



S3: Social-network Simulation System with Large Language Model-Empowered Agents

arxiv Oct 2023 / 23 refs



Introduction

- S³: Social network Simulation System
- Social Simulation:
 - has dynamic feedback / populations = society
 - Predicting future evolution of individual / populations
- Already, we use computer-based agent for microlevel simulation.
 - (micro: agent modeling / macro: system modeling)



Introduction

- Try LLM agent for social simulation
 - ‘LLM agent’ have capabilities
 - Perceive / reasoning(limit) / generate text
- How to assess? => two scenario.
 - Gender Discrimination
 - Simulate user response / observe evolving public sentiment
 - Nuclear Energy
 - Simulate reaction to policy / conflict between two opposings.

Table 1: The utilized datasets for social network simulation.

Scenario	#Users	#Relations	#Posts	Demographics	Purpose
Gender Discrimination	8,563	25,656	103,905	Age, Gender, Occupation	Information&Emotion Propagation
Nuclear Energy	17,945	77,435	229,450	Age, Gender, Occupation	Information&Attitude Propagation



Architecture

- Architecture Design
 - Environment Network
 - Directed Network
 - Influential / regular / low
 - Exclude zombie / bot
- User
 - Initial attribute
 - Demographic(G, O, A*)
 - Emo, attitude is abstract
 - Messages
 - Interact to social event, change emo and attitude, even generate.

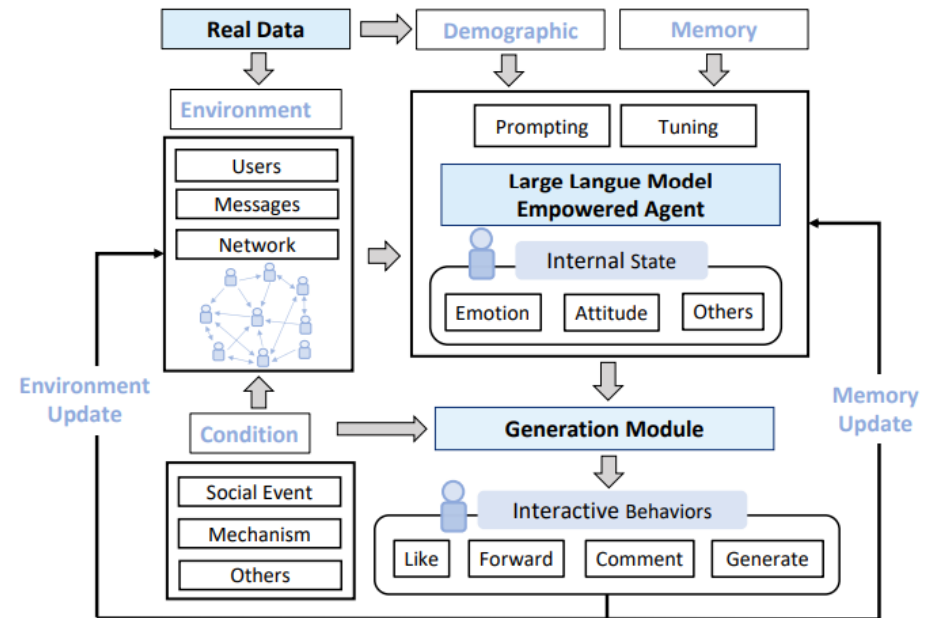


Figure 1: The overview of the social network simulation system.



System – Individual level

- Individual level simulation
 - To assess LLM **self-behavior**
 - Can evolve internal state?
- 1. Emotion
 - calm, moderate, intense
- 2. Attitude
 - Positive, Negative
- 3. Generation
 - Perplexity
- 4. Interactive behavior
 - Get msg => forwarding / posting / nothing / like ...

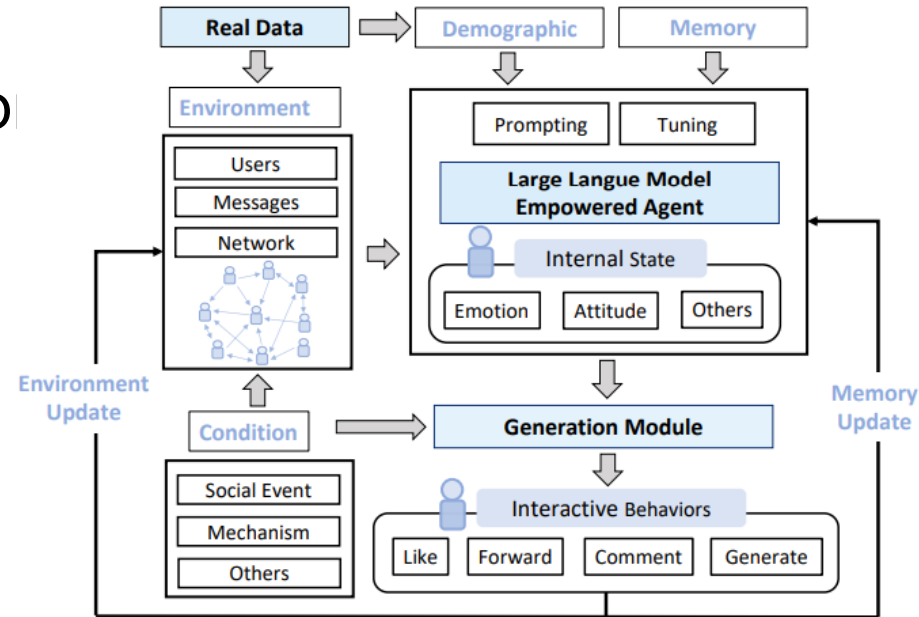


Figure 1: The overview of the social network simulation system.



