

Workshop 6: An introduction to genetic algorithms

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Recorded example

- At construction
 - 1
 - old: UrroiYcEGINxivFNjIstQKiYe
 - new: UrroiYcEGINxivFNjIstQKiYe
 - 2
 - old: fVxLLbIvpZbCsWAEkAJFkugrxa
 - new: fVxLLbIvpZbCsWAEkAJFkugrxa
- At mutation
 - 1
 - old: UrroiYcEGINxivFNjIstQKiYe
 - new: Urroi nEGINxivFNjIstQKiYe
 - 2
 - old: fVxLLbIvpZbCsWAEkAJFkugrxa
 - new: fVxLLbIvpobCsWAEkAJFkugrxa
- At crossover
 - 1
 - old: Urroi nEGINxivFNjIstQKiYe
 - new: Urroi nEGINxivFNjIstkugrxa
 - 2
 - old: fVxLLbIvpobCsWAEkAJFkugrxa
 - new: fVxLLbIvpobCsWAEkAJFQKiYe

Question 1

Describe how the mutation operator works in this program.

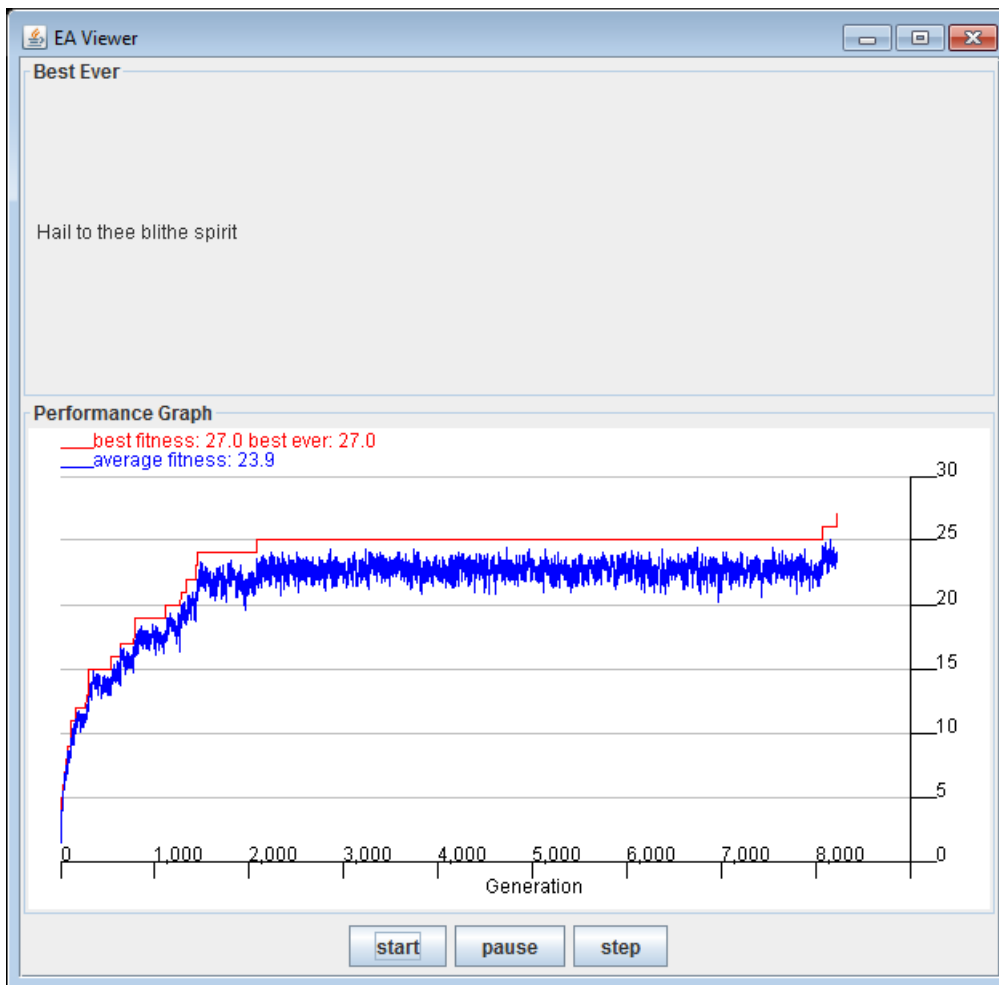
- When mutation occurs
 - A single gene is changed to a random letter
 - The original chromosome is kept in "old"
 - Mutation is stored as "new"

Question 2

Describe how the crossover operator works in this program. Is this one-point or two-point crossover?

- When crossover occurs `StringSearchEvolvable.crossover()`
 - Random int generated to divide string into two substrings
 - Will be referred to as "sub1" and "sub2"
 - 1's sub1 concatenated with 2's sub2
 - 2's sub1 concatenated with 1's sub2
- Is one-point crossover

Question 3



Question 4

What is the size of the search space here? ie. How many different random strings can be made using a sequence of 26 letters from the 49 allowed letters?

$$26^{49} = 2.1562249e+69$$

Question 5

Describe what happens with `MUTATION_FACTOR = 0.0`. Attempt to explain why.

- Infinite loop
- Without mutation, string 1 and 2 just crosses over the same substrings
- Never has the chance to "adapt"

Question 6

Describe what happens with `MUTATION_FACTOR = 30.0`. Attempt to explain why.

- Ran til ~300,000 generations
- Average fitness never goes above ~2.5
- Too much randomness introduced

"too high mutation rate increases the probability of searching more areas in search space, however, prevents population to converge to any optimum solution" (Kazimipour, 2013)

Kazimipour, B. (2013, January 3). *Why is the mutation rate in genetic algorithms very small?* [Online forum comment]. Retrieved September 9, 2015, from http://www.researchgate.net/post/Why_is_the_mutation_rate_in_genetic_algorithms_very_small

Question 7

Try different amounts of mutation and crossover until you find a combination that gives an average number of probes near to 40,000. What were the mutation factor and crossover probability that gave that result?

`MUTATION_FACTOR = 0.3`
`CROSSOVER_PROB = 0.8`

Mean number of probes = 37573.0

Can you say anything from this about what mutation probability and crossover probability should be used in a Genetic Algorithm?

- Should be kept low, so that it does not introduce too much randomness
- But should also have enough probability to mutate/crossover so that the result can adapt towards the desired goal