Home problem 2

FFR105 Stochastic optimization algorithms

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Solution proposal

Problem 2.1 - Traveling salesman problem

The result from using the ant swarm algorithm on the traveling salesman problem are shown in figure 1. The corresponding path is saved in the file "BestResultFound.m". Shortest path was 99.8 distance units.

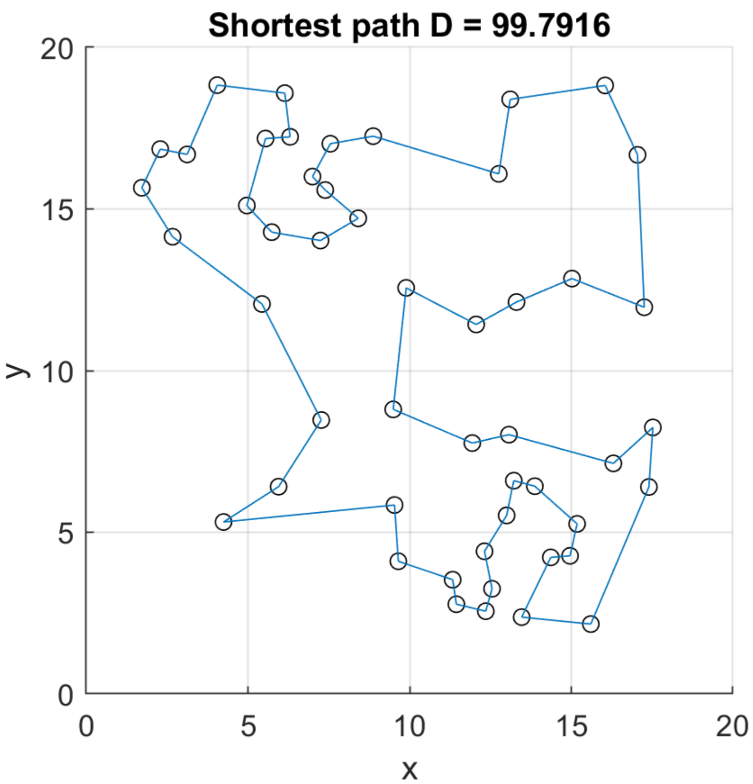

Figure 1: *The figure shows the solution to TSP with an ant system. The path length is* $D = 99.7916$ *distance units. Parameters used: 50 ants,* $\alpha = 1$, $\beta = 3$, $\rho = 0.3$ *and* $\tau = 0.1$.

Problem 2.2 - Particle swarm optimization

The particle swarm optimization was done for the function

$$f(x,y) = (x^2 + y - 11)^2 + (x + y^2 - 7)^2 \tag{1}$$

in the interval $x \in [-5,5]$ and $y \in [-5,5]$. The function minimas is shown in figure 2. However it's displayed as $\ln(a + f(x,y))$ to enhance the visibility of the height curves. Tabular 1 shows the four minimas x and y coordinates as well as the corresponding function value. Settings in code.

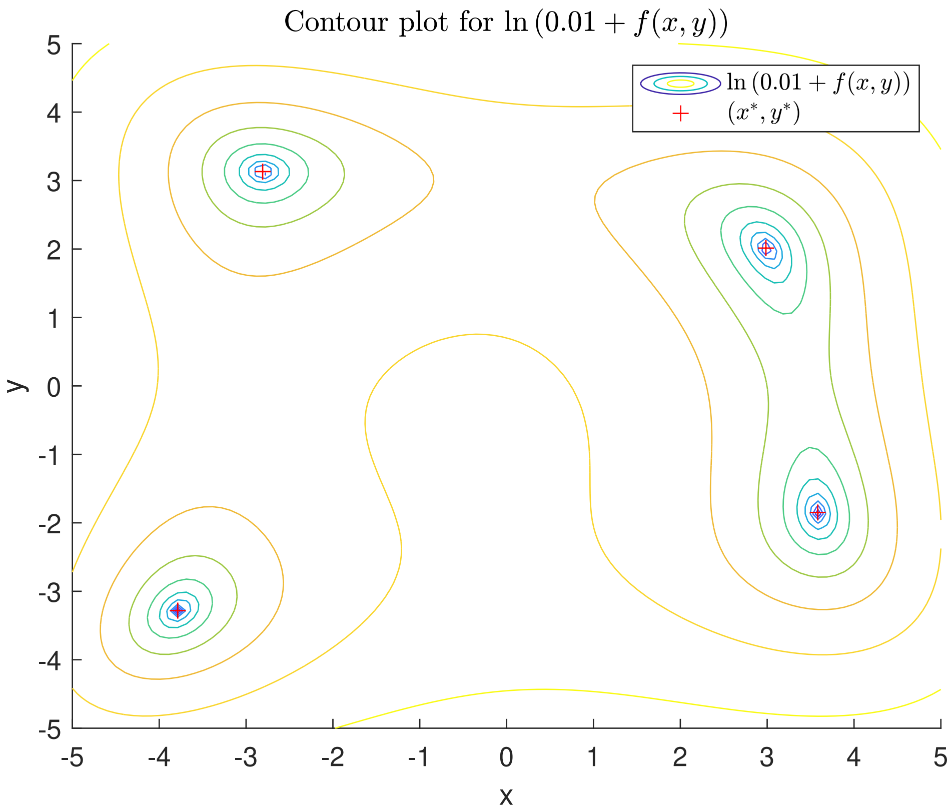

Figure 2: *The figure shows an elevation plot for the function where the red plus signs are the minimas of the function. As can be seen they are relatively good placed.*

