Social Media Simulation of Human Satisfaction with Bot Interaction

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Phenomenon Overview

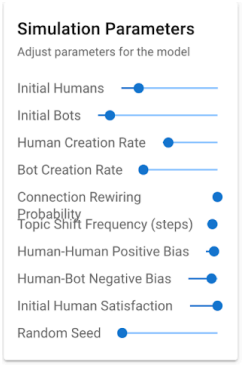
Social media platforms are an essential part of digital communication, but over time, many have become overwhelmed by AI-driven bots. While corporate decisions often play a role in the decline of these platforms, another major factor is the increasing presence of bots that manipulate engagement, spread misinformation, and distort online interactions. This process, commonly referred to as enshittification, results in a decline in user experience, growing distrust, and eventual user disengagement. Our project explores how bots contribute to this decline by interacting with both human users and other bots, ultimately shaping platform dynamics in a way that erodes trust and satisfaction.

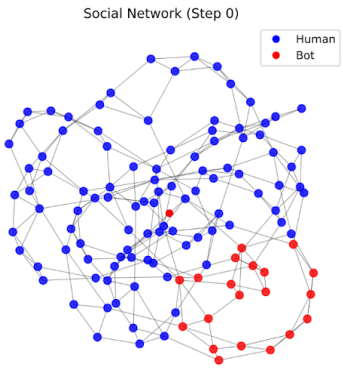
One of the biggest concerns with bots is their ability to amplify misinformation and create artificial engagement loops. Many users on social media are passive consumers of content rather than active contributors. With apps such as twitter having an estimated 10% of the platform comprising 80% of all tweets (4). If bots make up a large portion of active participants, they can dominate discussions, manipulate trends, and reinforce misleading narratives. Especially when they contribute to heavily political or business oriented discussions.

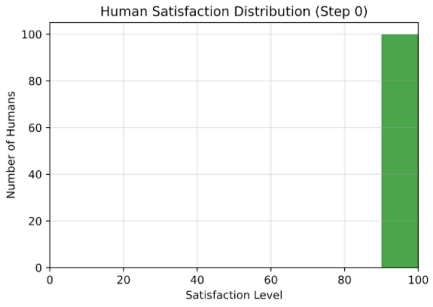
"*Although previous works mainly focused on Twitter bots in the political domain — our findings reveal that Twitter bots are heavily active in various domains, particularly cryptocurrency and technology. This highlights the importance of studying bot impacts beyond politics, with implications for financial fraud, market manipulation, and more.*" (3)

Bots don't just interact with human users—they also engage with each other, forming automated echo chambers that continuously recycle and spread false information. This feedback loop artificially boosts the visibility of misinformation, making it appear more credible and further distorting the platform's information ecosystem. Our study focuses on how the increasing presence of bots influences user satisfaction and retention over time. We are building a simulation using Agent-Based Modeling (ABM) to analyze interactions between bots, human users, and platform algorithms. The goal is to observe how social media environments evolve as bots become more prevalent. Specifically, we want to explore whether platforms reach a tipping point where the number of bots and the amount of misinformation drive users away.

To simulate this phenomenon, we will model a network-based social media ecosystem, where both human users and bot agents interact based on predefined behaviors. The simulation starts with 85% human users and 15% bots. These agents will have randomly or predefined parameters that determine how they interact with and influence each other. Using this ABM we can simulate a large population in order to see how it compares from an initial point to the end. In this case we'll be simulating the early 2000s environment of twitter to present day. We'll be borrowing current population size and estimated bot counts in order to determine the values of parameters.







In this early visualization of the simulation we have human and bot nodes that are connected to each other. In this current state, humans and bots interact with nearby connected

nodes with varying satisfaction levels with their interactions. The bot nodes that are clustered together are a result of them being populated in similar topic environments and echo chambers.

This study lays the groundwork for the next phase of our project, which involves defining specific agent behaviors, platform engagement rules, and data collection methods. By running this simulation, we hope to answer a crucial question: At what point does bot activity become too overwhelming, leading to widespread user dissatisfaction and platform decline? Understanding these patterns will help us better predict the future of social media and explore ways to mitigate the negative effects of AI-driven interactions.

Design and Implementations

The core components are **humans**, **bots**, and their given **parameters**. With these parameters we want to simulate an interactive web that can show and predict rates and patterns within social media platforms. What we want to predict is how bots and networks can contribute to enshittification and dissatisfaction of human users. The components are the following:

Humans

Satisfaction - How satisfied are the users. Interaction can bring positive or negative satisfaction. Once the satisfaction reaches a low point the human agent will be removed. The scale will be between 0 to 100; negative to positive.

Movement?

Interaction - Affects satisfaction. Interaction is between the closest or connected nodes.

Activity - Date of account creation and deactivation. Also how often the user posts or engages the posts.

Bots

Interaction - Affects satisfaction. Bots don't have a satisfaction gauge; they only affect other humans.

