Opinion Dynamics with Mesophilic Agents

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Motivation

Opinion dynamics research has experienced a gain in interest over the last few decades, especially with the advent of mass individual communication infrastructures. Works like the classic Schelling Model investigate a middle ground between homophily and heterophily (the desire for similarity and the desire for difference). We use a similar modeling approach, and also include an opinion dynamics framework to act simultaneously with this model to shed light on the ways in which the two processes intermingle and influence each other.

Modeling Methodology

We incorporate self-organization and opinion diffusion together in our model. Our agents have binary opinions, and update according to a majority rule – when >50% of an agent's neighbors have the "wrong" opinion, depending on their preferences, that agent flips to the opposite opinion.

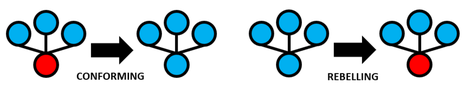

Figure 2: Opinion Trajectories

Agents prefer an even mix of agreement and disagreement with a neighbor. When either one becomes exclusive, agents unfriend that neighbor. One new neighbor is given to agents each step, probabilistically and at random.

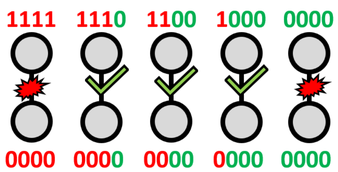

Figure 3: Topological Rules

Research Goals

This work is meant to explore and characterize several salient aspects of network evolution in a simulation with agents who have opinions that change over time, and the ability to modify their local social structure. This work has three goals:

- to introduce new agent models into the context of opinion diffusion,
- to characterize the ways changing opinions influence network topology, and
- to characterize the ways self-organization influences opinion diffusion.

Single-type Results

We studied two agent types: *mesoconforming* (MC) and *mesorebelling* (MR). MC agents conform to the majority opinion, MR agents conform to the minority opinion. Each agent type prefers 50% agreement/disagreement with each neighbor.

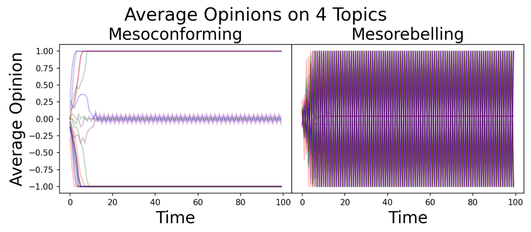

Figure 4: Average Opinions in Single-type Networks

MC agents tend to all gravitate toward consensus on each topic. When this happens, networks become extremely sparse as no agent gets reward from any other. MR agents tend to flip-flop opinions frequently, and therefore are able to form larger social groups that persist over time. MC agents can form better-connected networks, but *only* when there is at least one topic with a diversity of opinion representation.

Mixed-type Results

In addition to single-type networks, we examined multi-typed networks under different conditions. We tried all three pairwise combinations of our two agent types, as well as the "classic" agent: one that monotonically prefers similarity, and conforms to the majority opinion.

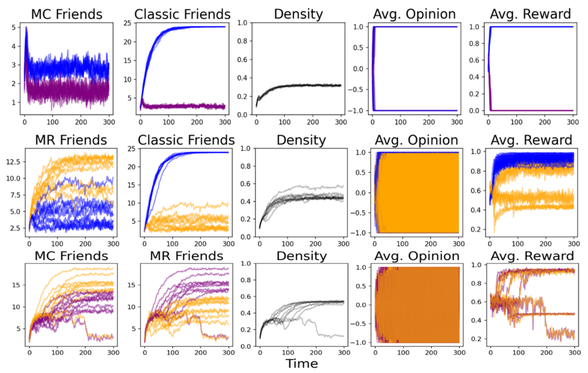

Figure 1: Various Metrics on Dual-type Networks

We made several interesting observations. MC agents are not generally well-suited to an environment with classic agents – they foster a population-wide consensus, but then ostracize themselves because they strongly dislike total agreement. Even though new friend connections are proposed, none of them is appealing to an MC agent. Interestingly, MR agents fit in much better with the classic agent style. They always rebel against the majority opinion, but not enough to disconnect them from the rest of the population. This allows them to stay (loosely) connected to classic-style agents, opening the door for the possibility of influence. This can be seen by the fact that classic agents tend to have no MC friends, but do maintain a handful of MR friends. MR and MC agents appear to slightly favor each other over their own type for friendships. These evolutionary rules also appear to indicate theoretical density bounds for the networks over time. For example, many networks involving these agents eventually move to a 50% density equilibrium, likely owing to the fact that the agents prefer 50% agreement with each neighbor.

Networks containing MR and MC agents never form a consensus, and instead foster a more organic fluidity of opinion than MR agents by themselves, which tend to oscillate mechanically. Finally, in terms of agents' personal sense of reward, MC agents tend to fare the worst because they foster consensus but do not like it. The only exception to this scenario is when MC agents and MR agents inhabit a network together, in which case they appear to be synergistic and their pursuit of reward is closely intertwined.

Conclusion

- An agent type that prefers agreement and disagreement, but is conforming, is difficult to satisfy.
- This agent type is poorly suited to inclusion in a more classical opinion diffusion environment.
- An agent type that prefers agreement and disagreement, but conforms to the minority opinion is both better suited to homogeneous networks of its own type, as well as mixed networks with classical agents.
- Networks composed both agent types show several desirable properties: fluid and diverse opinions, increased personal satisfaction for agents, and a fairly even mix of inter-type friendships.

References

[1] Thomas C Schelling. Dynamic models of segregation. *J. of Mat. Soc.*, 1(2):143–186, 1971.

[2] C. Borghesi. Chaotic, staggered, and polarized dynamics in opinion forming. *Phys. Rev.*, 73(6), 2006.

Future Research

- Simulate how a marketing campaign would affect a targeted population to ensure the campaign would not have unforseen negative impacts.
- Forecast how a population's favor towards each candidate during an election may change based on the sources of information they are exposed to.

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