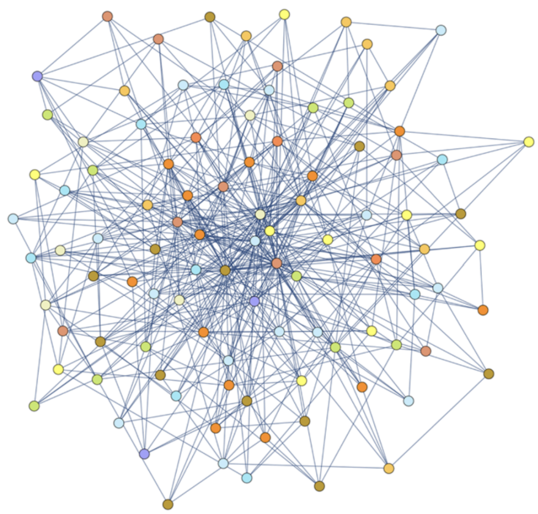
Voting Prototyping
Milestone 2 Report



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Executive Summary

Utilizing Monte Carlo simulations, we aim to unravel the complexities of voting systems. We are particularly interested in the distinction between voters scoring projects without cost versus preferential voting with quadratic costs. Our model considers individual voter preferences, community welfare metrics, and the transformative impact of distributed governance. Through this investigation, we aspire to shed light on decentralized voting's role in fostering inclusive decision-making.

Milestone Description and Deliverables

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- Literature review for informed research design.
- Prototyping Plural Voting: initial design a model to simulate multi-agent interactions, aiming to analyze social phenomena and voting patterns in groups.
- Monte Carlo computational modeling: simulate decisive social complex phenomena.
- Selection of 2-3 experts by the community to form the 'Red Team'

Deliverable Description:

- A comprehensive literature review to guide the research design, focusing on voting dynamics and individual preferences.
- An Initial prototype of a Plural Voting model, designed to uncover voting patterns and facilitate expressions in interactive groups.
- A Monte Carlo computational model using random number sequences to model social voting dynamics.
- Selected expert reviewers to form the 'Red Team'.

Milestone Accomplishments

- ☑ Literature review for informed research design.
- ☑ Prototyping Plural Voting: initial design a model to simulate multi-agent interactions, aiming to analyze social phenomena and voting patterns in groups.
- ☑ Monte Carlo computational modeling: simulate decisive social complex phenomena.
- ☑ Selection of 2-3 experts by the community to form the 'Red Team'

We developed Monte Carlo simulations to understand the dynamics and potential outcomes of quadratic voting systems. By utilizing this powerful computational technique, we've been able to model various scenarios and permutations of quadratic voting, enabling us to explore its impact on decision-making processes within communities.

Our voting model aims to provide key insights regarding the voting outcome of a community with, initially, two possible options. Essential to this model and simulations is the definition of utility functions tailored to individual voters, encapsulating their preferences, priorities, values, and most importantly, return of investment to benefit the SNET community. Additionally, we've introduced a holistic metric to gauge the collective welfare of the community, serving as a vital indicator of the system's overall voting efficacy.

Furthermore, we focused on exploring how quadratic governance could change voting results, comparing the dynamics of one person one vote versus a small fraction of users with significantly more voting power and the possibility of outvoting an organic majority. Considering that users with more tokens naturally want to exercise their preference on SNET development in a proportional fashion. We defined an utility function that addresses the potential benefit of a winning voting choice for each user designed to balance property and control in the community, while adding the return of investment to the system – a critical feature of quadratic voting mechanics.

We believe that once exploring the intricacies of quadratic voting systems and their implications for democratic governance via simulations, we will shed light on their potential as tools for fostering equitable and inclusive decision-making processes. In the future steps, we plan to align our efforts with the next project milestone: Comparison Voting Simulation.

Voter Model

After conducting an exhaustive literature review and in-depth analysis, we have developed a pioneering voting model tailored specifically for simulating crucial scenarios in our research. In the subsequent sections, we provide a comprehensive overview of the voting mechanics, distinctive features, and robust estimators employed within our model.

