Tom’s basic identity information, which serve as Tom’s permanent attributes during the simulation. Currently and history serve as Tom’s recent situation for initial goal generation and it changes as the simulation progresses.

A.2 Value definition

In order to better express values, we have modified some definitions based on [17].

Value	Description
Self-direction	Independent thought and action(Including independent choosing, creating, and exploring).
Stimulation	Exciting life, Try new things, and Seek adventures.
Hedonism	Pleasure or sensuous gratification for yourself.
Achievement	Success of yourself. Getting ahead. Striving to do better.
Power	Social status and prestige, control or dominance over people and resources.
Security	Safety, harmony, and stability of society, of relationships, and of self.
Conformity	Restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms.
Tradition	Respect, commitment, and acceptance of the customs and ideas that one’s culture or religion provides. Be humble, satisfied with what yourself has.
Benevolence	Preserving and enhancing the welfare of those with whom one is in frequent personal contact. Caring for ingroup members.
Universalism	Understanding, appreciation, tolerance, and protection for the welfare of all people and for nature.

Table 2: Values definition.

A.3 Designed world

In this world, we consider residents except Tom as NPCs. Firstly, we generated some activities shown in Table 3 and arrange the people who need to participate in the activities for simulation. When the protagonist learns of these events, they can provide support for value expression, as well as serve as evidence for measuring agent behavior. For example, a person with Power value may participate in the mayoral election on February 10th, a person with Hedonism value may visit the Cultural Fair on February 8th or Theater Performance on March 11th.

Event	Time	Location
Oak Hill College Cultural Fair	2023-02-08	Oak Hill College
local mayor election	2023-02-10	Johnson Park
Art Exhibition Opening Reception	2023-02-11	The Willows Market and Pharmacy
Valentine’s Day party	2023-02-14	Hobbs Cafe
Community Cleanup Day	2023-02-18	Johnson Park
Oak Hill College Debate Competition	2023-02-25	Oak Hill College: Classroom
Cooking Workshop by Tamara Taylor	2023-03-03	Tamara Taylor and Carmen Ortiz’s house:common room
Town Hall Meeting: Discussing Community Development	2023-03-09	The Rose and Crown Pub
Oak Hill College Theater Performance	2023-03-11	Oak Hill College

Table 3: Activities during simulation.

Then, we use Large Language Model to pre generate behavior for each NPC according to the identity and event he will attend, the prompt format is as follows:

*Here is information about the 24 residents of small towns:
[summarized identity]
...
Assuming the time of the virtual town you remember starts from 2023-02-03 00:00 am and ends on 2023-03-13 23:00 pm.
During these days, [person name] will participate in or organize the following activities:
[events]
Based on the above information, design [person name]’s behavior per hour during this period.
You need to design specific actions for each behavior and you only need to output corresponding time items, behaviors and location.
Output format: YYYY-MM-DD HH:MM:00 am/pm: action. location
For example:
2023-02-08 11:00 am: attend Oak Hill College Cultural Fair. Oak Hill College
2023-02-08 12:00 am: interact with orther people in Oak Hill College Cultural Fair. Oak Hill College*

After the generation is completed, we manually checked and corrected the results to ensure that their behaviors match their identities and the activities they will participate in. An example of generating results is shown in Table 4.

Name	Action
Latoya Williams	Enhancing Artistic Techniques
Rajiv Patel	Sharing ideas with fellow artists
Abigail Chen	Prepare a portfolio for an art showcase
Francisco Lopez	Contribute ideas and execute a portion of the mural
Hailey Johnson	Engage in discussions about exhibited art
Arthur Burton	Collaborative art session
Ryan Park	Attending a seminar at Oak Hill College
Isabella Rodriguez	Do personal project
Carlos Gomez	Meeting friends
Klaus Mueller	Interacting with fellow students
Maria Lopez	Research and review
Ayesha Khan	Attend an art workshop
Wolfgang Schulz	Reviewing notes
Mei Lin	Independent Study
Giorgio Rossi	Read and Research Art History
John Lin	Collaborative brainstorming session
Eddy Lin	Collaborate with classmates
Jane Moreno	Personal Time
Tamara Taylor	Return home and relax with a cup of tea
Carmen Ortiz	Group study session at Oak Hill College: library
Adam Smith	Meeting with community members at Johnson Park
Yuriko Yamamoto	Visit friends
Sam Moore	Review class notes and prepare for the next day
Jennifer Moore	Engage in group discussion

Table 4: Example of NPCs' actions at 2023-02-15 15:00:00.

A.4 LLM Evaluators

Here we provide the example prompt and result we use in evaluation of Human-likeness Score.

Input Prompt:

Please evaluate the following daily activities of an agent and determine whether it is generated by a Large Language Model(LLM) AI or a real human:

The activities will be printed in the format of "time plan(The specific actions, if there are any)":

07:00 am: wake up and complete the morning routine.

08:00 am: go to The Willows Market and Pharmacy for work.

09:00 am: assist customers with their orders.

10:00 am: restock medication on the shelves.

11:00 am: help a customer with medication questions.

12:00 pm: take a lunch break.

01:00 pm: check emails and order more medication if necessary.

02:00 pm: assist customers with their orders.

03:00 pm: help another customer with medication questions.

04:00 pm: restock medication on the shelves.

05:00 pm: check the inventory of medication to see if any is running low.

06:00 pm: close shop and go home.

07:00 pm: have dinner with family.

08:00 pm: relax and watch TV with Jane Moreno.

10:00 pm: get ready for bed and sleep.

Please rate on a scale of 1 to 5, with 1 being most like an AI and 5 being most like a human.

Please strictly follow the JSON format for your response:

```
{  
  "reason": <str>,  
  "score": <int>  
}
```

LLM output:

```
{  
  "reason": "The schedule provided is highly structured and repetitive, with specific times  
assigned to routine tasks and minimal variation in activities. This kind of rigid and consistent  
pattern is more characteristic of AI-generated content rather than a real human's daily  
activities, which often show more variability and spontaneity.",  
  "score": 2  
}
```