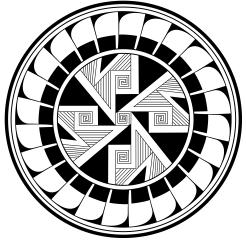


Reputation-based leadership for shared resource allocation

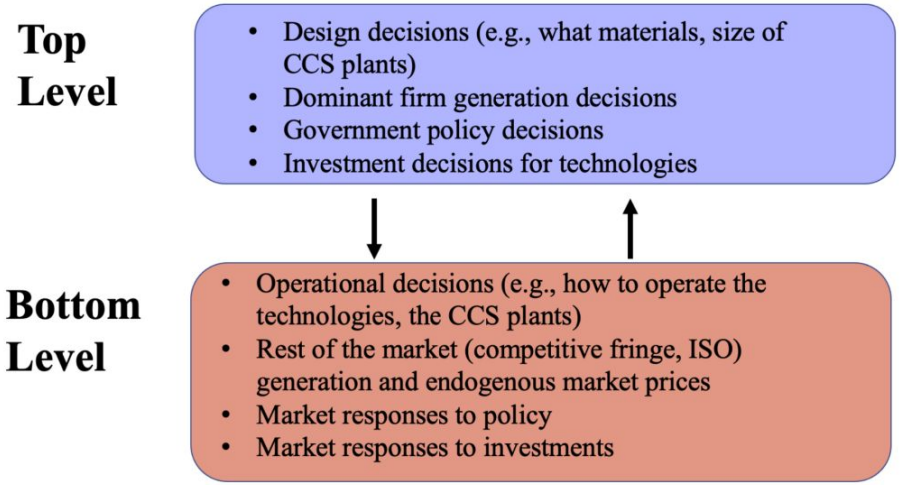
2023 SFI GWCSS

Nathan Boyd

Ana Macanovic

Research Questions

1. How can agent preferences be a proxy for opaque resource dynamics?
2. Can agents self-regulate using a reputation-based leadership scheme?

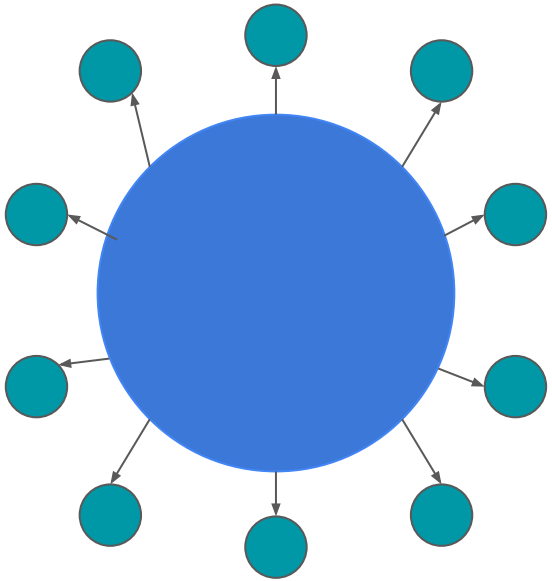


CCS=Carbon, capture, and sequestration.

Resource

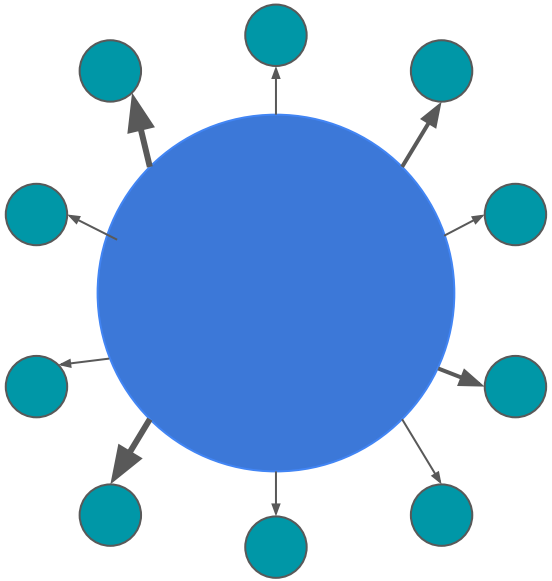
- Finite resource
- Replenishment of the resource
  - Variability
  - Uncertainty

