**Lab 11: Simulating Disease Transmission with NetLogo**

For this lab we will become familiar with the program NetLogo. NetLogo is an Agent-Based Modeling (ABM) programming language.

Complete all tasks and answer all questions for full credit.

**Task 1.** **Getting Started with NetLogo.**

1. Open a new session window in NetLogo.
2. Create a setup button:

Click on Add (+), then click on the button tool to the right of Add. Move the cursor to the white space next to the display window. Place the button in the white space and in Commands, type ‘setup’.

1. Create a go button

Click on Add (+), then click on the button tool to the right of Add. Move the cursor to the white space next to the display window. Place the button in the white space and in Commands, type ‘go’.

**Task 2. Adding Agents to the Diagram.** NetLogo is a programming language with built-in capabilities for modeling agents, places, and actions. NetLogo uses the saved keywords ‘turtles’ (agents), ‘patches’ (places), and ‘ticks’ (actions) to map out these interacting pieces. The next series of steps will familiarize you with these features.

1. Add agents to the display

The NetLogo programming code is written in the Code tab (to the right of Interface and Info). Click on Code and enter the following code:

to setup

clear-all

reset-ticks

create-turtles 1

end

This code has defined the procedures which will be executed when you click the ‘setup’ button in the Interface display. ‘clear-all’ starts the display and sets the variables fresh in case you have been working on a prior project. ‘create-turtles 1’ has created a single agent available to operate within the display.

1. Get the agents to move in the display

Return to the Code. Define the actions associated with the ‘go’ button in the display. To do this, enter the following code:

to go

ask turtles[

pen-down

fd 5

rt 90

fd 5

]

tick

end

This set of code instructs the program the operations to execute when the ‘go’ button is pressed. ‘ask turtles’ indicates that the next set of operations are for the agents. ‘pen-down’ tells the program to leave a visual display. The next set of statements tells the actor to move forward 5 units in the grid, turn right 90 degree, and then move forward 5 more units. Return to the Interface tab and push the ‘setup’ and ‘go’ buttons.

**Question 1: What happens when you press ‘go’ more than once?**

**it goes 5 forward and right 90 and 5 forward more from the immediate previous position.**

1. Change the number of agents to 10 in the setup code. Return to the interface and press ‘setup’ and ‘go’ several times.

**Question 2: Now what happens? How is the initial direction of an agent determined?**

there are 10 turtles at different directions.randomly.

**Task 3. Interacting Agents with Places.** We will now add places to the diagram. Places (‘patches’) can be given properties just as agent (‘turtles’) can. By setting a property for a place, we can alter the commands for our agent based on being at a particular location.

1. Change to ‘go’ command to the following:

to go

ask (patch-set one-of patches)[

set pcolor green

]

ask turtles[

pen-down

if pcolor = green[ rt 90]

fd 1

]

tick

end

**Question 3: What changes do you see in the display?**

with each step, there is a new gree patch. when an arrow hits a patch, its direction changes in 90 degree. when an arrow go outside the edge, it just comes from the other side from the same height.

**Task 4. SIR Network Dynamics.** Now we will use a developed code to investigate network dynamics.

1. Open the SIR Model file. Notice that the file has added some additional features, such as a slider bar and an outcomes display window. Set the Disease-Infection-Rate to 0.08 and the Infection-Duration to 4. Press ‘setup’ and ‘go’. Stop the display by pressing ‘go’ again.

**Question 4: What happened in the model?**

**The infected people recovered. Only a few 2 or 3 got infected.**

1. Press ‘setup’ and ‘go’ again a few times. Is the result always the same?

No. With more time, no of infected people is increasing.

1. Change the Infection-Duration constant to 3. Gradually increase the Disease-Infection-Rate.

**Question 5: At what value of Disease-Infection-Rate do epidemics become common?**

**10% gives 66% infection rate. So we can say 10% makes epidemic pretty common.**

1. At the inflection point noted in part c), change the Infection-Duration to 4. Run the model enough times to get a sense of the patterns.

**Question 6: Now what has happened to the rate of epidemics?**

**the disease has started to spread quickly.**

**Task 5. Summary.** Investigate different combinations of the start variables and model parameters. Summarize your findings about disease transmission and epidemics. Discuss how you would alter this type of model to learn about disease transmission in a real world setting.

**In the SIR model, as the infection duration increased, more and more people started to get infected. But after the first wave, infection got cleared up. It indicates that as the infection time of a disease increase, the spread increases.**

In the coupled contagion model, in fear state, people hide. So epidemic spread and infection rate get decreased. As fear infection rate is increased, the infection rate decreased. Also, the more people start to hide for longer period, lesser people got infected.

However, if the flights are open, feared people will try to move oto other places less infected and eventually they will create an epidemic at some other part of the world.