Table 1: The tabular shows one solution for each minimum. There are better ones but these was picked with uniquetol to automate it and they still achieve a relatively small function value.

x*	y*	f(x*, y^*)
-3.7820	-3.2863	0.0006
-2.8070	3.1280	0.0006
2.9896	2.0047	0.0034
3.5827	-1.8490	0.0002

Problem 2.3 - Truck model (unfinished)

The code for this problem is included but there are a couple of errors/unfinished things. For example I have yet implemented get slope but instead test on a slope constant to 5 degrees and the InitializePopulation doesen't give weights between -5 and 5. The truck is not improving. Only little: for 2000 generations it goes from fitness 2200 to 2400 with a distance of 80 meters. I also use a struct which may be illegal by the lab PM.

Problem 2.4 - Function fitting using linear genetic programing

In this problem a function was fitted to a set of data. The error is given as

$$e = \sqrt{\frac{1}{K}\sum_{k=1}^{K}(\hat{y}_k - y_k)^2} \tag{2}$$

and the fitness is $1/e$. The fitness obtained was $3.5113 \cdot 10^8$. The estimated y-data is printed against the real y-data in figure 3. As can be seen they are almost perfectly overlapping since they are so similar. Therefore an attempt to visibly separate them has been made by changing color and different line drawings. The chromosomes can be translated into a more traditional form (as in equation 8 in lab particulate matter). This gives $g(x)$ as follows

$$g(x) = \frac{1 - x^2 + x^3}{1 - x^2 + x^4}. \tag{3}$$

To achieve this three constants (-1 3 1) and seven variables was used. The approximated y-data findings are shown in figure 3.

There are things one can do to avoid premature conversion even beyond the standard measures with tournament select with $p < 1$, varying crossover points and having mutations. This could be using a varying mutation rate, adding a penalty if the chromosome length is ”too long” or add more operators than the operator set ($+$, -, $\cdot$, $/$) given.

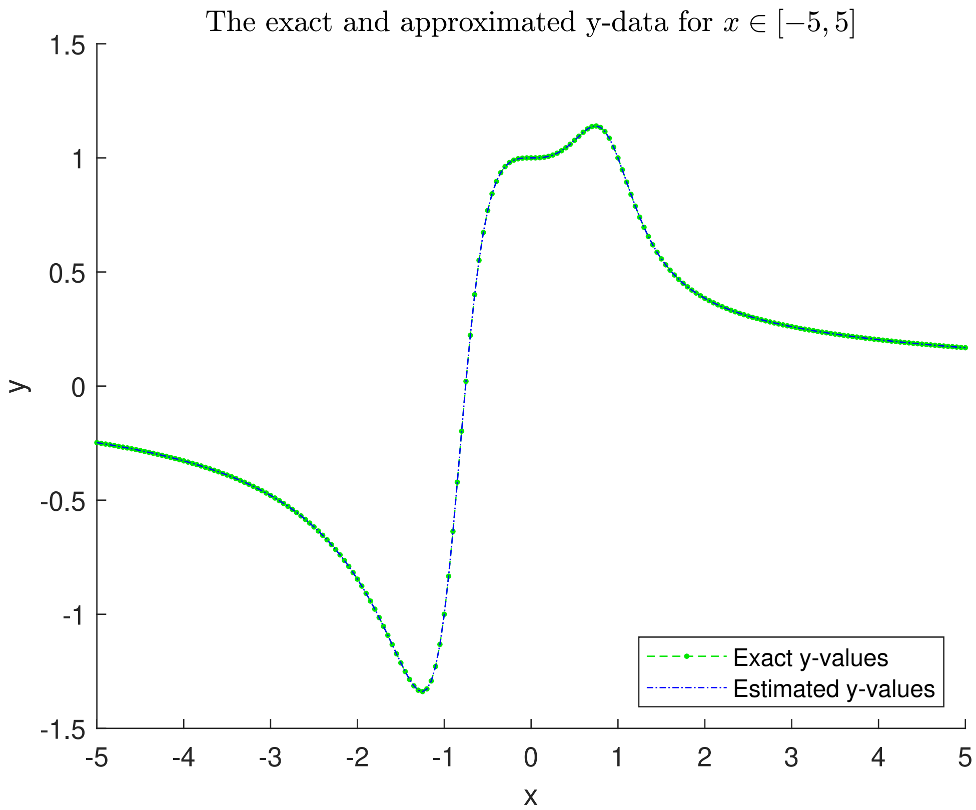

Figure 3: *The figure shows a plot for the x-y data from an unknown function and a plot of the estimated y-data for the real x. The two are very similar giving the error from equation* (2) *to* $2.8480 \cdot 10^{-9}$ *and fitness as one over the error as* $3.5113 \cdot 10^8$.