



3장. Selection

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3. Selection

❖ selection

- Selection is the choice of those individuals that will participate in creating offspring for the next population, that is, for the next generation.
- Such a choice is made by the principle of natural selection, according to which the most adapted individuals have the highest chances of participating in the creation of new individuals.
- As a result, an intermediate population (or parent pool) appears. An intermediate population is a set of individuals that have acquired the right to breed.
- Adapted individuals can be recorded there several times. The abandoned individuals will most likely not get there at all.



3. Selection

❖ selection

- NOTE: It is important to understand that the same individual can be selected several times by the selection method, which means it can repeatedly participate in the process of creating new individuals.



3. Selection

❖ selection methods

- Tournament selection
- Proportional selection
- Stochastic universal sampling selection
- Rank selection
- Elite selection



3. Selection

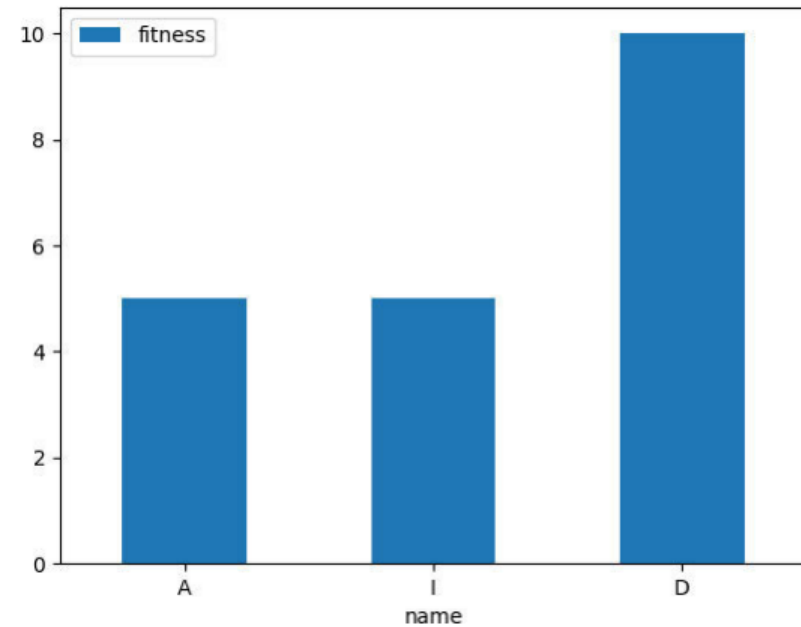
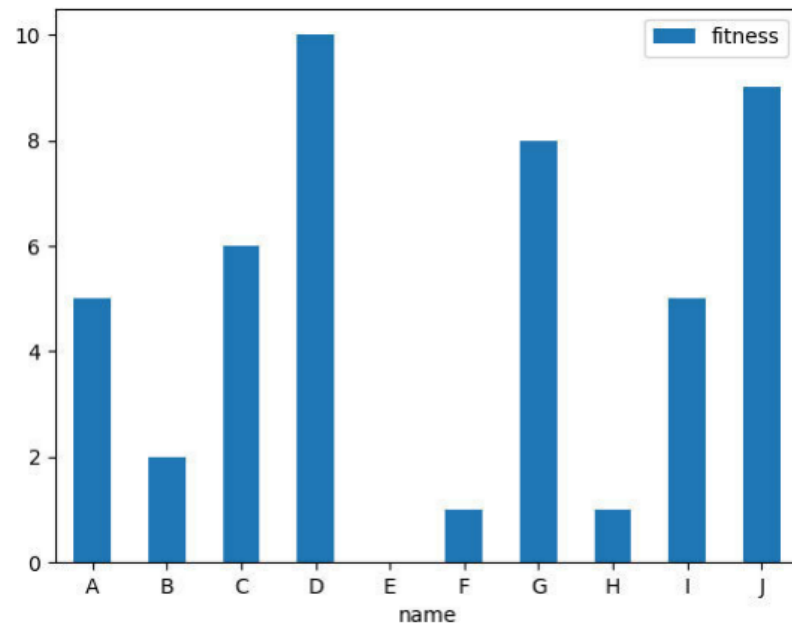
❖ Tournament selection

- Tournament selection is one of the simplest selection methods, and we will start with it.
- In tournament selection, a subgroup is selected in a population, and then the best individual in this subgroup is selected.
- Typically, the size of a subgroup is 2 or 3 individuals.
- NOTE: It is worth mentioning that if the group size is two, then the worst individual will never be selected; if the group size is three, then the two worst individuals will never be selected, and so on



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❖ Tournament selection



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❖ Tournament selection

- As expected, two worst individuals, A and C were not selected.
- But we have one more interesting result – the individual D, which has the second fitness score, was also not selected.
- You always have to keep in mind that the tournament selection is a random process, and there is no 100% guarantee that the best individual will be selected



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❖ Proportional selection

- This method can be illustrated with a roulette wheel.
- Each individual is assigned a sector of the roulette wheel, the value of which is set proportional to the value of the fitness function of a given individual; therefore, the greater the value of the fitness function, the larger the sector on the roulette wheel.
- From this, it follows that the larger the sector on the roulette wheel, the higher the chance that this particular individual will be chosen



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❖ Stochastic universal sampling selection

- Stochastic universal sampling selection method is an alternative method of proportional selection.
- In this method, the entire roulette wheel is divided into N cutoffs with equal spacing.
- This method smooths out the elements of randomness which proportional selection has, and ensures that the individuals are selected according to the following principle – many good individuals, some average individuals, and a few bad individuals.