Voter options. We consider a group of voters of size N that can adopt one of two possible outcomes A and B. The number of possible outcomes can be generalized to more than two. The opinion variable of the i-th agent is represented by the variable s(i) which can assume one of two values +1 and −1, representing the vote in proposals A and B, respectively, without any scoring considerations.

Credit distribution. To each agent i, we assign a credit variable σ(i) distributed using a distribution function P(σ), where σ can assume different values in $\Re \geq 0$.

Utility function. The voter's utility for the referendum, which could be negative if they oppose it, can be expressed mathematically. When differentiating this utility function with respect to the number of votes, it reveals that the voter maximizes their payoff by acquiring votes in proportion to their utility. In other words, rational voting under QV (Quadratic Voting) demands that voters accurately assess their utility regarding a specific outcome and estimate the marginal impact of a single vote on the overall result. We define a utility function for each agent i as u(i).

Voting power. The voters may purchase the amount of votes necessary to express their preferences. For the particular case of Quadratic Voting, the maximum number of votes casted by an agent i is equal to v(i) = sqrt[σ(i)].

User welfare. We define a user welfare function w(i) = u(i) if sgn[s(i)] = sgn[∑s(i)v(i)] and zero otherwise. That is, w(i) = u(i) if the vote casted by agent i is in the same direction of the outcome of the voting event.

Aggregate Welfare. We define a system welfare function W = ∑w(i) that encloses the perceived welfare of the whole system. When W = max, the voting process yielded the best outcome for all voters.

Voting Simulation

Our simulation runs in discrete steps, each representing a distinct unit of time or iteration within the simulated environment.

(1) Initial voting configuration. We distribute voting choices to each agent of the system using voting choice distribution function S(s).
(2) Credit distribution. We use the credit distribution function P(σ) to distribute credit (tokens) for each agent of the system.
(3) Utility distribution. We distribute utility perceived to each agent of the system using a utility distribution function U(u).
(4) We set a probability p for an agent to choose option A. Conversely, the chance of adoption choice B is $(1 - p)$.
(5) We visit each agent and he cast all possible votes in the selected proposal v(i) = sqrt[σ(i)].
(6) We calculate the fraction of users that voted in each proposal and the total number of votes each proposal received.
(7) We calculate the Aggregate Welfare of the system.

This step-by-step approach allows us to model and analyze complex systems more effectively, breaking down processes into manageable units for observation and manipulation, enabling us to test hypotheses, explore scenarios, and make informed decisions based on the simulated outcomes."

Red Team Onboarding

The team has initiated the process to onboard Walter Karshat and Deborah Duong, two highly active members within the SNET community. Walter, known for his dynamic involvement, and Deborah, serving as the CTO of Rejuve, both come highly recommended by the internal Photrek team and Jan Horling. The selection of these members was based on their proven expertise and the strong endorsements they received. Once onboarded, they will join the 'Red Team,' which operates independently to deliver critical insights and detailed analysis derived from the proposed simulations.

Budget & Schedule

April 1, 2024 - April 30, 2024: Literature review and Prototyping of Agent-Based Modeling

Budget: 5000 USD

Computer Supply Budget (overhead): 1000 USD

Total = 6000 USD

Milestone	Description	Budget	Status
1	Contract Signing & Management Reserve	$2,400	Submitted - Approved
2	Prototyping of Monte Carlo Simulations	$10,970	Submitted - 20 May
3	Simulation of Voting Methods	$11,080	Planned - June
4	Analysis of the Voting Dynamics	$11,660	Planned - July
5	Final Report & Roadmap	$13,890	Planned - Aug

Future Plans & Change Notifications

In future steps of the project, we will continue the exploration of simulated scenarios concerning the voting dynamics. By employing probability models and algorithms, we aim to gain insights of voter behavior, coalition formation, and the impact of different voting mechanisms on election outcomes. Through these simulations, we aspire to reveal intricate patterns and trends, shedding light on the underlying mechanisms that govern voting processes. This exploration will deepeI wn our understanding of voting systems and provide valuable insights for policymakers and stakeholders to enhance the fairness, efficiency, and integrity of decentralized decision processes.

References

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