Multi-Agent Modeling

Final Project Proposal

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I intend to model societies whose members have the opportunity to steal from or protect other members of the society, and the equilibria that are established within those societies depending on the likelihood of getting caught and the rewards and punishments for stealing or protecting. Stealing seems to me to be an effective shorthand for a variety of ethical transgressions, which is my personal area of interest. Depending on the initial parameters of the model I can imagine a variety of final states of the model. This project is a good fit for ABM because it is an agent-centric model of emergent behavior; the pertinent question is not about the behavior any individual agent, but what a society looks like after generations of theft, protection, and inaction.

I do not have a particular reference pattern in mind but there are a variety of evolutionary psychology findings that are relevant. For example, there has been a great deal of research on how altruism, aggression, and sexual violence could be evolutionarily adaptive traits. I predict that it will be relatively simple to determine initial setups that ultimately select for thievery or for altruism, but that it will be harder to find a model that selects for both and establishes a balance of both traits.

My model will only concern turtle agents; patches and links will not be involved. Each turtle will have a theft-threshold and a protection-threshold such that protection-threshold > theft-threshold. These thresholds will be randomly assigned within ranges set by the user through sliders. Each turtle will also have a social-currency value initialized at 21, although this parameter is changeable by the user (I chose 21 because turtles gain and lose social-currency in increments of 10, so this gives turtles two chances to be caught stealing before they die). There will be several global parameters: a global reproduction-threshold, global thresholds defining the average likelihood of stealing or protecting, and a probability of turtles getting away with stealing. Hidden parameters include the initial number of turtles, how much they gain or lose, average life expectancy, and the size of their neighborhood.

At each time-step, the turtles do the following:

1) Take a step towards the turtle within their social group that has the highest social-currency.

2) Choose whether to Steal, Protect, or Do Nothing, by randomly choosing a number between 0 and 100 and taking the action whose range their number falls under (i.e., Steal if 0 < N <= X-Threshold; Do Nothing if X-threshold < N <= Y-threshold; Protect if Y < N <= 100). If they steal, determine whether they get away with it.

3) Resolve the consequences of their actions (see below).

4) If their social-currency value is 0 or less, die. If they are past their life expectancy, die. If their social-currency value is above the reproductive threshold, reproduce.

Reproduction happens between turtles, and the child turtle has the average parameters of its parents.

Resolution of actions is as follows:

* If a turtle decides to Steal, and no turtle in the radius has decided to Protect or it gets away with the theft, then the thieving turtle gains Gain amount of social-currency. This amount is divided by the number of turtles in the thief’s social-radius; each one of those turtles loses that much social-currency.
* If a turtle decides to Steal and one or more turtles in the radius has decided to Protect AND it does not get away with the theft, then the thieving turtle loses Gain amount of social-currency. That amount is divided by the number of turtles Protecting, each of whom gains that amount of social-currency.
* If a turtle decides to Do Nothing, it does nothing. Its social-currency value may still go up or down depending on the actions of other turtles.
* If a turtle decides to Protect, and no nearby turtles tried to Steal, then that turtle loses Gain social-currency for being a nosy busy-body who is all up in the other turtles’ business. The social-currency is divided amongst all the other nearby turtles.
* If a turtle decides to Protect and at least one turtle nearby has tried to Steal, then the thieving turtle loses Gain social-currency, which is divided amongst all the turtles that Protected against its thieving.

To be clear, the user has the following parameters exposed: maximum theft threshold; minimum protection threshold (protection threshold must be greater than theft threshold); reproduction-threshold; and probability of getting away with theft.

Note that, within this model, Protecting can be a viable short-term strategy but may end up being problematic in the long term: if turtles Protect to the point where all thieves are exiled or killed, then after all the thieves are gone, Protecting can be damaging to turtles if all the other turtles do nothing (and if all turtles Protect, functionally all turtles are doing nothing, since they all gain the same amount of social-currency they lose).

I am collecting measures of the proportion of each type of action that are taken at each step, and the proportion of turtles of a particular “kind”. Turtles are designated as thieves, protectors, or placids if they perform the corresponding action more than ten times (turtles can be members of more than one group).

Finally, as a 400-level student, I will create a complementary HubNet model. The HubNet model will not feature thresholds, but rather, at every time step the user will get to choose whether to protect, steal, or do nothing. Turtles caught stealing will be turned redder; turtles who protect will turn greener (regardless of whether they gained or lost social-currency; by changing the colors gradually, there will be something of a record of which turtles generally do which action). For each round, first turtles who were caught stealing last round move; then all other turtles move; then turtles choose an action.