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Final Project: Rats

OVERVIEW

- To model a simple rat ecosystem in which the agents—rats—attempt to maximize their reproduction constrained by the food and water available in their environment.
- The rats will attempt to acquire the food they need in order to mature and mate (local decisions).
- The environment itself will only provide enough food to sustain a certain rat population.
- The rat population as a whole will be affected by the carrying capacity of this ecosystem, leading to global coherence.

CONSTANTS

Parameter	Range of Values
Aggressiveness Threshold	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0
Food Source Capacity	1,2,3,4,5
Global Food Source Availability	0,1,5,10
Initial Rat Population Size	10, 15, 20, 25, 30
Initial Rat Population Aggressiveness Constant	Normal Distribution around 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0

RAT PROPERTIES

- Age y where y is the time the rat has been alive measured in t, rat time units.
- Time since Last Meal m where m is the time since the rat has eaten in t, rat time units.
- Hunger Factor $\mu = m/1000$
- Sexual Desire Factor s where s is a piecewise function. When $0 <= y <= 25000$, $s = 0$. When $y >= 25000$,
  $s = 0.5 + 0.00004y$
- Aggressiveness Factor $a = (\mu + \beta)/2$ where β is an aggressiveness constant based on the aggressiveness of the parent rats (or initiated randomly in the initial population based on simulation input) as $0 <= \beta <= 1$ where male rats are inherently more aggressive than female rats.
- Physicality $p = (y/50000 + \mu)/2$.

FOOD SOURCE PROPERTIES

- Number of food items available “a” where $0 < a < 5$, manipulated by simulation input.
- Within the ecosystem, food resources will appear in specific areas that signify grates in the streets above the rats’ environment. The number of active grates multiplied by the number of food items available at each grate will never to exceed the inputted global max food available at any given time.
- Rats that die in a conflict will become a food source where “a” = 1.

RAT ACTIONS

- Exploratory mode—looking for food or mates (depending on sexual desire factor and hunger factor)
- Eating mode—attaching to and depleting food resource. It takes rats t = 100 rat time units to consume their meal, at which point m (Time since Last Meal) will be reset to 0.
- Mating mode—a male rat attaches to a female rat for t = 100 rat time units.
- Fighting mode—two rats fight when conflicting over a food resource or mate. Willingness to fight is determined by the aggressiveness factor as compared to a threshold which can be manipulated as input.

DEATH

- If Time since Last Meal m >= 1000, the rat will die.
- Rats are assumed to die at y = 50000.

EMERGENT BEHAVIOR

- Rats will mate in the specific areas mentioned above where food resources appear

HYPOTHESES

- Hypothesis 1: Decreasing the aggressiveness threshold will increase the number of inter-rat conflicts, the number of rats in fighting mode, and the number of rats serving as food sources.
- Hypothesis 2: Overtime, the aggressiveness of the rats will converge to a constant.
- Hypothesis 3: Aggressiveness and life expectancy of rats are inversely correlated.
- Hypothesis 4: More aggressive rats are less likely to win fights based on the effects of the time since the rat has eaten on physicality and aggressiveness.
- Hypothesis 5: As the food source capacity is lowered, the proposed emerging behavior will minimize as it will be less likely that a rat of the other gender will be present at the food source if the capacity is low.
- Hypothesis 6: Aggressive rats will fare better when the global food source availability is low as compared to when the global food source capacity is high.
- Hypothesis 7: Males rats will kill proportionally more male rats than female rats, with the disparity enlarging as food source capacity and global availability are increased, causing the killings to be motivated primarily by competition over mates.