Autonomous Intelligent Systems,
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Exercises for Artificial Life (MA-INF 4201), SS24

Exercises sheet 9, till: Mon 16. June, 2025

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Assignment 57 (2 Points)

Derive a formula that calculates the probability ω_i for an individual i to be chosen as parent. The rank of the individual i shall be $r(i)$, the size of the population is P.
The selection shall be probabilistic, fitness dependent, rank depending using the *Wheel-of-Fortune* method.

Assignment 58 (2 Points)

Within an Evolutionary Algorithm the probabilistic, rank based parent selection selects $\rho = 4$ parents from the population of $P = 32$ individuals.
The method shall be *Tournament selection* (as described in the lecture) starting with 16 different individuals, chosen randomly from the population.
Calculate the probability ω_T that the best individual from the population ($P = 32$) is among the $\rho = 4$ selected parents.

Assignment 59 (2 Points)

Within an Evolutionary Algorithm the probabilistic, rank based parent selection selects $\rho = 4$ parents from the population of $P = 32$ individuals.
The method shall be *Wheel-of-Fortune* (as described in the lecture).
Calculate the probability ω_F that the best individual from the population ($P = 32$) is among the $\rho = 4$ selected parents.

Assignment 60 (2 Points)

Explain in a few words some necessary/desirable properties of fitness functions in the context of Evolutionary Algorithms. As a hint: explain why a binary fitness function yielding only 0 or 1 is inappropriate for Evolutionary Algorithms.

Assignment 61 (2 Points)

Someone told me, that the process of generating pseudo random numbers is rather time consuming. Since random numbers are necessary in a lot of EA steps, this would be a severe drawback.
Can you help me to check if this is true or not?
Please cite scientific literature if possible.

Assignment 62 (1 Point)

The distribution of the fitness value $f(g)$ for a population of P individuals within an evolutionary algorithm happens to be (almost) a normal distribution around a rather bad fitness value $\overline{f}$, with a standard deviation σ. The best fitness value within the population shall be f^*, with $f^* \geq \overline{f} + 4\sigma$.

The stochastic, **fitness proportional** selection process is selecting μ individuals to be the pool of parents. Explain the resulting distribution of fitness values within the pool of parents. Depict the distribution; a sketch is sufficient.

Assignment 63 (2 Points)

Make two proposals how to avoid *Super-Individuals* in an Evolutionary Algorithm and describe them.

Assignment 2^6 (2 Points)

Propose an inheritance operator (recombination, $k = 2$ parents) and a mutation operator for tree-based genetic/evolutionary programming genomes. Explain the functionality of the proposed operators using a little example. Support your explanation with a sketch or a diagram.