

Using Large Language Model Agents for Generative, Data-Driven Simulations in Urban Planning Decision-Making

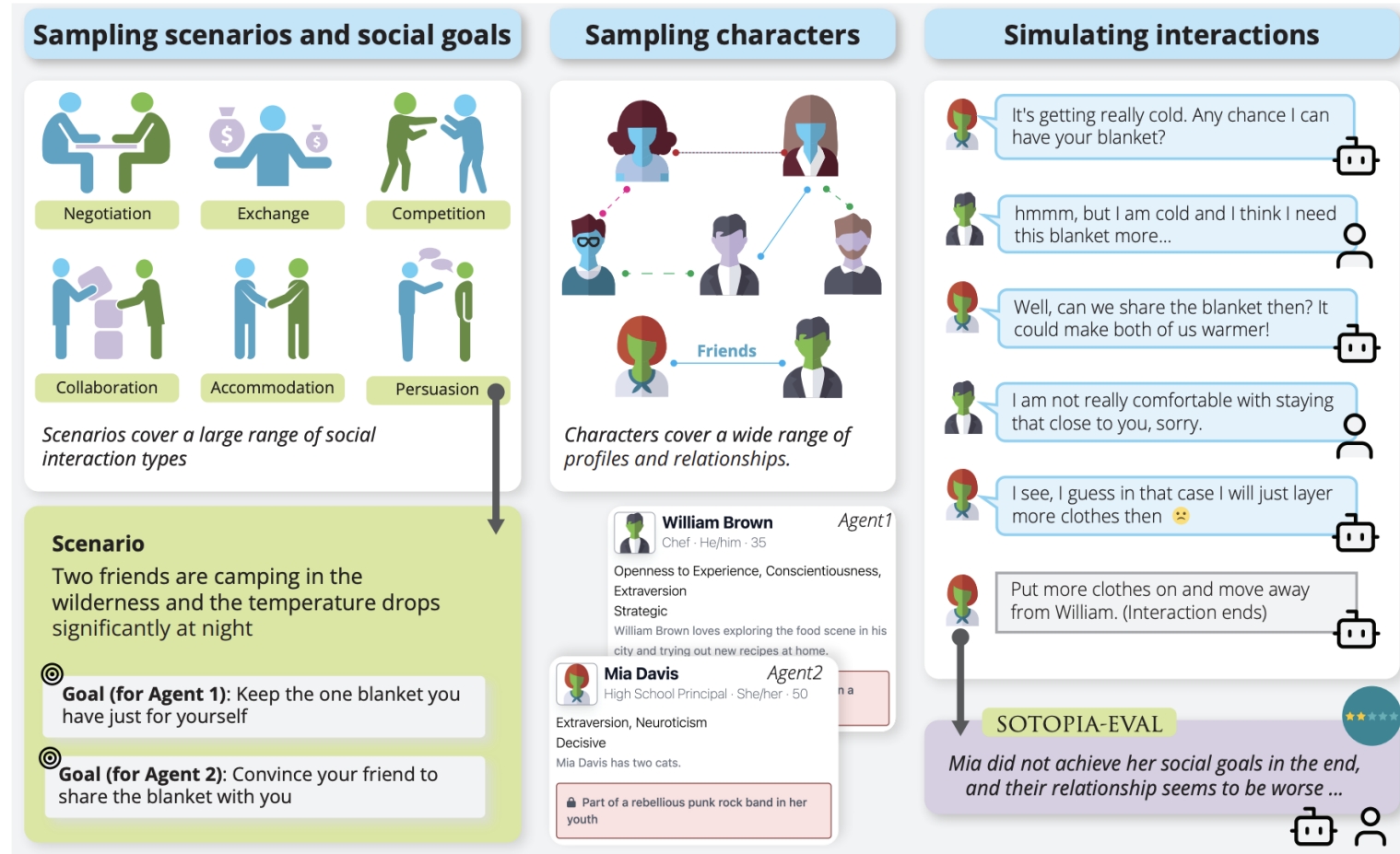
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GenAISim Project

- Background :
 - This project addresses the limitations of traditional decision-making in handling complex societal challenges.
- Motivation:
 - This project explores a hybrid decision-making system that integrates socio-technical observations, knowledge from multiple stakeholders, LLM priors, and open datasets.
- Target
 - The main goal of this project is the development of **GenAISim**, a generative, data-driven simulation suite for urban scenarios like mobility, policymaking, and health, introducing a simulation-in-the-loop paradigm through a multidisciplinary approach.

