INTERNSHIP OFFER

Towards hybrid and communicative generative agents for simulating urban mobility behaviour

Information about the internship offer

Supervision	Kamaldeep Singh Oberoi (CESI, CESI-LINEACT), Benoit Gaudou, Yves Bru (Université Toulouse Capitole, IRIT)
Topic	Towards hybrid and communicative generative agents for simulating urban mobility behaviour
Dates	5 to 6 months - starting from Feb/March 2027 according to the candidate's availability
Location	Université Toulouse Capitole (Manufacture des tabacs)
Application	Applications should be sent by email to ksoberoi@cesi.fr, benoit.gaudou@ut-capitole.fr and bru.yves@protonmail.com with your CV, a motivation letter and recent mark sheets

Description

Context

In recent years, generative agents [1] based on Large Language Models (LLMs) have attracted growing interest for simulating realistic human behaviour in various fields such as urban planning [2], transport [3, 4] and social simulations [5, 6]. At the same time, researchers working on multi-agent modelling and simulation are increasingly interested in integrating these generative agents with agents based on precise logical rules [7] in order to develop hybrid approaches [8].

The laboratories CESI-LINEACT and IRIT are collaborating on research challenges related to the simulation of thousands of generative agents within a multimodal transportation system using the GAMA simulation platform (https://gama-platform.org/), the calibration of these simulations through distributional alignment [9] between LLM-generated outputs and real-world data from mobility surveys (EMC2) conducted in the city of Toulouse, and the quantification of generative agents' ability to adapt to unforeseen situations conveyed through textual information, such as public or media campaigns and safety or security incidents.

Objectives

This internship aims to continue the ongoing research [10, 11] and further develop the results obtained around two main objectives.

First, the internship will focus on developing hybrid architectures that combine rule-based decision-making with reasoning based on LLMs. The objective is to enhance the existing architecture by leveraging the advantages of both approaches: exploiting predefined knowledge and rules in familiar situations while enabling exploration of the decision space through LLM-augmented reasoning, thereby allowing new decisions to be generated in unforeseen situations.

The second objective of the internship will be to integrate communication capabilities between generative agents, enabling them, for example, to exchange information and make decisions about the use of available resources and the allocation of activities within a "family of generative agents": who will use the family car, who will travel by bicycle, or who will take the children to school. These communication capabilities could also influence decision-making among colleagues or, more generally, among agents located in close proximity to one another.

Missions

This internship builds upon our previous work [10, 11] and aims to:

1. Extend the existing architecture by introducing hybrid agents capable of combining rule-based decision-making with LLM-based reasoning.
2. Investigate and analyse, using quantitative metrics, the trade-off between rule-based approaches and those relying on LLMs.
3. Integrate communication capabilities into each generative agent to investigate the impact of social relationships (e.g., among members of the same family) on modal choices.
4. Develop test scenarios to present and showcase the results obtained to both expert and non-expert users.

Desired candidate profile

The candidate must:

1. Be enrolled in an M2 computer science programme, with solid experience in Python and Java/C++
2. Have knowledge of multi-agent systems, data science, generative AI and LLMs in particular. Prior experience with the GAMA platform is a plus.
3. Be passionate about intelligent mobility as a field of application
4. Be independent and curious about research
5. Have a good level of English and French (spoken and written)

References

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2. Zhou, Z., Lin, Y., Jin, D. and Li, Y., 2024. Large language model for participatory urban planning. *arXiv preprint arXiv:2402.17161*.
3. Feng, J., Du, Y., Zhao, J. and Li, Y., 2024. Agentmove: Predicting human mobility anywhere using large language model based agentic framework. *arXiv e-prints*, pp.arXiv-2408.
4. Liu, Q., Li, C. and Ma, W., 2025. GATSim: Urban Mobility Simulation with Generative Agents. *arXiv preprint arXiv:2506.23306*.
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