Autonomous Intelligent Systems,
Institute for Computer Science VI, University of Bonn

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Exercises for Artificial Life (MA-INF 4201), SS15

Exercises sheet 8, till: Mon 15.6.2015

8.6.2015

Group	Name	50	51	52x	53	54	55	$\sum$

Assignment 50 (2 Points)

Name, and describe at least three aspects, why evolutionary algorithms are so popular.

Assignment 51 (3 Points)

Draw a typical development of the best fitness within the population (performance graph) during an evolutionary algorithm working with a deterministic rank based, elitism, $(\mu + \lambda)$ strategy with no mutation for the parents.

Assignment 52x (2 Points)

Explain the term *Hamming-Cliffs* with respect to Evolutionary Algorithms.
Discuss the negative and positive aspects of this phenomenon in the context of EAs.

You are explicilty encouraged to seek the literature about Evolutionary Algorithms to complete the task, provided you give a correct reference (citation).

Assignment 53 (2 Points)

Depict the fitness sorted distribution of fitness values within a population of an Evolutionary Algorithm before and after applying the 3 EA steps (4 diagrams):
1. External selection $(\mu + \lambda)$ with rank based elitism, 2. Inheritance step, 3. Mutation step.

Assignment 54 (2 Points)

Describe two operators for an evolutionary algorithm: one that is implementing a pure *exploration* strategy, and a second one implementing a pure *exploitation* strategy.

Assignment 55 (4 Points)

Describe the overall idea and the stucture of evolutionary algorithms, and discuss advantages and problems of EAs using the example of producing soft-drinks. Describe all essential steps that you propose for the EA with respect to the given task, and propose a setting of the relevant EA parameters whenever appropriate.

The soft-drink shall consist of water, sugar, carbon dioxyde and a mixture of additives. The task for the EA is to determine a mixture of additives to gain a *good* soft-drink. The mixture of additives can consist of up to $A = 20$ ingredients, out of possible $M = 50$ ingredients; None of the ingredients shall exceed 10% of the mixture.

Assume further, that you have access to a large pool of students, that are willing to test, and judge the quality of your creation.

Programming Assignment PA-E (10 Points, due date 22.6.15)

Write a C, C++, Java or Python Programm, that implements an evolutionary algorithm to maximize the length of a route going twice through a given set of N points (cities) in 2-dimensions. Starting, and ending point are open to be determined by the algorithm; each point must be visited **exactly twice**.

It is completely your choice, which variant of evolutionary algorithm to take. The parameters P, μ and λ, are to be set by the user at runtime, the N points $\mathbf{X}_n = (x_1, x_2)_n$ shall be read in from the text-file `Positions_PA-E.txt`. Allow a maximum of up to $N = 150$ points.

The program has to output the fitness of the best individual, the mean fitness and the least fitness of the parents in every generation in a Gnuplot readable format. Depict and draw the development of these three values into a graph (Gnuplot preferred). Hand it in together with the other solutions.
When your algorithm has finished (implement a reasonable criterion for that), print the resulting length of the path found and the resulting sequence of coordinates (one position with two coordinates per line).