Cutting-Edge Work -- SOTOPIA

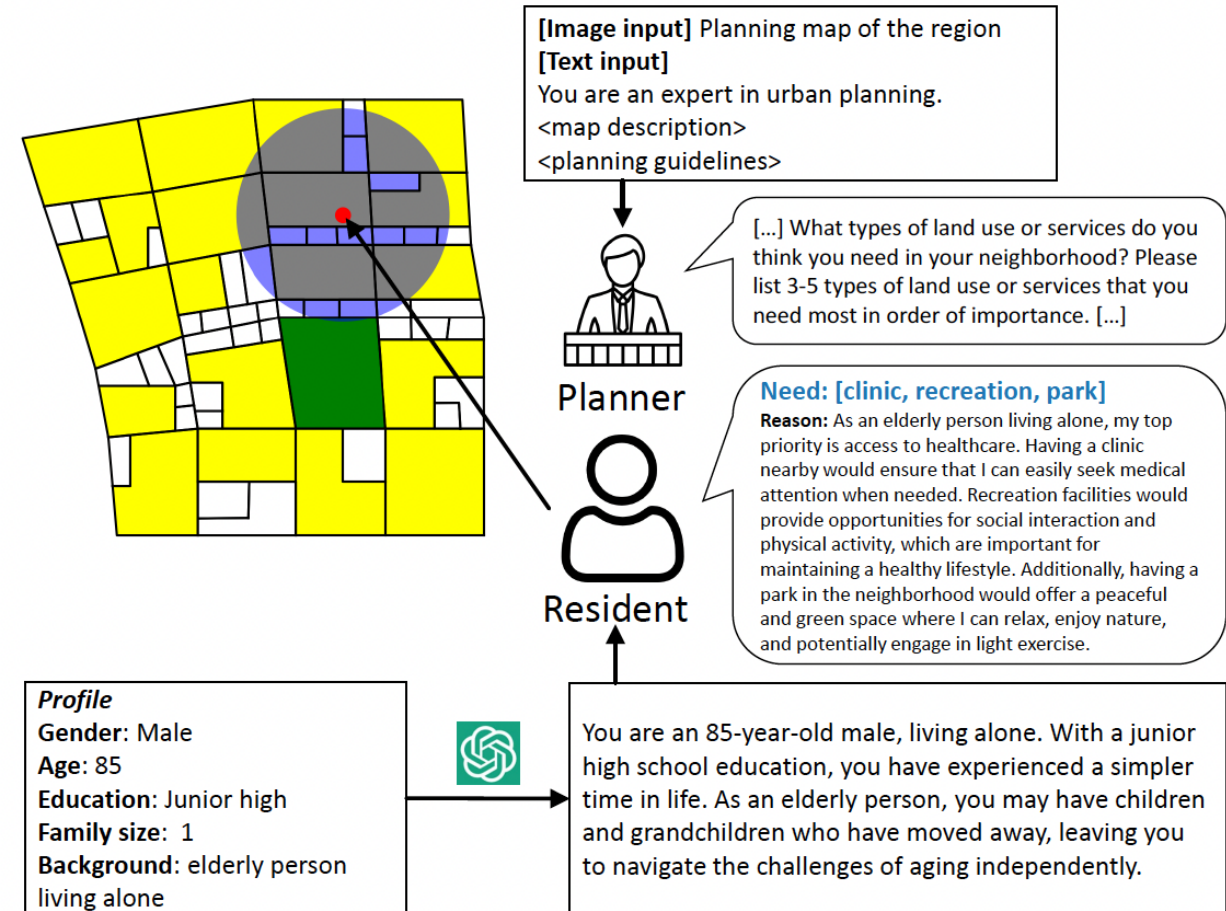
- **SOTOPIA**^{1, 2}: an open-ended environment to simulate complex social interactions between artificial agents and evaluate their social intelligence.
- This platform can only simulate the interactions of **a few agents** and cannot model the group effects of a large number of residents;
- therefore, it cannot study **demographic** characteristics.



1. <https://arxiv.org/pdf/2310.11667>
2. <https://arxiv.org/pdf/2403.08715>

Cutting-Edge Work -- LLM for Participatory Urban Planning¹

- Policy Making Simulation
 - Users can specify the **issues** that require decision-making, the simulated **urban environment**, agents with different **profiles**, and the **interaction methods** of the agents.
 - The platform automatically generate a simulated virtual community with different stakeholders.
 - Through the interactions of agents, **regional decisions** can be made, providing a reference for decision-makers.
- However...
 - The platform lacks the capability to simulate residents' mobility, making it unable to study the collective actions of community residents.



1. <https://arxiv.org/pdf/2402.17161>

Cutting-Edge Work -- OPENCITY¹

- Simulation
 - OpenCity enables the simulation of maximum 10,000 agents' daily activities across 6 major cities (such as Sydney and Beijing) in one hour time interval.
 - The "agents" here can be regarded as realistic individual humans who can move (with simulated Points of Interest in the scene) and meet other agents.
 - We can use the collected urban mobility data to establish the simulated city and reproduce Urban Dynamics.
- However...
 - The platform cannot simulate the interactive behaviors of agents, meaning the agents do not "talk" to each other.

Human Input	What places did you go today and why?
Agent Output	About the places I visited today and the reasons: 1.Sleep at home (00:00 - 10:00): Resting to start the day. 2.Brunch (10:00 - 11:32): Enjoying a leisurely meal. 3.Outdoor Activity (12:06 - 14:45): Engaging in physical activity 4.Curry Boyz (15:43 - 17:10): Likely for a meal, perhaps trying Indian cuisine. 5.Walgreens (17:53 - 20:38): To pick up personal care items or medication. 6.Blush! Wine Bar (21:23 - 23:02, and stayed until late): Relaxing, enjoying wine, and possibly socializing. Each place was chosen for a mix of relaxation, exercise, dining, and socializing.

Human Input	How many people did you see today? How were they?
Agent Output	The people I met today: 1. When I went to Curry Boyz, I met [547] and [1032], [547] is an IT engineer, [1032] is a teacher, [547] has a high level of consumption, [1032] has a medium level of consumption. 2. When I went to Blush! Wine Bar, I met 1032 and 779, [779] is a worker, [779]'s consumption level is slightly low. The above is about the people I met today and what they were up to.

1. <https://arxiv.org/abs/2410.21286>

Our GenAISim Project Objectives

- Explore LLM agent-based synthetic data generation techniques to simulate and augment human behaviours in diverse contexts;
- Create a reliable framework for testing hypotheses about real-world phenomena and relationships, minimizing the risk of false correlations;
- Investigate diverse stakeholder settings, often with nonoverlapping and potentially conflicting objectives, priorities, constraints, incentives and pain points;
- Investigate the dynamics of hybrid decision-making, particularly when an LLM agent serves as a substitute for a human decision-maker in specific contexts.

Thank you!