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❖ Stochastic universal sampling selection

- As with the proportional selection method, the stochastic universal sampling selection has the possibility to select the worst individual, and also has the possibility to not select the best individual.
- Even if it seems contradictory, this approach shows very good results for a particular class of problems.



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❖ Rank selection

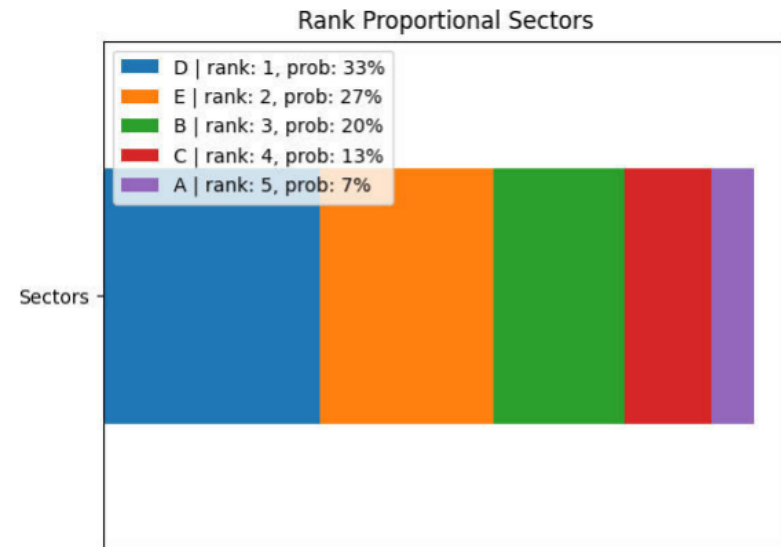
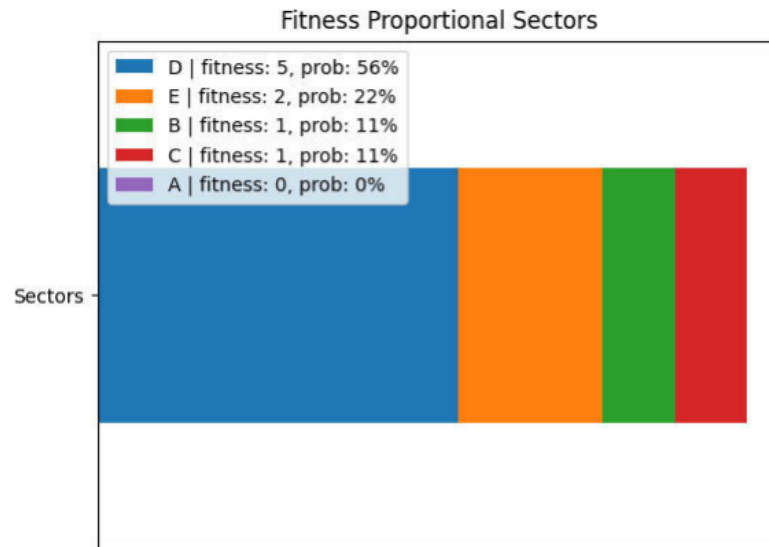
- Rank selection has the same principle as proportional selection, but individuals of the population are ranked according to the values of their fitness function.
- This can be thought of as a sorted list of individuals, ordered from the fittest to the least fit, in which each individual is assigned a number that determines its place in the list, called rank.
- Rank selection smoothens out the large difference between individuals with high fitness values and individuals with low fitness values.



3. Selection

❖ Rank selection

- the best individual in rank selection has a lower chance of being selected than it has in the proportional selection, and on the contrary, the worst individual, which had no chance of being selected in proportional selection has some positive probability of being selected.



3. Selection

❖ Rank selection

- How rank selection is calculated?
 - ✓ $\text{rank_shift} := 1 / \text{population_size} = 1 / 5 = 0.2$
 - ✓ $\text{rank_weight_sum} := (\text{population_size} + 1) / 2 = 3$
 - ✓ $\text{Nth_individual_weight} := (1 - (\text{rank} - 1) \times \text{rank_shift}) / \text{rank_weight_sum} * 100\%$
 - ✓ For D we have $(1 - (0 \times 0.2)) / 3 * 100\% = 33\%$
 - ✓ For E we have $(1 - (1 \times 0.2)) / 3 * 100\% = 27\%$
 - ✓ For B we have $(1 - (2 \times 0.2)) / 3 * 100\% = 20\%$
 - ✓ And so on..



3. Selection

❖ Elite selection

- As we have already seen, none of the selection methods that we have considered – tournament, proportional, stochastic universal sampling, and rank selection – guarantee the selection of the best individual.
- The genes of the best individual can be very valuable for the next generations, so there is an approach that protects the best individuals.
- This method is called elite. Elite selection can be based on another method, such as rank selection, but the main change in this method is the guaranteed inclusion of the best individuals in the selected population.

