Introduction to Complexity

Homework 5

Graded Part: This part you will submit on the course webpage, by doing the exercises, and then clicking on the "Homework 5" link in Unit 5.6, filling out the answers, and then clicking on the "Submit" button at the bottom of the page.

1. **Robby the Robot GA:** *Effect of population size.*

 Read these directions carefully before starting.

 Download RobbyGA.nlogo from the Course Materials page. Set `number-of-generations` to 100, `population-size` to 100, and `mutation-rate` to 0.050 . Click `setup` and `go-n-generations`.   Wait until the run of 100 generations has finished — this might take some time! (Remember to set the speed bar to the fastest setting.) After the run is finished, write down the best-fitness at generation 100.   (Read the best fitness from the bottom of the large output window on the right side of the interface, not from the plot.) Repeat two more times (each time, click `setup` and `go-n-generations`). Each time write down the best-fitness at generation 100.   Finally, take the average of the three values you obtained.

Now, set `population-size` to 30 and repeat the steps above to do three runs of the GA. Take the average of the three values you obtained (best-fitness at generation 100 for each run).

Select the true statement, given your results;

   A. `population-size` = 100 gives higher best-fitness, on average

   B. `population-size` = 30 gives higher best-fitness, on average

2. **Robby the Robot GA:** *Effect of mutation rate.*

For RobbyGA.nlogo, set **number-of-generations** to 100, **population-size** to 100, and **mutation-rate** to 0.15 . Do three runs of the GA for 100 generations, and calculate the average best fitness at generation 100.   Then repeat for **mutation-rate** = **0.**   Compare with the results you got for the first part of question 1.

Select the true statement, given your results;

   A. **mutation-rate** = 0.15 gives higher best-fitness, on average

   B. **mutation-rate** = 0.050 gives higher best-fitness, on average

   C. **mutation-rate** = 0 gives higher best-fitness, on average

Ungraded Part:

Beginner option:

1. For **population-size** = 100 and **mutation-rate** = 0.050, run RobbyGA.nlogo one generation at a time. That is, set **number-of-generations** = 1, do **setup** once, and then keep clicking on **go-n-generations** without doing "setup" between generations. This will result in stepping through a GA run, one generation at a time. After each generation on which the fitness changes significantly, watch the behavior of the best individual, by clicking **set up environment** and then **step thru best strategy**. Figure out what behavior is changing when the fitness increases.

2. Add sliders to the interface to change the values of the rewards and penalties. Hint: this will involve changing the following lines in the code:

        set wall-penalty 5

        set can-reward 10

        set pick-up-penalty 1

Experiment to see if and how changing these rewards changes the behavior of the best evolved strategies.

Intermediate option: In addition to Beginner options:

Add a slider for crossover-probabilty to RobbyGA.nlogo that enables the user to change the probability of crossover occurring each time two parents create an offspring.   (If crossover does not occur, then the children are clones of the parents, possibly with some mutations.)   Experiment with different settings for crossover probability. What happens if you set crossover to zero?

Advanced option:

In addition to the Beginner and Intermediate options:

Modify RobbyGA.nlogo to allow users to put "walls" in any square in Robby's world. Experiment to see how putting in walls in different places affects the fitness and behavior of the best individuals.