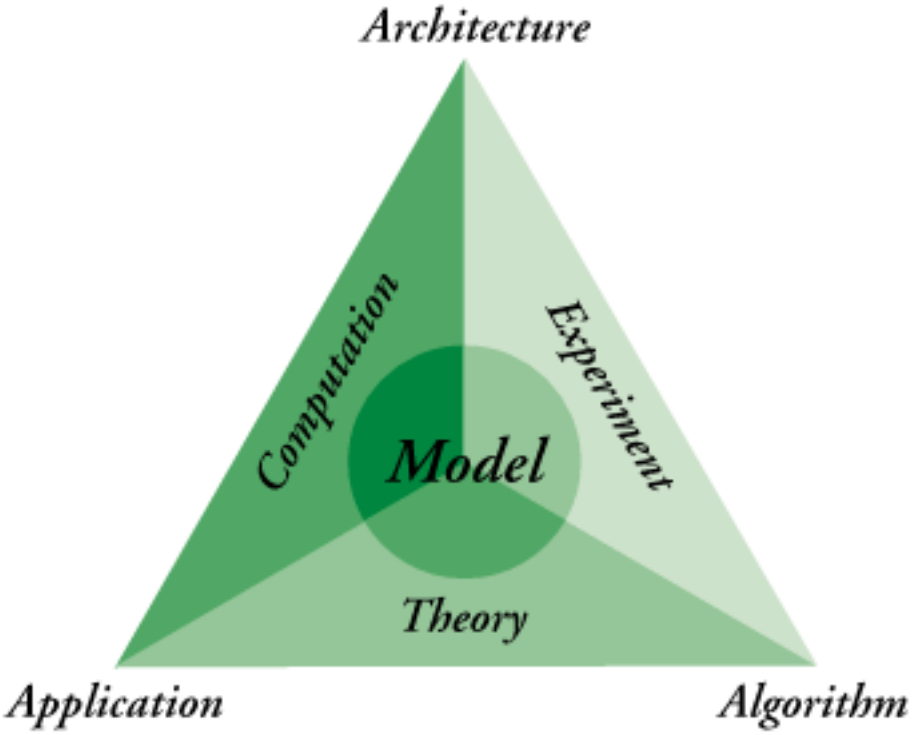
COSC150: Laboratory 6
A Simple Introduction to Agent Modeling:
Tell a Good Story, Build a Good Model



This exercise has three motivations:

- To explore the mental space of expectation, observation, and reflection in science;
- To build a simple model in AgentCubesOnline starting with a good story;
- To realize how much of Nature could have similar, and simple, generating rules.

Even though it may look like a specific recipe for a specific model (how the flu spreads), the steps here are really generally applicable: Thinking, observing, conjecturing, observing, and back to thinking.

Expectation, Observation and Reflection: The process of science comes down to these three basic and very active steps: *expectation, observation, and reflection*. AgentCubesOnline offers a wonderful way to explore science in a variety of ways, offering a chance to learn how to model from limited input information, to explore emergent phenomena, and to interpret the qualitative and quantitative aspects of a dynamic, visual, interactive model.

Not everything that we will do is written in this handout. That's because I have no idea what each of you will suggest along the way, and I suppose that it would be more fun to do what you think of as interesting and fun, than for me to try to get you to do something I might think is fun.

Part of the motivation of this exploration is to change the "sound" of science from, "*What is the answer to this question?*" to "*How many different ways could we explain what we observe, and what does that tell us about the world*?"

In agent modeling, there are many modes of action between agents, and we will explore several of these. For example, suppose we wanted to model how a disease is spread (or how predators eat prey, or how atoms interact to become molecules, or how a fire spreads from one tree to another, or how someone's wallet is "transferred" to another person, etc.). For a disease to spread from one person to another, the story could be:

- If I am sick and you are directly in front of me, *I* could "change" *your* state to being sick, or,
- If I am sick and you are directly in front of me, *I* could "make" *you* "make" yourself sick, or,
- If I am healthy and sense that you are sick and next to me –or if I see you directly in front of me– *I* could "change" *my own* state to being sick or,
- If I am healthy and sense that you are sick and next to me –or if I see you directly in front of me–, *I* could "make" *myself* be sick.

(Some of these will be more clear as you understand program thinking!)

All are pathways or processes that in some ways are equivalent, but they are different enough that they support the telling of a different story. Again, the motivation here to is to understand clearly that ***the story is the basis for the model in science.***

AGENT MODELING: The starting point in agent modeling, particularly using AgentSheets or AgentCubesOnline, is a well-told story, that is, a story having a rich collection –but not too rich! – of **nouns** and **adjectives** and **verbs**.

Our approach will be to start with the story, analyze the story for its main components, and to identify clear ***instances*** that will enable us to build the model in ***stages***, one stage at a time. At each stage we will engage in two thinking explorations:

a. First, we will make observations to ensure that our model meets our expectations in our story, and we will modify our expectations or our model story until they are in agreement;

b. Second, we will reflect on how applicable our model at each stage is to serve as a model for other analogous stories in the real world or even in our imagination.

It is important to emphasize that you need to have your story, preferably **written down on paper, or on a shared space such as a flip chart, marker board, or file that is projected for all to see.** You shouldn't go near a computer until you have your story, until you have analyzed the story for its agents, depictions, actions, and stages. Having a written story helps with model specification, implementation, and testing.

NOTE: It is important that you actually do the work as we do it in lab. All models in AgentCubesOnline are publicly viewable, and I will look at each of the models tonight or tomorrow so I can "see" what you have done.

