Unit 4 - Model Design Assignment

(1) What part of your phenomenon would you like to build a model of? Make sure that the phenomenon is appropriate for an agent-based model that could be completed in the next month.

The phenomenon I would like to build a model of is the breeding behavior of a multi-agent population of cats in a wrapped world. The model aims to simulate the dynamics of cat breeding, including factors such as gender, genetic traits (folded ears), movement, mating, pregnancy, and the production of offspring.

(2) What are the principal types of agents involved in this phenomenon? Illustrate all of the agent types necessary for the model.

Each cat is an individual agent in the model. Cats can have different characteristics such as gender, ear type, age, happiness, and pregnancy status.

(3) What properties do these agents have (describe by agent type)? Describe for all agent types.

Each cat agent has the following properties:

* GENDER
  + Cats have a 50% chance of being male or female.
* EAR-TYPE
  + Cats have a 25% chance of having folded ears   
    Cats have a 75% chance of having regular ears.
* AGE
  + Cats have an age value that starts at 0 and increases by 1 every tick.
  + Cats must be at least 10 ticks old and no older than 200 ticks to be eligible to mate.
* HAPPINESS
  + Each cat is assigned a random number between 1 and 10.
    - This is one of *n* factors to determine success or failure in pregnancy.
* PREGNANCY-STATUS
  + Female cats can be pregnant or not pregnant. (Boolean)
* PREGNANCY-TIMER
  + Pregnancy lasts for 10 ticks.

(4) What actions (or behaviors) can these agents take (describe by agent type)? Describe all appropriate behaviors for all agent types.

Each cat agent can perform the following actions:

* MOVE
  + Cats move randomly throughout the wrapped world on each tick.
* ASSESS-MATE
  + When two cats movements intersect, they assess whether to have a pregnancy.
    - A pregnancy can only occur when an intersection happens between a cat and a girl cat.
    - Cats can only pick one cat at a time to assess.
    - A pregnancy can only occur if the female cat isn’t already pregnant.
    - A pregnancy can only occur if the average of the HAPPINESS numbers of both cats is greater than 7
    - A pregnancy can only occur if both cats are at least 20 ticks old and less than 200 ticks.
* PREGNANCY
  + A pregnancy is when two cats pass all assess-mate criteria successfully.
    - A pregnancy lasts 10 ticks
    - A pregnancy produces a random number of new cats between 1 and 6 at the end of the pregnancy.
    - Cats that result from a pregnancy all have a 50% chance of being a boy or a girl.
    - Cats resulting from a pregnancy have a 25% chance of having folded ears, and a 75% chance of having regular ears.

(5) In what kind of environment do these agents operate? Describe the basic environment type (e.g., spatial, network, featurespace, etc.) and fully describe the environment.

The cats operate in a spatial environment represented by a wrapped world. The wrapped world ensures that if a cat moves off the edge of the world, it reappears on the opposite side. This creates a toroidal grid where the cats can move freely without encountering boundaries. This is meant to replicate a real-world scenario where cats maintain an existing territory.

(6) If you had to “discretize” the phenomenon into time steps, what events and in what order would occur during any one-time step? Fully describe everything that happens during a time step.

1. Setup the world with a random selection of cats + properties
2. Randomly move the cats in the wrapped world for each tick
3. Check if another cat was encountered.
4. If another cat has been encountered, ASSESS-MATE
   * Was the intersection between a boy and girl?
   * Is the average HAPPINESS of both cats above 7?
   * Is the female cat currently pregnant?
   * Are both cats between 10 and 200 ticks old?
5. If all ASSESS-MATE checks pass, then PREGNANCY
6. If PREGNANCY, PREGNANCY-TIMER is set to 10 clicks.
7. If a cat is currently pregnant (PREGNANCY-STATUS = TRUE) decrease the PREGNANCY-TIMER by 1.
8. If the PREGNANCY-TIMER reaches 0, give CREATE a random number of new cats between 1 and 6.
   * New cats have 25% chance of folded ears & 75% chance of regular ears
   * New cats have a 50% chance of being male or female
9. Increment the age of all cats by 1 for each tick
10. Repeat

(7) What are the inputs to the model? Identify all relevant inputs.

* CATS
  + Number of cats in the world.
* GENDER
  + Male probability: 0.5 (50% chance of being male)
  + Female probability: 0.5 (50% chance of being female)
* EAR-TYPE
  + Folded ear probability: 0.25 (25% chance of having folded ears)
  + Regular ear probability: 0.75 (75% chance of having regular ears)
* HAPPINESS
  + Random number between 1 and 10 assigned as the happiness score for each cat.

(8) What do you hope to observe from this model? Identify all relevant outputs

* Population dynamics:
  + Observing how the population of cats changes over time, including the growth rate, gender distribution, and ear type distribution.
* Reproductive behavior:
  + Understanding the frequency of pregnancies, the average number of offspring per pregnancy, and the impact of happiness scores on reproductive success.
* Spatial distribution:
  + Analyzing the spatial patterns of cats in the grid and their movement patterns.
* Traits:
  + Analyzing the distribution of offspring traits based on the parents' traits.