Principle 4

Jiani Gao
jgao30@binghamton.edu

Department of Economics, Binghamton University

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To implement Principle 4, we need:

I. **Two types of agents: fisherman and monitor**

II. **Emergence rule**

Red words are specifically relevant to Principle 4.

1. Fisherman

   - Fishermen take fish from lake.
   - There are 24 hours per day, people go fish in the first 10 hours, and then go home to take rest.
   - Fishermen get happiness from taking fishes, and different types of fishes will give them different happiness. Specifically, carp: 1 unit of happiness, salmon: 2 units of happiness, tilapia: 6 units of happiness.
   - Cost of fishing: lose 0.1 happiness for every step they move.
   - Chance of catching a fish per tick: similar to wolves-sheep model, people wonder around and find preys.
   - New people showing up? leaving?: I let people leave if one is unhappy 5 days in a row.People move in if the percentage of happy fishermen is greater than 80%.
   - Each fisherman has a probability to break rules at the start of each day. If one is unhappy, the probablity one breaks rules will increase.
   - Rule breakers catch more fishes than daily quota.
   - Rule breakers who are caught for more than 3 times, they leave. For the first times, they just give away half of their happiness. For the second time, they give away 75% happiness (graduated sanction).

2. Monitor

   - Monitors check fishermen within a certain distance every night.
   - Monitor is set to be happy, so they will not move out. He take away 50% happiness from rule breakers.
   - If monitor catches zero rule breaker, he will trun into a fisherman.

3. Emergence

   - At the beginning, we have one monitor.
   - Community decide to increase the number of monitors if one of the two cases below happen:

     $$\begin{cases} A. & \text{The number of fishes in the lake is less than 50\% of the original lebel} \\ B. & \text{The number of unhappy fishermen is greater than } 1/3 \end{cases}$$

   - New monitor is selected randomly from fishermen who are unhappy.

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- *System trys to reach the steady state where the above 2 conditions are not violated with the right number of monitors.*

4. Fish
    - There are 3 fishes: carp, salmon, tilapia,
    - They reproduce at different rates.
    - Different types of fishes have different size and values.
5. Environment
    - One lake.
    - Link patches outside the lakes with agents, so everybody has a fixed location.
6. Programming logic:
    - Program physical environment first? **Done this part.**
    - Then: the "social" environment of rules? **In progress.**

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