

# Distributed Intelligence in Autonomous Robotics

## Assignment #5

**Out: Tuesday, March 25, 2003**

**DUE: Tuesday, April 8, 2003**

### NetLogo Investigations

In this assignment, we will explore the use of a different simulation environment – NetLogo – for investigating multi-agent behaviors. NetLogo is a programmable modeling environment for simulating natural and social phenomena. It is particularly well suited for modeling complex systems developing over time. Modelers can give instructions to hundreds or thousands of independent “agents” all operating in parallel. This makes it possible to explore the connection between the micro-level behavior of individuals and the macro-level patterns that emerge from the interaction of many individuals. NetLogo is available at: <http://ccl.northwestern.edu/netlogo/>. For this exercise, we will investigate the behavior of existing models, rather than program our own.

You should turn in the material indicated below for each of Parts I, II, and III.

### 0. Access NetLogo

Access the NetLogo website at the above link. The models we will be exploring are available by following either the “Models Library” link (3<sup>rd</sup> link down on left side) and paging down, or by following the “NetLogo User Community Models” link (4<sup>th</sup> link down on left side).

You should be able to run the models from your web browser, so there is no need to download the software for this assignment.

### Part I. Pathfinder

The first model to explore is the Pathfinder. While we studied a technique for multi-robot path planning in class, this model shows a different kind of distributed path planning, which enables teams of robots to find a path between two goal points (the start and end of the path) by invoking a simple control law for each robot. The Pathfinder model is available from the “NetLogo User Community Models” link, or by just going to: <http://ccl.northwestern.edu/netlogo/models/community/Pathfinder>.

Go to the Pathfinder model and read the instructions for using this model. Invoke the model in your web browser by following the provided link. Note that in this model, each “dot” (i.e., robot/agent) is numbered sequentially. A “neighbor” is the dot that has an adjacent number. For example, the neighbors of “dot” 7 are 6 and 8, regardless of where these dots are located spatially relative to each other. A path from the starting dot (always numbered 0) to the ending dot (highest numbered dot) is a path that goes sequentially through the positions of the dots from 0 to the end. Thus, the emergent path is the path that “connects the dots” sequentially.

In running this model, first click “Setup” and then click either “Step Once” or “Go Continuously”. If you click “Go Continuously” again, the simulation stops. The instructions on the web site should give you the other important instructions you’ll need to run this simulation.

### Do the following:

Explore the use of the Pathfinder model, investigating the effect of the number of dots, the types of obstacles in the environment, the noise level, the dot movement rate, and the use of simulated annealing (as explained on the web site).

***TURN IN THE FOLLOWING FOR PART I:***

Answer completely the questions on the Pathfinder web site under EXPLORATIONS. Your answers should be submitted in typed form – not hand-written. (Make sure it is clear which question each answer corresponds to, since the questions on this web site are not numbered.) Include at least one screen shot of running this model in order to illustrate points you supply in your answers. Your writeup should explicitly refer to the screen shot and explain what it shows.

**Part II. WolfSheep Predation**

The second model to explore is WolfSheep Predation. This model is available from the “Models Library” under the “Biology” category, or directly from <http://ccl.northwestern.edu/netlogo/models/WolfSheepPredation>. This model looks at issues of predator-prey ecosystems.

Do the following:

Explore the use of the WolfSheep Predation model, investigating the effect of different parameter settings, as described on the web site.

***TURN IN THE FOLLOWING FOR PART II:***

Answer completely the questions on the WolfSheep Predation web site under the two sections: THINGS TO NOTICE and THINGS TO TRY. Your answers should be submitted in typed form – not hand-written. (Make sure it is clear which question each answer corresponds to, since the questions on this web site are not numbered.) Include at least one screen shot of running this model in order to illustrate points you supply in your answers. Your writeup should explicitly refer to the screen shot and explain what it shows.

**Part III. Traffic Intersection**

The third model to explore is Traffic Intersection. This model is available from the “Models Library” under the “Social Science” category, or directly from <http://ccl.northwestern.edu/netlogo/models/TrafficIntersection>. This model looks at the interaction dynamics of multiple robots/agents moving through an intersection. Notice that these traffic rules are similar to the rules we discussed in our class on multi-robot path planning and traffic management.

Do the following:

Explore the use of the Traffic Intersection model, investigating the effect of different parameter settings, as described on the web site.

***TURN IN THE FOLLOWING FOR PART III:***

Answer completely the questions on the Traffic Intersection web site under the two sections: THINGS TO NOTICE and THINGS TO TRY. Your answers should be submitted in typed form – not hand-written. (Make sure it is clear which question each answer corresponds to, since the questions on this web site are not numbered.) Include at least one screen shot of running this model in order to illustrate points you supply in your answers. Your writeup should explicitly refer to the screen shot and explain what it shows.