

Simulation - Assignment 3

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Implementation

All tasks have been solely implemented in *Matlab*. Files *main_ga.m* and *tsp_ga.m* contain the implementations.

The implemented parts of the *Genetic Algorithm* (GA) were cross-checked individually for satisfactory behaviour. The GA was validated through the following two tests:

1. Fitness value decreasing with increasing number of generations.
2. Fitness value decreasing with increasing population size.

The test were performed on the tour with 48 cities and the simulation parameters given in the assignment instructions. The results are presented in Table 1 and 2.

Table 1: Fitness value vs. increasing number of generations. The population size was set to 100.

Number of generations	Fitness value
100	100000
1000	60000
2000	50000

Table 2: Fitness value vs. increasing population size. The number of generations was set to 1000.

Population size	Fitness value
10	140000
50	65000
200	50000

It was noted that the implemented GA did not perform as well as the algorithm used in lab 3. For a population size of 100 and 1000 generations it reached a fitness value of 34000 (cf. 60000 for this GA). This is troubling. However, it can be due to many reasons. For instance:

- The simulation parameters in this GA might not be as optimised as in the other GA.
- The GA implementation itself might not be as optimal as in the other GA.

Task 1

The results of the simulations are presented in Figure 1.

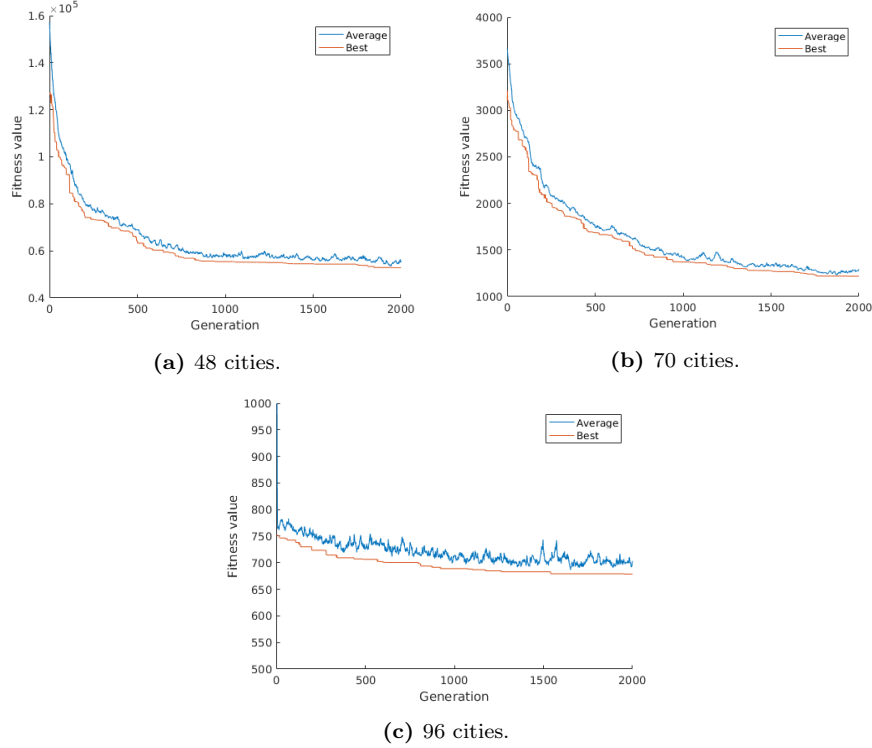


Figure 1: The implemented GA was run for three different TSPs. The population average and the best fitness value has been plotted vs. the population generation.

Using these plots, explain the convergence behavior of GA for the three data files (i.e. do they converge? How quickly they converge?).

The fitness, of the population average such as the best in the generation, decreases as the generations pass. This indicates an improvement of the population in general and the best individual in the population. The slope of the curves decreases the further along the generations one goes. Thus, it can be interpreted that the population converges to a certain mix of solutions.

The average fitness follows the trend of the best fitness strictly, but with an added positive shift. Of course the average should be larger than the minimum of the population. Interestingly, the curve patterns are, if fluctuations are neglected, almost identical. This is probably due to the *roulette wheel* selection which always works to favour the best fitted individuals.

If one compares the three simulations it can be observed that the convergence is the fastest for the 96 city TSP. The convergence is very similar between the 48 and 70 city TSP, but the 48 city TSP might converge the fastest. It seems

logical that the more cities in the TSP the longer you can be from the optimal solution. Hence, a more rapid convergence should be pronounced. However, this is not observed comparing the 48 and 70 city TSPs. Strange ...

Task 2