Seals-Fish Predator-Prey Model
Requirements and High Level Design (HLD) Document
Spring 2015 Apprentice Group Project

1 Introduction

The Problem

To study the behavior of animals, scientists may tag them and track them with a signal, such as a high frequency sound wave. Using tags on sea animals helps scientists track their migratory patterns. Tagging a single fish can allow scientists to track the whole school.

However, there is the chance that the act of observation will change the subject(s) being observed. Seals eat fish. Some seals have been able to hear the signal from these fish tags and easily find and eat said fish (source). However, this is not the only effect of tagging. Predators that are tagged have been known to have difficulty surprising (and catching) prey.

Scientists can use different kinds of tags: ones that emit something other than sound waves or using frequencies above any animal's hearing range. But Dr. Maris Prentice already tagged many fish. To lessen the effect of her tags, Dr. Prentice decided to tag a proportion of fish and seals so that the overall populations of them stabilize back to their original numbers. In the fall, you helped her find a balance to the seal-fish populations with the agent-based and system-based models you built. Now, you need to implement the model in a way accessible to more scientists, so that they can use the model and benefit from it.

Your Assignment

To effectively communicate the understanding from the models built in the fall by programming an analogous model in Javascript. An incomplete program is available to you, and instructions are left in the code as to what must be done to complete the model, both in terms of minimum requirements, and enhancements that go beyond what the original authors even dreamed of.

2 Subject Matter Experts Agreement List

Person	Title/Role	Approved?
Apprentice	Co-Developer	
Apprentice	Co-Developer	
Phil List	Program Director	
Mentor	Client (Dr. Prentice)	

3 Requirements

The general requirements for this project are:

a. The team project will be publicly accessible from each team member's website.

b. Instructions on how to use your model must be provided either as a (linked) secondary webpage or along with the model.

c. Ensure that all html files will validate at http://validator.w3.org/

d. Must use the <canvas></canvas> HTML tag and JavaScript.

e. Teams must write out a plan in their notebooks (or on other physical medium) and show the Apprentice Director and/or upon request.

f. Barring excused absences, the deadline for the project and presentation is Saturday, March 21st. If more time is needed, groups should confer with the Apprenticeship Director and consider meeting during weekdays at Shodor.

The specific requirements for this project are:

Because your Javascript model relies greatly on the placement of agents in the two-dimensional world, there is great variability with this model (similar to Agentsheets). Complete a model that shows the behavior of the ecosystem with tagged fish. You must ensure that fish and seals can eat, reproduce, and die (from starvation, old age, and being a meal of another). Also, the tagged fish must be detectable by seals, who then move towards the tagged fish and will eat them if they catch them.

You can decide the best algorithms for behavior for the fish and seals, though some are implemented already. You can change these; if you do, document why you think another method may be better. One part of the model that is not implemented is a set of variables to track details of the fish and seals. At least keep track of the number of the seals and fish that exist in a running of the model; other data that could be tracked includes: average age at death, most common cause of death, etc.

At present, fish move around randomly in the water; seals do too. Also, all the fish are tagged fish, though you need to implement a mechanism for seals detecting the sound and pursuing it. Two animals cannot occupy the same space in the model (with the exception of one eating another). If a seal is immediately next to a fish, there is a chance that it will eat the fish. If a fish is next to another fish, there is a chance for reproduction; likewise if a seal is next to another seal, there is a chance for reproduction. If an offspring is to be born, it must be on a space that is not currently occupied by another animal (nor can it be off the canvas). Each fish and seal will have to keep track of its own age. Each seal also has an appetite, so you need to keep track of how long it has been since a seal ate. Your model might look very different than your neighbor's because this HLD does not provide specific values here, and the configuration of your 2-dimensional worksheet is your own choosing. When you present your project, you will simply explain why you made the choices you made (why your decisions are reasonable or interesting). You can make other conditions part of your model if you want (for instance, seals who haven't eaten in a while cannot reproduce, because it would be unrealistic to successfully nurture a baby seal while starving).

Once you have tagged fish being pursued, you should create fish without tags. You decide if they should be the same fish objects as the tagged fish, or different.

Action items to plan & execute:

- Ensure fish can eat when conditions are right
- Ensure seals can die from hunger
- Ensure seals can die from old age
- Ensure seals can reproduce
- Implement the function that determines where strongest signal is (left, right, up, down, self)
- Create "non-tagged" fish (note: these don't have to be a separate class of fish)
- Optional: display the strength of the fish tag signal
- Optional: introduce tagged seals that can be detected by fish, who then flee
- Optional: is the eating, the reproduction, or the death realistic? If not, make it so!

Things that might be helpful:

- Read through the code and the comments to best understand what is going on.
- When you have to implement functionality, understand what is being asked of you, then look for something similar in the code that you can copy or modify.
- Write out your plan in your lab notebook.
- Use console.log() printouts to help you understand the flow of the program.
- When the HLD describes "a chance" of something happening, it is greater than 0%.
- When the HLD mentions something "can" happen, make sure it is visualized or tracked with variables.
- The signal of a tag should stop when that animal dies.
- If you think the above statement (or any of the rules/parameters) is too unrealistic, tell me why, and how you would like to something a little different! I am open to your reasoned and creative thoughts in the matter!

Your Presentation

You will need to present your completed model to the rest of the office. Your presentation style needs to be as if you are presenting to your client, Dr. Maris. Make sure to address these questions in your presentation:

- What are advantages and disadvantages of the implementation choices you made?
- Based on your model what did you find? Show your work!
  - 'Work' can be partly typed out, but some should be in your lab book (drawings count!)
- What do you think are some advantages and disadvantages of programming by hand versus using modeling software?
- What was the most challenging part to implement? Why?
- What part of your models are you most proud of? Why?

4 Timeline

Your project and presentation is due by March 21, 2015. March 7, 14, and the morning of March 21 are for your planning and implementation of this model. You may also come to the office outside of Saturdays.

5 Conclusion

The goal of this project is to demonstrate your current understanding of programming concepts while continuing to learn and better understand such concepts. You will need to present your completed model to the rest of the office. You should also have fun doing it and learning along the way. It is not expected that you will be able to complete this without referencing notes, asking questions, researching online, and trial-and-error. Enjoy the learning process!