Multi-agent setup



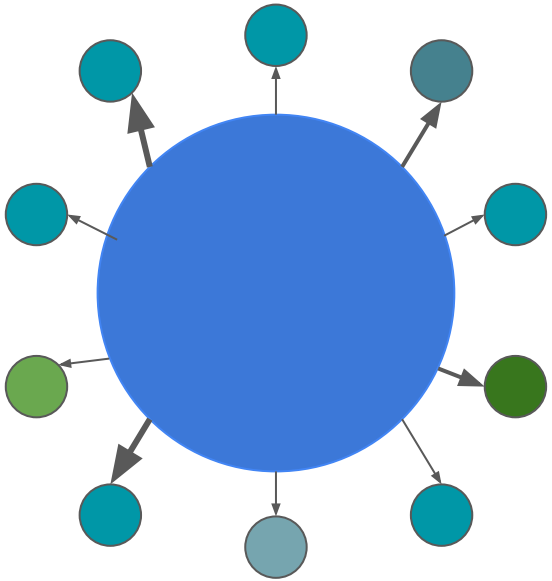
- N members of the group
- Shared resource
  - Members need a share in the resource
- Resource scarcity
  - Demands higher than the availability
  - Lagrange multipliers

Member heterogeneity



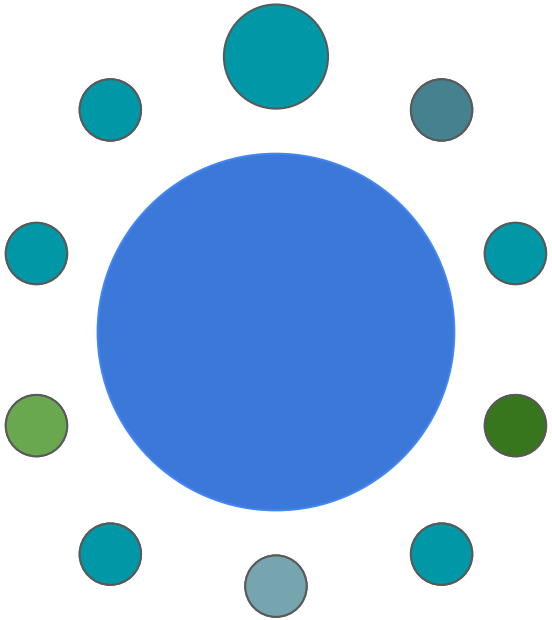
- Different demands on the resource

Member heterogeneity



- Different demands on the resource
- Different levels of generosity when dealing with other agents

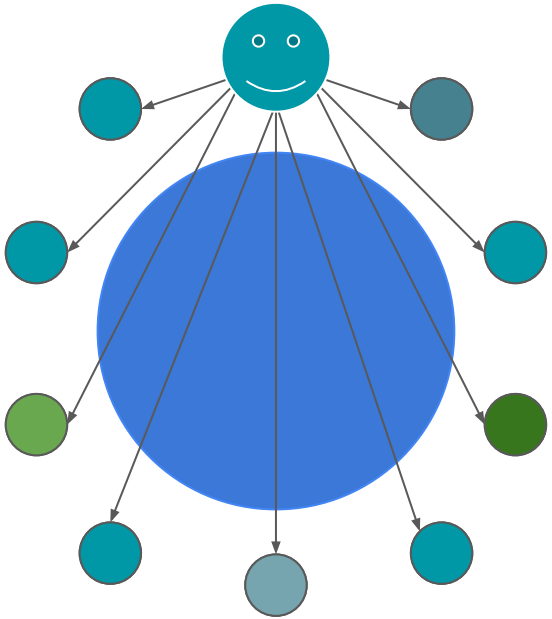
Leadership structure



- To overcome the scarcity problem: **resource allocation** by a representative
  - Nathan’s work

