

Stochastic Optimization Algorithms Report

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Home problems, set 2

Problem 2.1, The traveling salesman problem (TSP) (mandatory)

a)

We want to calculate the number of distinct paths in the general case of N cities.

If we choose a starting city, then there will be $N-1$ different cities to go. At the second city, there will be $N-2$ different cities to go. In this way, it continues. So, the total number of paths in the case of N cities = $(N-1)!$. Now, the direction in which we take around the tour does not matter. Therefore, the number of distinct paths in the case of N cities = total number of paths in the case of N cities / 2 = $\frac{(N-1)!}{2}$.

b)

Matlab files.

c)

Matlab files.

d)

Matlab files. The nearest neighbour path length is 147.7235 units. The length of the best path from the GA, after 2000 iterations, is 181.3336 units. Therefore, the nearest neighbour path length is shorter than that of GA.

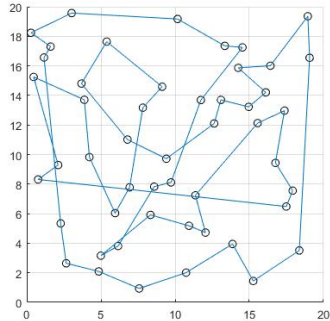
e)

The shortest path found with each of the two algorithms (GA and ACO) is shown in figure 1.

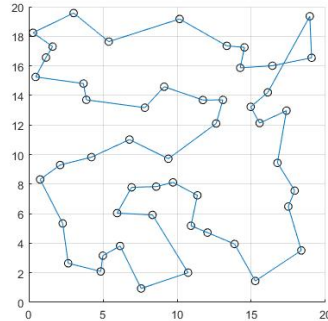
The GA is run for 3000 iterations shown in figure 1(a). The minimal length is 190.1886 units.

The ACO is run shown in figure 1(b). The minimal length is 122.41475 units.

The length of the nearest-neighbour path from part d) is 147.7235 units.



(a)



(b)

Figure 1: Figure (a) shows the path for GA while figure (b) shows the path for ACO.

Problem 2.2, Particle swarm optimization (mandatory)

The problem is to determine the number of minima of the function

$$f(x, y) = (x^2 + y - 11)^2 + (x + y^2 - 7)^2.$$

The contour plot, with four minima clearly identified in the range $(x, y) \in [-5, 5]$ is shown in figure 2. In figure 2, the four minima identified at upper left, upper right, lower left and lower right are $(-2.805118, 3.131313)$, $(3.000000, 2.000000)$, $(-3.779310, -3.283186)$ and $(3.584428, -1.848127)$ respectively.

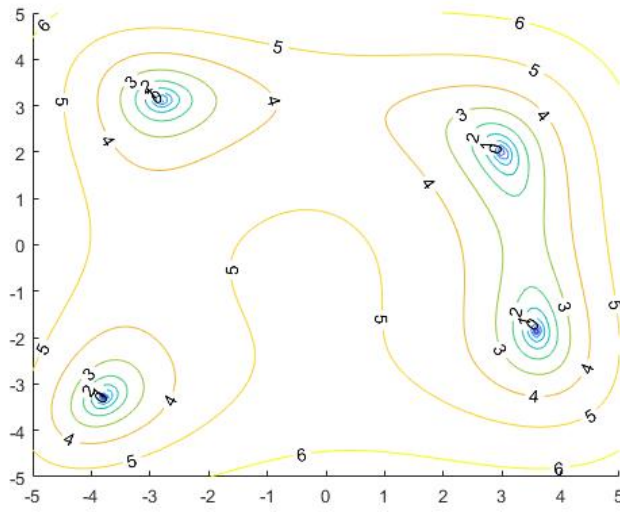


Figure 2: The figure shows the contour plot with four minima.

Table 1 represents the four minima of the function $f(x, y)$ using particle swarm optimization algorithm.

Table 1: The table presents the minima of the function $f(x, y)$ using particle swarm optimization algorithm.

x	y	f
-2.805118	3.131313	0
3.000000	2.000000	0
-3.779310	-3.283186	0
3.584428	-1.848127	0