

Assignment 5

Genetic Algorithms

Write a report on the tasks given below.

Task 1 (15 points)

1. Experiment with Different Mutation Rates.

Study question: how the optimization process of the genetic algorithm is affected by the intensity of the introduced mutations?

Short instructions:

Download *RobbyGA.nlogo*. Set the speed slider to its fastest value, and turn off “view updates” (checkbox next to speed slider). This will allow the program to run at its fastest speed.

For each parameter setting below, run the GA five times: for each run, click Setup, then go-n-generations. For each run, record the final best fitness in the population (from the output window on the right side of the interface) in the table below. Each run may take a long time. You may want to do something else while you’re waiting for each run to finish! If you want, you can automate doing these runs via [NetLogo’s Behavior Space module](#).

Then fill in the rest of table below.

Table 1. Fitness Dependence on Mutation Rate

Number of Generations	Population Size	Mutation Rate	Best Fitness in Final Population	Average Best Fitness in Final Population
200	100	0.05	Run1: Run2: Run3: Run4: Run5:	
200	100	0.1	Run1: Run2: Run3: Run4: Run5:	
200	100	0.01	Run1: Run2: Run3: Run4: Run5:	

What effect do you see on the final best fitness with the different mutation rates?

2. Experiment with Different Population Sizes.

Study question: how the optimization process of the genetic algorithm is affected by the population size?

Short instruction:

Do a similar set of experiments testing the effect of increasing the population size.

Task 2 (25 points)

1. Experimenting with “hidden” parameters.

Study question: how the optimization process of the genetic algorithm is affected by the “hidden” parameters (the rewards and penalties for various actions, the number of “environments” each strategy is tested on to compute its fitness and the number of actions each strategy takes in each environment)?

Short instruction:

The program *RobbyGA.nlogo* has a number of parameters that are set “behind the scenes”. Some of these are the rewards and penalties for various actions (*wall-penalty*, *can-reward*, *pick-uppenalty*), the number of “environments” each strategy is tested on to compute its fitness (*num-environments-for-fitness*), and the number of actions each strategy takes in each environment (*num-actions-per-environment*). Modify the code so that these parameters can be set by the user (via sliders in the interface). Experiment with different settings of these parameters. (If you haven’t already, take a look at the “behavior space” module of Netlogo, that allows you to do experiments with many parameter settings: <http://ccl.northwestern.edu/netlogo/docs/behaviorspace.html>).

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

2. Allowing user to set crossover probability.

Study question: how the optimization process of the genetic algorithm is affected by the crossover probability?

Short instruction:

In the current version of *RobbyGA.nlogo*, each child is created via a crossover between the parents. However, in many GAs, the user can set a “crossover probability”, which gives the probability that two parents will create a child via crossover, or via cloning of one of the parents. Modify *RobbyGA.nlogo* to include a user-settable crossover probability. Then, using the Behavior Space module, test several crossover probabilities (with a set population size and mutation rate) to see the effect of crossover probability on the performance of the GA.

Task 3 (35 points)

1. Study question: how the optimization process of the genetic algorithm is affected by the selection method.

Short instruction.

Read *CommonSelectionMethods.pdf*. Note that *RobbyGA.nlogo* currently uses a “tournament selection” method for choosing parents to create offspring. Modify *RobbyGA.nlogo* so that the user can choose from a variety of selection methods (using a drop-down menu on the interface). The ones we suggest that you implement are:

Fitness-Proportionate Selection (with Roulette-Wheel sampling)

Elitism: At each generation, copy the best individual from the previous generation

Linear Rank selection

Also, for tournament selection, allow the user to set the number in the tournament.

Experiment with these various selection methods—does the particular selection method make a big difference in the GA’s performance for a given set of parameter settings?

2. Study question: experiment to see how putting in walls in different places affects the fitness and behavior of the best individuals.

Short instruction.

Modify *RobbyGA.nlogo* to allow users to put “walls” in any square in Robby’s world.