System – Individual level

- Testing Simulation Capability
 - Use real-world dataset, compare LLM output with data
- Markov Process
 - demographics + message history + current emotion, received post is LLM input

Table 2: Performance of our system on five prediction tasks for individual simulation.

Scenario	Prediction Task	Accuracy	AUC	F1-Score
Gender Discrimination	Emotion Level	71.8%	—	—
	Event Propagation	66.2%	0.662	0.667
	Initial Attitude	74.3%	0.727	0.834
Nuclear Energy	Attitude Change	83.9%	0.865	0.857
	Event Propagation	69.5%	0.681	0.758

Table 3: Performance of our system on conditional text generation

Scenario	Perplexity	Cosine Similarity
Gender Discrimination	19.289	0.723
Nuclear Energy	16.145	0.741



System – Population level

- Propagation
 - Information Propagation
 - With social media, specific event will be spread as the day pass.
 - Emotion / Attitude Propagation
 - How about emotion / attitude change?

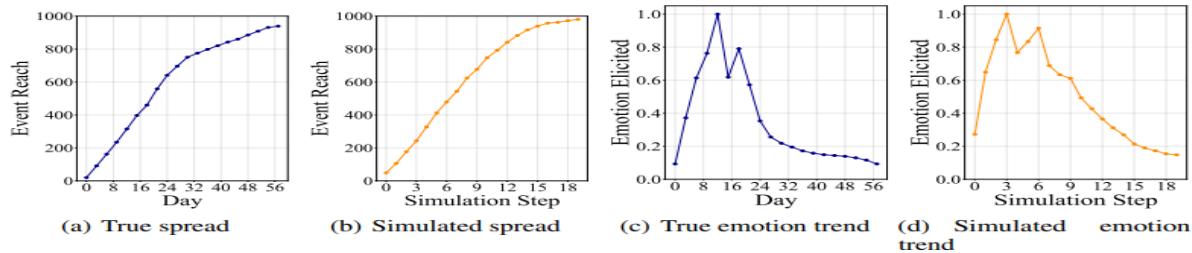


Figure 2: True spread, simulated spread, true emotion trend and simulated emotion trend of Chained Eight-child Mother Event.

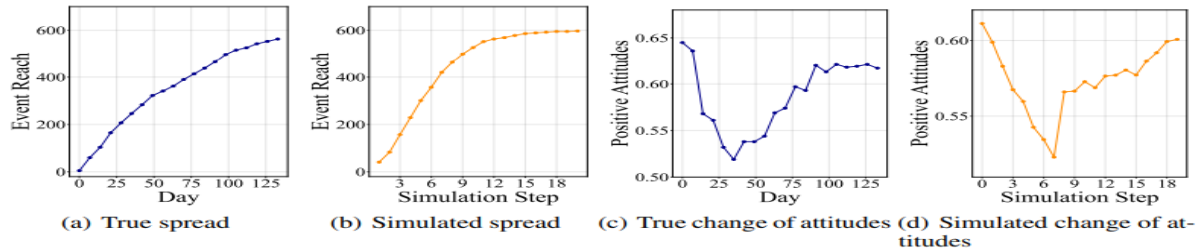


Figure 3: True spread, simulated spread, true and simulated changes in proportion of positive attitudes towards nuclear energy during the Japan Nuclear Waste Water Release Event.

Emotion Elicited: 감정 변화 유발을 측정



More details

- Important points
 - Decaying emotion
 - Use prompt to diminish emotion as time passes.
 - Message management
 - Use **influence factor** : weight for msg importance remove messages with this weight to manage user msg history
 - Predict demographic / occupations
 - For some private users
 - Model
 - GPT3.5 / ChatGLM



Limitation / Improvements

- Low performance / Dataset construction

- Emotion / attitude를 제한하였음에도 정확도가 엄청 높지 않았다. 이는 공개되지 않은 데이터와 상관이 있을 수도 있고, prompt 개발 방법에 따라 발전의 여지는 있을 것
- 애초에 데이터 결측치 예측에도 LLM을 썼기에 데이터의 validity가 조금 의문 (데이터에 관한 설명이 거의 없다)
- 실제 활용 시에도, 관련 데이터 획득을 어떻게 할지 고민 필요
 - Facebook / Instagram follower graph // demographics
 - 데이터 일부로부터 신규 페르소나 / 가상의 인물을 만들어 사용



Limitation / Improvements

- No Specific Implementation

- 구체적 구현방법은 써져 있지 않다
 - Environment 관리, message spread 방식 (확률모델? Directed?), 메시지 관리
 - Interaction (posting)의 예시를 보여주었으면 어땠을지
 - 정말 system 하나만 딱 던져놓은 느낌 - 세부 구현, 실험 관련 디테일이 없다. 오히려 스스로 어떻게 설정해야 더 좋을지를 더 고민하게 만드는..
 - 큰 규모의 사회 실험 requirement 참고

- Cost

- Agent society 사람이 많아질 수록 simulation cost가 상당하므로 극복 대안이 필요

- Evolutions

- (여전히) more validation about ai agent society simulation
- 여론 조작, 악의적인 글, 허위사실에 대한 agent 사회의 변화
- 반대로 어떤 것을 해야 agent 사회를 흔들 수 있을지
 - 가장 확률이 높은 정책이나 글 등을 찾아보기 등등



Applications

- Prediction of social phenomena, trends
- Reasoning and explanation
- Pattern discovery
- Policy making



Q&A