Our Story: How Disease Spreads

We are going to explore communicable diseases, that is, a disease that spreads from the infected person to an uninfected person through direct contact, such as the flu or cold.

Here is one possible story:

If a Healthy Person in the World,
Is next to any Sick Person,
with some (to be defined) percent chance,
Then that Healthy Person will change themselves into a Sick Person.
Healthy Persons move randomly in the World.
Sick Persons move randomly but more slowly in the World.

We first identify the NOUNS. In the story above, what are the "substantial" nouns?

_____ _____

These will be our AGENTS.

Do any of these nouns have adjectives in our story?

_____ and _____ both modify _____

These will be the depictions or shapes (what something looks like) of the agent they modify.

Are there any Active Verbs in our story?

_____ and _____

These will define the ACTIONS of the _____ agent.

We will build this model in stages, observing and reflecting at each stage and comparing to our expectations, and if the model needs to be improved, we'll go back each time and change our story *first.* We will also think about other stories that our model models as we implement things along the way.

Let's get "on-line"

Go to: http://agentcubesonline.com

Username: **COSC150**
Password **W0ff0rd!!** (Capital-W Zero eff eff Zero are dee bang bang)

DO NOT SHARE THIS WITH ANYONE, DO NOT CHANGE THE PASSWORD!!!
From Story to Model in AgentCubesOnline:

Some of us have found it useful, to prepare expectations, to recall the steps in building a model ***once you have a story.*** We want to emphasize the priority of the thinking that goes into the story that comes to life in the model.

The Basic Steps in AgentCubesOnline:

We will create a *new project (you will need to give it a name)*. Please pick a name related to the model topic, NO SPACES or PUNCTUATION, and put your first name and initial in your project name (such as BILL_SIR or SUSIE_SIR).

We then create each agent (you will need to give each agent a name), and
we will make different shapes for the agents that have more than one adjective, *keeping the initial shapes simple! I suggest tiles-with-color*

Write down your choices for colors of your agents and their shapes:

In AgentCubesOnline, there is a default "world" into which we can place the agents(shapes); you can create other worlds later if desired.

We will test the model and see how it behaves at each stage.

We will modify the behavior of the agents and test, modify the behavior and test, again and again at each stage.

We will pause at each stage and reflect on what we have observed, how it compares to our expectations, and then go through "modify behavior, test" phase again. (And again, as needed!)

When we decide we want a better model, we will start by modifying our story, then implement the changes, test, and cycle again: ***Expectation, Observation, Reflection***.

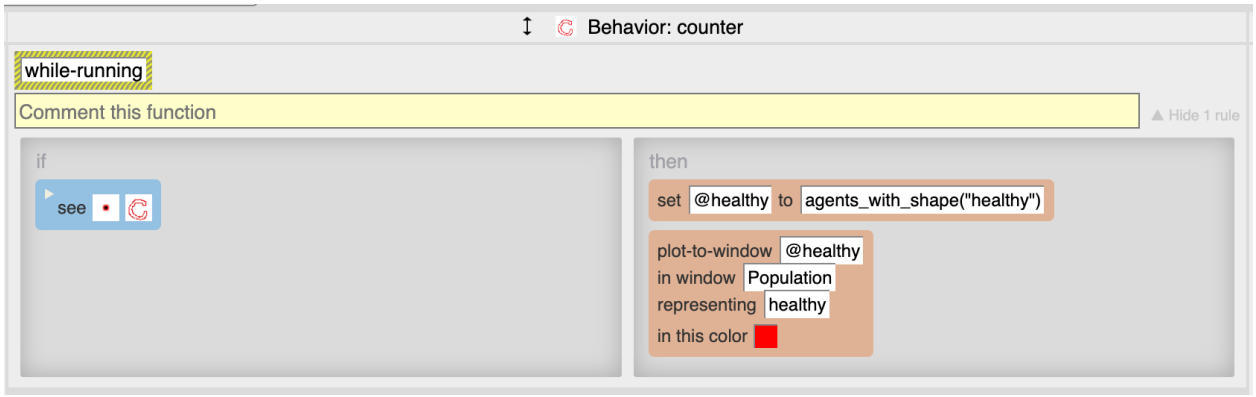
If we change the model, we start by changing the story!

Counting and Plotting

Quantity plays an important role, not just qualitative observations. In science we want to count and visualize the objects and their properties so we can detect and understand *patterns.*

In our model world, we would need to give some agent the "job" of counting and plotting. Often it is good to give this job to a separate agent that isn't moving around, getting sick, or in any other way interacting with the world or agents in it.

You can use the following behavior for your counter agent:



Note: we are using a GLOBAL VARIABLE indicated by the @ since there is one value of "@healthy" for the whole simulation. Each individual agent/shape can also have its own ***attribute.***

Repeat the definition (in same "then" window) for the sick.

You should run your model for 3 different world sizes: 9x16, 25x25, 51x51

Extensions of the Model, to be done on your own and discussed in class Tue 9 Nov:

1. How would you introduce recovery? ***How many different ways*** can you think of to model how an infected person would recover and become immune? How would you have to change your model to match your story?

   Pick at least one way and change your story to introduce a path to recovery, and then change your model to match that story.

   Compose some driving questions and use your model to answer those questions.

2. Comparing the three sizes for the "world" how does population density affect the progress of the infection?

   Compose some driving questions and use your model to answer those questions.

3. How would you introduce Loss of Immunity?