Homeproblem 2

Anders Segerlund
851017-4934

October 13, 2021

Problem 2.1

Background

In the travelling salesman problem (TSP) the aim is to minimize the cost (shortest possible path in this very example) between cities (nodes) subject to visiting all given cities; is in this exercise done by utilizing an Ant Colony Optimization algorithm.

Defining algorithm parameters

The Ant System (AS) is using algorithm 4.1 in the course book [Wah08] with free parameters α, β, ρ and number of ants N. By making several trials the algorithm seem to give good performance with the parameters set to $\alpha = 1, \beta = 3, \rho = 0.5$. This corresponds with the theory about optimal parameter values given in the course book. Increasing the number of ants does not seem to affect the algorithm very much and is thus set to $N = 50$.

Generating the best path

The algorithm will run over several iterations until the total path length drops below the target path length of 103. This will result in a shortest path route which can be seen in Figure 1 which has a total length of **101.95226** The path is found in the matlab file `BestResultFound`

Problem 2.2

The function $f(x,y) = (x^2 + y - 11)^2 + (x + y^2 - 7)^2$ is minimized by using a Particle Swarm Optimization algorithm (PSO). By examining the contour plot of the function we can easily conclude that there are four minimas of the the function, see Figure 2

As we know that there are four minimas, the algorithm will continue to search until four minimas are obtained. The algorithm will search for x and y values with an accuracy to 14 digits. This is intetentionally set in order to get as accurate minimum value as possible. The result from the algorithm can be seen in Table 1 and the corresponding plot of the function can be seen in Figure 3

x	y	functionValue
−3.77931025337775	−3.28318599128617	6.21622393314157e−28
−2.80511808695275	3.13131251825057	1.28505441460503e−27
3	2	0
3.58442834033049	−1.8481265269644	2.8083448225868e−28

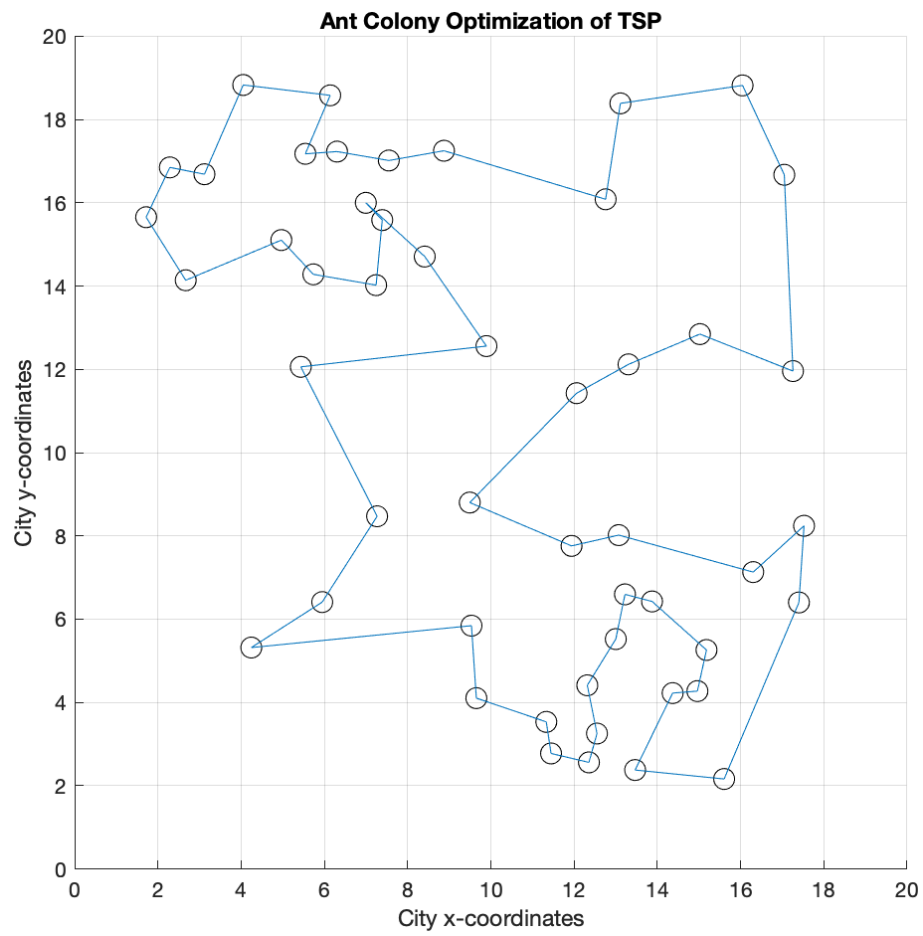Table 1: Minimas obtained from the PSO algoritm and corresponding function value

