Lab 4: Genetic Algorithms

DUE: Wednesday, November 3, online on Blackboard by 2pm.
(Your report should be in Word format with a *.doc or *.docx extension.)

In this lab you will experiment with a genetic algorithm that evolves strategies for Robby the Robot. This lab will work only on Windows; if you are using another operating system and don't have access to Windows, please make use of one of the PSU Windows machines in the computer labs.

1. Create a folder for your GA experiments.
2. Download Lab4robby.exe from the class web page into your new folder.
3. Run Lab4robby.exe. It will prompt you for parameter values. Use the following parameters:
    a. Population size: 200
    b. Crossover rate: 1 (probability of crossover taking place between two parents)
    c. Mutation rate: 0.005 (probability of mutating each bit of an offspring after it has been created)
    d. Number of moves per session: 200 (number of moves Robby will make for each fitness calculation)
    e. Number of generations: 300

(This may take a few minutes.) When finished, the program will write out three files; the file names will have the run's random seed as a preface and ".header", ".short", and ".best" as suffixes. The .header file contains information about the run (e.g. the parameter settings).. The .short file reports the fitness of the best individual in the population at each generation. The .best file contains the string representing the best individual in the final generation. (The fittest individual's 243 long genome.)

Repeat this two times to get three different runs with these parameters. Plot the data in the .short files for the three runs (all three on a single plot). Be sure to record what file names are generated for each experiment you conduct so you can easily find the right data for your plots. Your plot should be of a similar form to Fig. 9.6 on p. 141 in the text, except we are only doing 300 generations.

4. Try running Robby with the same parameters as in step 3, except set the crossover rate to 0. Again, do three runs with these parameters, and plot the data in the resulting .short files on a single plot (different from the plot in step 3.)

5. Same as step 4 but with crossover rate set to 1 and mutation rate set to 0.

6. Devise one experiment of your own—that is, different settings of the parameters (crossover and mutation rate). Predict how the behavior of the genetic algorithm will differ for your settings versus what you saw in steps 3-5. Then run the GA, three times for your parameter settings, and see if your predictions hold up. Again plot the three runs on a single plot

7. Downloaded RobbyGraphics.nlogo from the course website.

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8. Find the best strategy among all your experiments as well as one medium good strategy among your experiments. For each of these two strategies, do the following:
    a. Open the ".best" file for that experiment in a text editor (e.g. NotePad). Copy and paste the 243-digit strategy into the Strategy input box. (Erase or paste over the "null" that initially appears there.) Make sure there are no line-breaks in the strategy string.
    b. Click on "Initialize" to set up a new random environment for Robby.
    c. Click on "Go" to have Robby perform an action. The current version of this NetLogo program doesn't allow Robby to keep moving continuously; you have to keep on clicking "Go" every time you want him to perform the next action. The boxes beneath the "Initialize" and "Go" boxes will display the current action and the current (cumulative) score.
    d. Clicking on "Initialize" again will generate a new random environment for Robby, using the same strategy.
    e. Observe Robby's behavior and record a "dumb" behavior and a "smart" behavior for both the medium good strategy and the best strategy.

9. Write a paragraph or two reporting on and discussing your experiments in steps 3-6. What differences did you see among these runs and why do you think that these differences occurred?

10. Also write a paragraph discussing your observations of Robby's behavior in the NetLogo graphical version, comparing Robby's behavior for the medium-good and the best strategy.