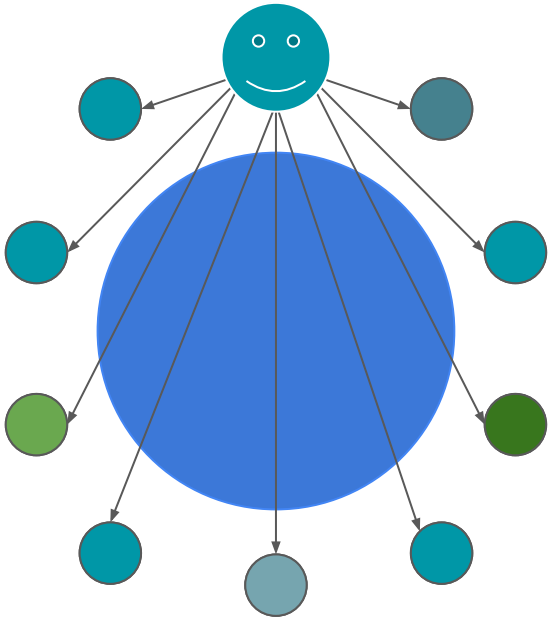
- One member randomly chosen as a representative
  - Initially, someone “steps” up

Leadership structure



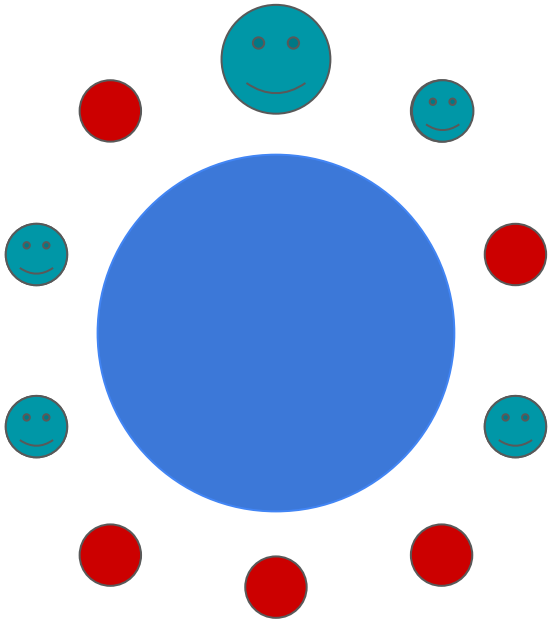
- Representative always allocates their demand to themselves first
  - Or everything if the resource is insufficient

Leadership structure



- Representative always allocates their demand to themselves first
  - Or everything if the resource is insufficient
- They then allocate other resource to other members proportional to their generosity
  - Sequentially, in random order
  - If the resource runs out, some members might end up without any resource allocated

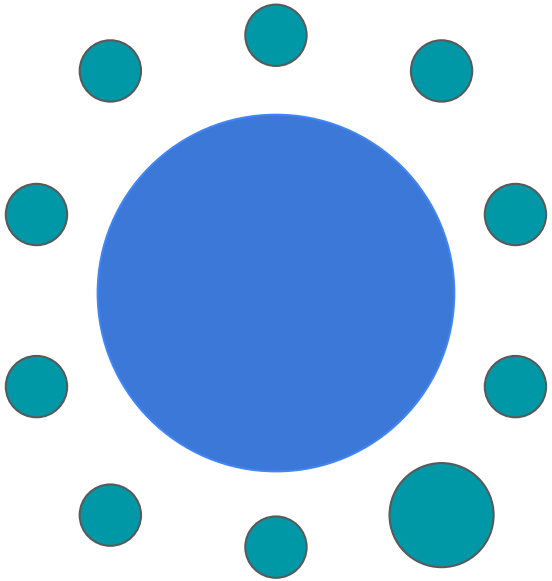
Voting structure



- Group members evaluate how much they have received compared to their demand
  - Voting the leader out proportional to their satisfaction

- Group learning of resource characteristics
- Individual learning not modeled yet

