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.

The two types of agents (BREED) are:

MALE-CAT  
FEMALE-CAT

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

MALE-CATS

* GENDER
  + Always MALE
* EAR-TYPE
  + Cats have a 25% chance of having folded ears = FOLDS  
    Cats have a 75% chance of having regular ears = REGULAR
* 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 ASSESS-MATE (aka have a pregnancy).
* HAPPINESS
  + Each cat is assigned a random number between 1 and 10.

FEMALE-CATS

* GENDER
  + Always FEMALE
* EAR-TYPE
  + Cats have a 25% chance of having folded ears = FOLDS  
    Cats have a 75% chance of having regular ears = REGULAR
* 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 ASSESS-MATE (aka have a pregnancy).
* HAPPINESS
  + Each cat is assigned a random number between 1 and 10.
* PREGNANCY-STATUS
  + 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
  + This procedure is run when the path of two cats intersects at the same time, and can only be run on one other cat at a time. The following properties are assessed in the ASSESS-MATE procedure.
    - GENDER
      * A pregnancy can only occur when an intersection happens with a cat whose GENDER is not equal to their own.
    - PREGNANCY-STATUS
      * A PREGNANCY can only occur if the FEMALE-CAT isn’t already pregnant.
    - HAPPINESS-SCORE
      * A PREGNANCY can only occur if the average of the HAPPINESS numbers of both cats is greater than 7
    - AGE
      * A pregnancy can only occur if the AGE of both cats are at least 20 ticks old and less than 200 ticks old.
* PREGNANCY
  + A pregnancy is when a MALE-CAT and FEMALE-CAT pair pass all ASSESS-MATE criteria successfully.
    - A PREGNANCY lasts 10 ticks
    - When PREGNANCY-TIMER reaches 0, a random number (between 1 and 6) of new cats are hatched (hatch command).
      * Cats hatched from a pregnancy all have a 50% chance of being MALE-CAT or FEMALE-CAT BREED with the properties of each breed applied.

(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 both BREED + their properties
2. Move cats random distances each tick in the wrapped world.
3. Check if another cat was encountered during movement.
4. If another cat has been encountered, ASSESS-MATE
   * Was the cat encountered a different BREED?
     1. If FALSE, no PREGNANCY,
     2. If TRUE then;
   * Is the average of both cats HAPPINESS above 7?
     1. If FALSE, no PREGNANCY
     2. If TRUE then;
   * Is the PREGNANCY of the female TRUE or FALSE?
     1. If TRUE, no PREGNANCY
     2. If FALSE then;
   * IS AGE between 10 and 200 ticks old?
     1. If FALSE, no PREGNANCY
     2. If TRUE then PREGNANCY.
5. If all ASSESS-MATE checks pass, then PREGNANCY is changed to TRUE and PREGNANCY-TIMER is set to 10 clicks.
6. If a FEMALE-CAT is currently PREGNANT=TRUE, decrease the PREGNANCY-TIMER by 1.
7. If the PREGNANCY-TIMER reaches 0, hatch a random number (between 1 and 6) of new cats and set PREGNANCY = FALSE.
8. Increment AGE of all existing cats by 1 for each tick
9. Repeat

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

* CATS
  + Number of starting cats in the world.
* BREED
  + MALE-CAT
  + FEMALE-CAT
* EAR-TYPE
  + Folded ear probability: 0.25 (25% chance of having folded ears)
  + Regular ear probability: 0.75 (75% chance of having regular ears)
  + \*This will most likely become a slider to change the prevalence of a folded-ear vs regular traits in the SETUP population.
* 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.
* Traits
  + Analyzing the distribution of offspring traits based on the parents' traits.

HATCH Creates a clone – probably use CRT instead.

Turtles-here = all turtled on current patch

aSyncronous

parallel – trmintes

spred of diseasde model from 6.1 may be good