Lecture 6 - Selection methods

> 💡 Selective pressure - the ratio of probability of reproducing the best individual over the probability of reproducing the average individual. The higher the selective pressure, the lower the diversity of resulting population.

- Scaling fitness values can adjust selective pressure.
- Too high selective pressure can lead to premature convergence.
- Too low selective pressure can lead to inefficiency and make it similar to random search.

The most popular selection methods

- Roulette wheel - the probability of selecting a given individual is proportional to its fitness. To more individuals just repeat the process.
- Stochastic remainder selection without replacement - each individual gets as many copies in the new population as in the integer part of $e_i = POPSIZE \cdot f_i / \sum F_j$. The remaining places are filled randomly with the probability for each individual being the fractional part of e_i.
- Selection according to random tournament - k individuals are randomly drawn and then the best solution if selected to the new population. Then this procedure is repeated until we get all the solutions we need. The size of the tournament k is proportional to the selective pressure.
- Deterministic - each individual gets as many copies as the integer part of e_i and the remaining places are filled in order of decreasing fractional parts.
- Stochastic remainder selection with replacement - each individual gets as many copies in the new population as in the integer part of e_i. The remaining places are filled with the roulette wheel proportionally to the fractional part of e_i.

- Ordinal selection - the selection is based on the probability proportional not to the fitness value, but to the rank of the individual, i.e. its relative fitness rank based on the other solutions.

Additional properties of selection

- Elitism - if during the selection process the best individual is somehow not selected to the new population elitism makes sure to include it anyways.
- Crowding factor model - new individual replace not the worst individuals in the whole population, but the most similar individuals to them.

Meta-schemes of selection

- Island model - a population is split into subpopulations, in each group the selection method and evolution operates independently with periodic migrations of some individuals.
- Convection selection - unlike in the traditional island model, the division into the subpopulations follows the similarity of the objective function of solutions.