Figure 1: Shortest path of TSP using ACO

References

[Wah08]   M. Wahde. *Biologically Inspired Optimization Methods, An introduction.* WIT Press, 2008. ISBN: 9781845641481.
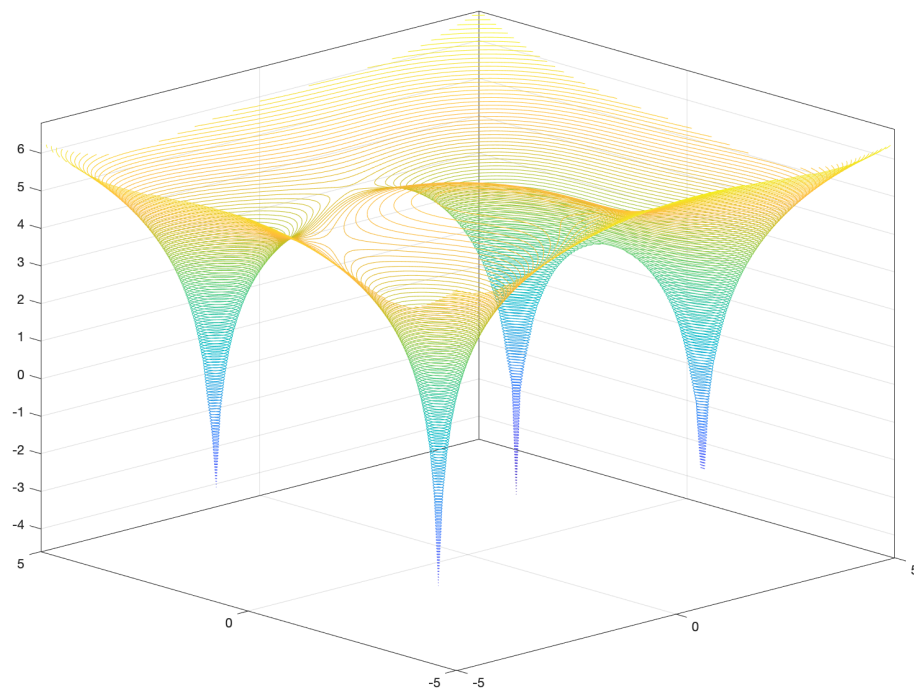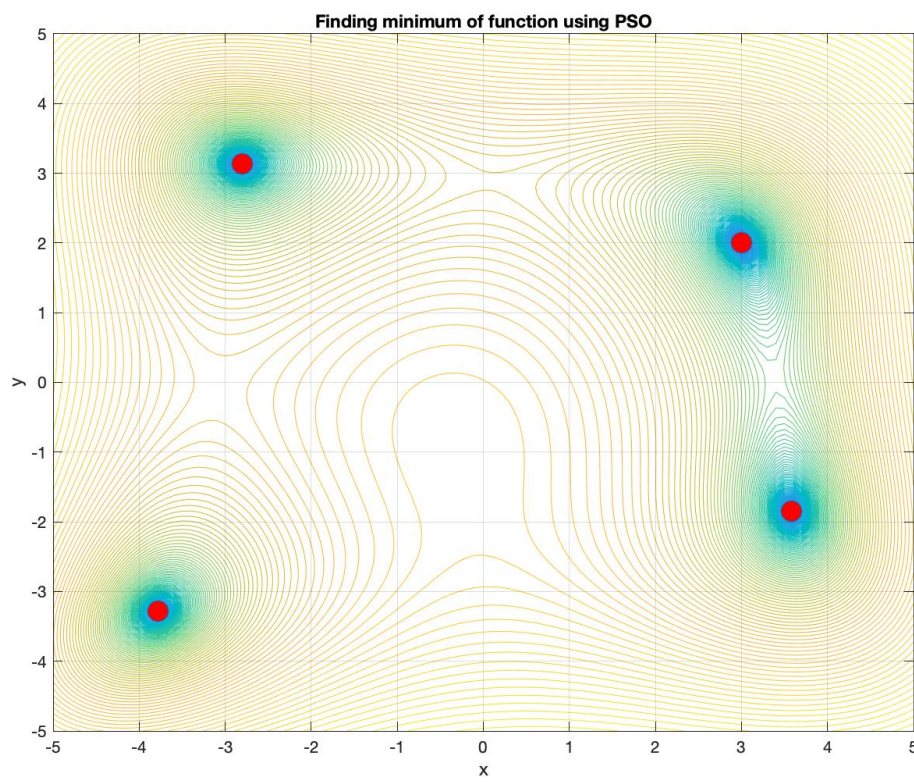
Figure 2: Four minimas visible

Figure 3: Contour plot with minimas marked in red