Movement?

Activity - Date of account creation and deactivation. Bans have a chance of being banned due to being a bot.

The agents are placed onto a web-like network that is changed periodically to mimic human behavior of moving around different topics and environments. The web will allow for multiple interactions and the proximity between nodes can affect the likelihood of interaction and form environments. However bots will have a different property that limits their movement as they are typically programmed to follow specific tags or networks. Since the environment is based on twitter we want to replicate similar statistics of twitter. As such we want the start and end of the simulation to have a similar user count to current twitter statistics. This will influence parameters and values of stats, such as the rate of new human or bot nodes, ban rate chances, and post rates. Agent based interactions are divided between human to human, human to bot, and bot to bot interactions.

Human To Human Interaction

Slightly favored positive interaction, meaning human satisfaction rates are likely to increase. Can still be negative, just unlikely. Positive interactions will increase the likelihood to interact with each other again, while negative interactions will decrease the chance to interact with each other. This is to simulate environments such as echo chambers.

Human To Bot Interaction

Mostly negative interaction, low chance to be positive. Bots can fit into echo chambers that further encourage certain behaviours.

Bot to Bot Interaction

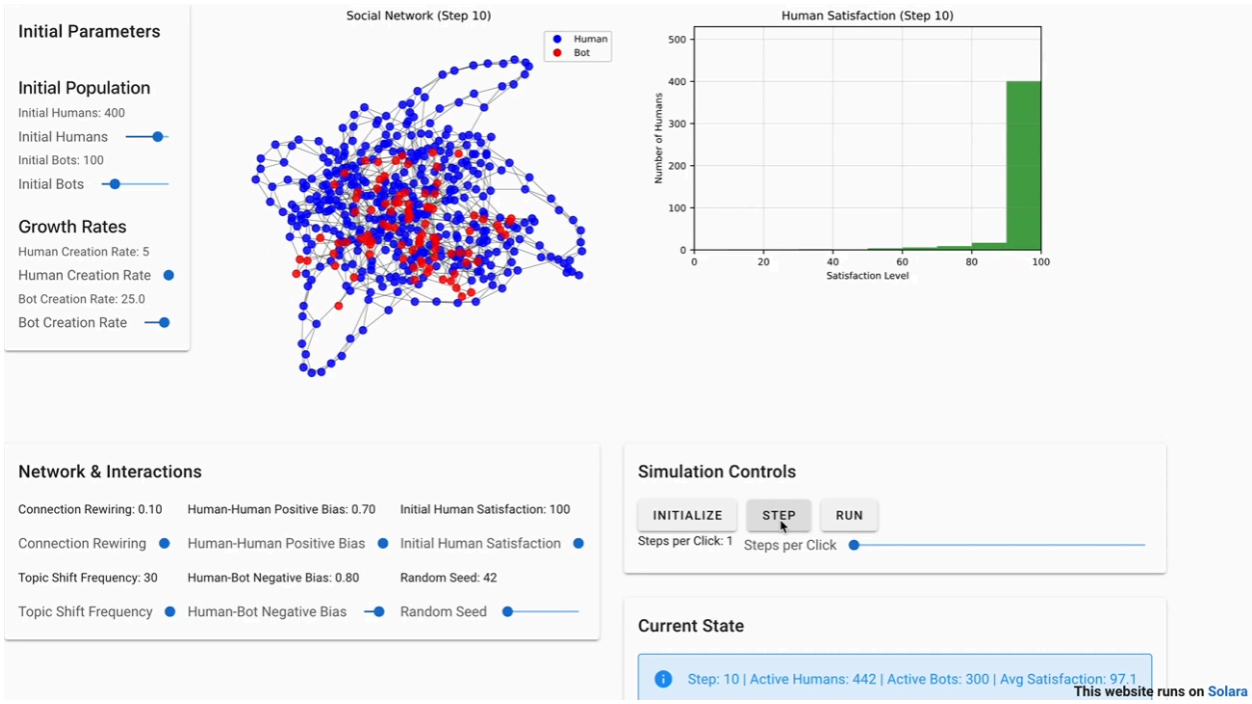
Bots don't have satisfaction, they only affect humans. However connected bot nodes will connect them. They are not affected by the periodic shift and scrambling of networks. Bot networks will have a higher chance of being banned due to bot-like behaviours.

With the model and design in place we want to replicate and simulate an environment similar to twitter. We want to collect the rate of user engagement, satisfaction or dissatisfaction and the rate that they leave. With this we can predict and determine the state of social platforms and how bots have contributed to enshittification and user satisfaction.

Observation

This is how the simulation looks in its first step or initial state. The red nodes are bot and blue nodes are humans. In it we can see that there's significantly more humans than bots at the moment. This is to represent the early life cycle of social media platforms like Twitter when bots and LLMs were less frequent. On the right is the satisfaction chart that we'll use as measurement to determine how happy users were with the state of Twitter with the correlation of bot numbers.