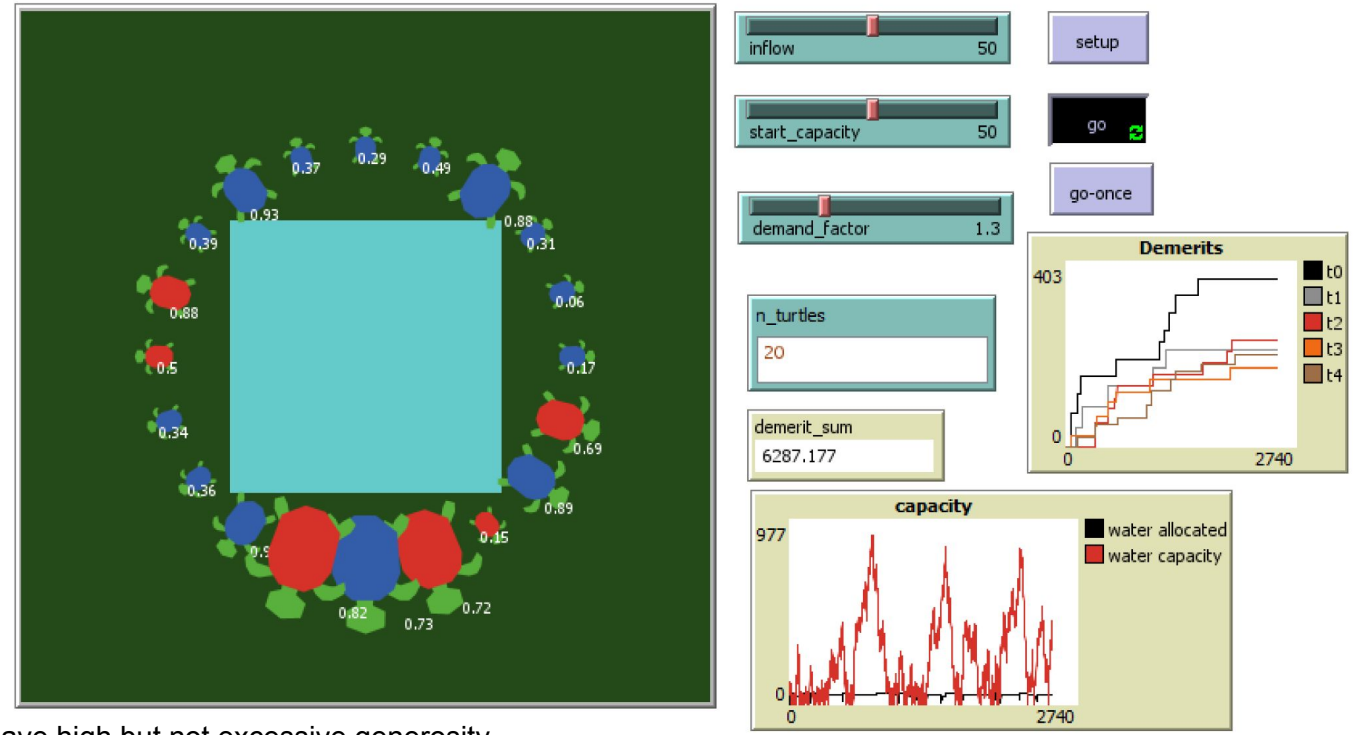
Voting structure



- Group members evaluate how much they have received compared to their demand
  - Voting the leader out proportional to their satisfaction

- A new leader is chosen based on their **previous reputation** for allocation
  - Ana’s work
  - The more efficient they were in allocating well, the higher the chance to be chosen

Results



Best leaders have high but not excessive generosity
Frequency of leader change seems related to variability
Demerits are not necessarily lowest for the best leader because they are so more frequently

Extensions - What could make this more surprising?

- Running simulations
  - Convergence on the leader
  - Depending on scarcity, variability, generosity distribution
- Learning - generosity updating
  - Based on own experience
  - Based on neighbour’s experience
- More advanced reputation tracking in relation to resource variability
- Vary resource allocation ordering
  - Line graph
  - Different network structures