SELECTIONS

Contents

1.1. Elite Selection

Parameters
none

Elite selection method is used to assemble a group of parents basing on their fitness. First, the operator sorts the list of chromosomes by descending fitness values. Then, a given number of best chromosomes is taken to the parents' set and passed to the crossover.

For the selected number of parents, the same number of offsprings is produced by crossover and mutation operators. Since it is required for the output generation to have the same size as the input generation, the rest of free slots is filled with individuals from the input generation (so called reinsertion). So far elitist reinsertion is implemented, meaning that the free slots are filled with the original parents of the best fitness values. Such the reinserted elements are not affected by crossover and mutations operations.

1.2. Roulette Wheel Selection

Parameters
none

Roulette wheel selection operator assembles a group of parents by random selection of input individuals. It is assumed that the roulette wheel is divided into portions forming a kind of a pie-chart. Basing on fitness values, the better the chromosome, the greater chance of selecting it by the randomizer.

First, the sum of fitness values is calculated:

$$F = \sum_{i}^{\mathrm{n}} f_i$$

In the formula, i is an index of an individual, n is the size of input generation, f_i is a fitness value for the individual i. Size of each individual portion on the pie-chart (selection probability p_i) is directly proportional to its fitness value:

$$p_i = \frac{f_i}{F}$$

Then, a given number of random values is obtained. The operation may be compared with running the roulette wheel. By each of the random value, one chromosome is selected to the parents' set. Selection operation is finished when a given number of parents is collected. Selected parents are then passed to crossover.

For the selected number of parents, the same number of offsprings is produced by crossover and mutation operators. Since it is required for the output generation to have the same size as the input generation, the rest of free slots is filled with individuals from the input generation (so called reinsertion). So far elitist reinsertion is implemented, meaning that the free slots are filled with the original parents of the best fitness values. Such the reinserted elements are not affected by crossover and mutations operations.

1.3. Stochastic Universal Sampling Selection

Parameters
none

Stochastic universal sampling is a special variant of the roulette wheel selection (see: chapter 1.3). Considering the roulette wheel selection operator, even though an element selection probability is directly proportional to its fitness value in relation to the total fitness in the generation, even the best chromosomes have no guarantee of selection.

As opposite to the roulette wheel, stochastic universal sampling selection ensures that the final parents' set consists of individuals in proportion to selection probability p_i defined in chapter 1.3. Therefore, if a given element occupies 5,2% of the roulette wheel, 5 or 6 instances of the element in the parents' set may be expected, assuming that the desired size of the set is 100.

For the selected number of parents, the same number of offsprings is produced by crossover and mutation operators. Since it is required for the output generation to have the same size as the input generation, the rest of free slots is filled with individuals from the input generation (so called reinsertion). So far elitist reinsertion is implemented, meaning that the free slots are filled with the original parents of the best fitness values. Such the reinserted elements are not affected by crossover and mutations operations.

1.4. Tournament Selection

Parameters	
tournamentSize	*Number of random individuals taken to each tournament.*
allowRepetetitions	*Whether a given individual can win several tournaments.*

Tournament selection operator bases on sequence of subselections. Each subselection obtains one element that is passed to the parents' set. Number of subselections is equal to the desired size of the set.

Each subselection will be called tournament here. For each tournament a given number of individuals from the input generation is randomly taken (*tournamentSize*). Considering fitness values, the best of the chromosomes competing in the tournament is passed to the parents' set. After one tournament, another one is processed, starting from random selection of next elements to compete, and so on. If *allowRepetitions* is set as *false*, the same element cannot appear more than once in the parents' set.

For the selected number of parents, the same number of offsprings is produced by crossover and mutation operators. Since it is required for the output generation to have the same size as the input generation, the rest of free slots is filled with individuals from the input generation (so called reinsertion). So far elitist reinsertion is implemented, meaning that the free slots are filled with the original parents of the best fitness values. Such the reinserted elements are not affected by crossover and mutations operations.