Some parameters include the initial population. This stat will be based on whatever date we start from and is correlated with the population of Twitter of that time. Growth rate determines the increase of users across time, the parameter will also be adjusted based on the growth rate of Twitter by judging the start date population to the end date population of Twitter. Some other parameters include the interaction bias, which affects the likelihood of positive or negative interactions which increases or decreases satisfaction accordingly. In the bottom right we can see the current population with 400 human nodes and 100 bot nodes.



In this image we see the network in step 10. So after 10 steps There are now 442 humans and 300 bots compared to 400 and 100 previously, with the average satisfaction dropping from 100 to 97.1.

Finally in this step 50 network we can see that bots have overrun the total amount of humans with 554 humans and 1120 bots with an average satisfaction of 78.5.

Currently the simulation replicates what we want to happen but the values and parameters need to be a bit more calibrated. The bot growth rate might be too high and it doesn't seem like the system of being banned for suspicious behaviour has been implemented yet. However, based on the current simulation we can see that the average satisfaction of users has dropped by a decent amount from 100 to 78.5 within 50 steps in the simulation. While satisfaction is a subjective thing and ranges between person to person, this decrease does seem somewhat realistic as despite the dissatisfaction with the current state of Twitter and word of migration, Twitter is still growing, though whether or not they are real users is to be determined. Another thing is that the human growth rate is a bit slow. Our goal is to have it replicate the growth rate of twitter. So an estimated 200 million monthly active users in 2013 and 600 million in 2025. Our nodes should be proportional to that amount with one node representing 1~ million individuals.

Challenges/Next Steps

As our group only has one proficient Python coder (Andriy) any issues encountered with making the simulation will be read verbatim from them. One issue our coder had was implementing the echochamber system as it would always make it so that bots and humans would become isolated between one another.

"*One roadblock I ran into was implementing the echo chamber formation mechanism. It was ruining the simulation as no matter the perimeters given, the humans would eventually move into smaller and smaller groups while the bots were left on the periphery. I decided to remove the echo chamber mechanism from the prototype as it is not a key function of the simulation.*"

Our current prototype won't have the echochamber system but if it's possible to fix it and adjust it so that it doesn't always isolate human and bot nodes it might be reinstated. Another issue was parameters as we haven't detailed the specific of what they should be or any specific values that we should start with. While we have an idea of what ratio it should be, picking specific numbers hasn't been discussed yet.

"*Parameter tuning proved to be another time-consuming obstacle. Finding the right balance between human satisfaction decay rates, bot creation frequencies, and network rewiring probabilities took many iterations. Too aggressive bot parameters and human satisfaction degradation would rapidly drive all humans out of the network, while high ban rates of bots and high rates of humans breaking connections with bots in favour of humans caused the human users to enjoy their social media experience unperturbed.*"

As such we'll need to adjust the parameter to a small but steadily growing rate so we can get the result that we're expecting or remake some aspect of the simulation so that we don't get a rapid growth or decay. Overall the current simulation achieves the basics of what we wish to accomplish, but we need to polish the finer details of the simulation and agents. The parameters need to be specific values based on known and confirmed twitter statistics. Some of the systems might need more time in order to be fully realized or reimagined and implemented for proper results and visual representation of social media networks.

References

Citations:

LLMs Among Us: Generative AI Participating in Digital Discourse by Kristina Radivojevic, Nicholas Clark, Paul Brenner, 08 Feb, 2024 (1)

Large Language Models in Cybersecurity Threats, Exposure and Mitigation, by Andrei Kucharvy, Octave Plancherel, Valentin Mulder, Alain Mermoud, Vincent Lenders, 2024 (2)

BotPercent: Estimating Bot Populations in Twitter Communities by Zhaoxuan Tan, Shangbin Feng, Melanie Sclar, Herun Wan, Minnan Luo, Yejin Choi, Yulia Tsvetkov (3)

Sizing Up Twitter Users ByStefan WojcikandAdam Hughes (4)

Attestation

Yinkan Chen

Conceptualization

Assisted with ideas of implementations and parameters

Resources

Sources for citations and research and data for parameters

Writing – original draft

Responsible for Design/Implementation, Challenges/Next Steps, and Observations.

Writing – review & editing

Revised and reviewed sections of the report

Andriy Sapeha

Software

Purely responsible for all the coding done with the ABM simulation.

Validation

Responsible for making changes for the implementations

Supervision

Ensuring communication and responsibility of the group.

Visualization

Provided visual elements and recording of the simulation for the report.

Writing – original draft

Provided personal accounts for the Challenges/Next Steps section for issues encountered while implementing code and system.

Data curation

Provided data and results from the simulation

Hongji Tang

Methodology – Development or design of methodology; creation of models.

Provided visual representation for simulation structure

Writing – original draft

Responsible for Phenomenon Overview section

Writing – review & editing

Revised and reviewed sections of the report