# Principle 4

Jiani Gao
Elisa Taveras Pena
Iryna Anufriyeva
Thanh Pham
Justin Kizner

*Department of Economics, Binghamton University*

April 24, 2018

# 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 fish, and different types of fish 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 fish 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:

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

jgao30@binghamton.edu

- New monitor is selected randomly from fishermen who are unhappy. (collective decision)
- *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 fish 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.**

**We will build a model without monitors first, and see the average level of happiness. Then we will introduce monitors into the model, and find out the average level of happiness. By comparing these two results, we can know which one is more successful. We will use behavior space to find out the optimal level of monitors.**

jgao30@binghamton.edu