# Home Problem 2

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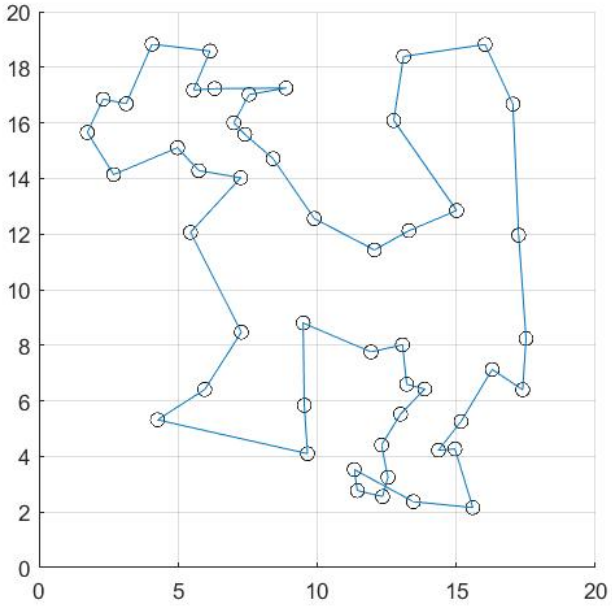
## 1 Problem2.1 The traveling salesman problem

The Total distance traveled in figure 1 is 98.7965 and the parameters used to get the result is in Table 1

Tabell 1

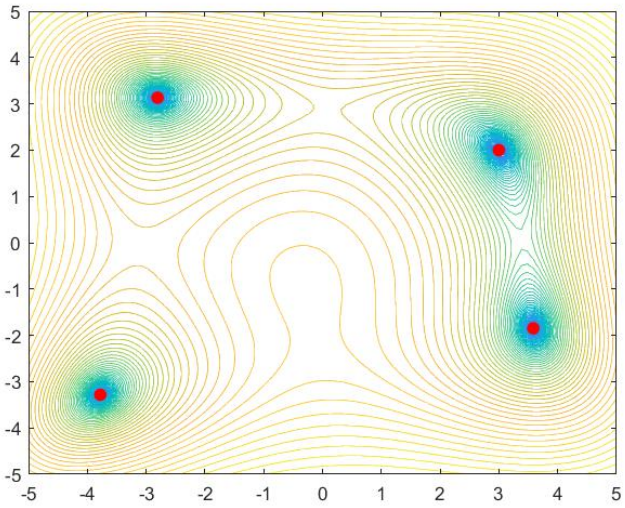
| | |
|---|---|
| numberOfAnts | 100 |
| $\alpha$ | 1.0 |
| $\beta$ | 3.0 |
| $\rho$ | 0.4 |
| $\tau_0$ | 0.1 |




Figur 1: Antwalk after a few iterations

## 2 Problem2.2 Particle swarm optimization

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



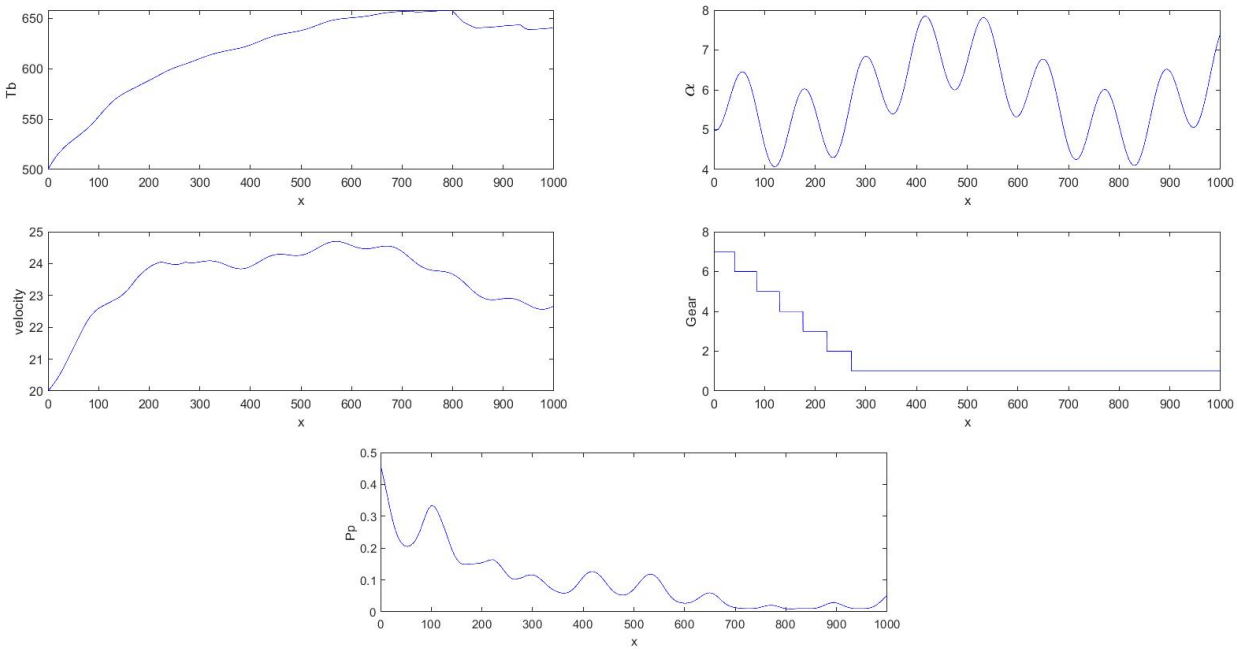

Figur 2: Contour of ln(0.01+f(x,y)),with minima points of f(x,y) marked as red dots

Tabell 2: Position and function value gotten from PSO algorithm

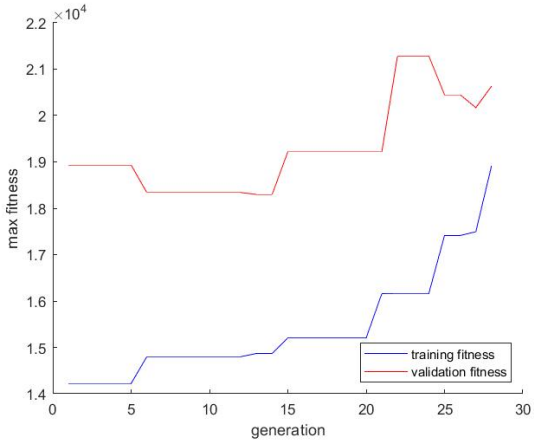
| x | y | f(x,y) |
|---|---|---|
| 3.0000 | 2.0000 | 0 |
| -2.8051 | 3.1313 | 0 |
| -3.7793 | -3.2832 | 0 |
| 3.5844 | -1.8481 | 0 |

# 3 Problem2.3 Optimization of braking systems

The program was created by making a GA-algorithm where each chromosome gets evaluated by turning it into the weights of a fast-forward network. The network had three inputs and two outputs which correlates to different truck parameters and the slope's angle. The truck was simulated going down the slope by running the network and updating truck parameters for many small time-steps $\delta t$. I chose the fitness for each slope as $\bar{v}x$, since it seemed to work better or as good as other fitness choices tested. The fitness was gotten from the average of all slopes in the chosen data set, and training was stopped when both validation Fitness and Training Fitness was 72% of maximal Fitness $(18 \cdot 10^4)$.




Figur 3: How different parameters change as the best trained model travels along a test slope.



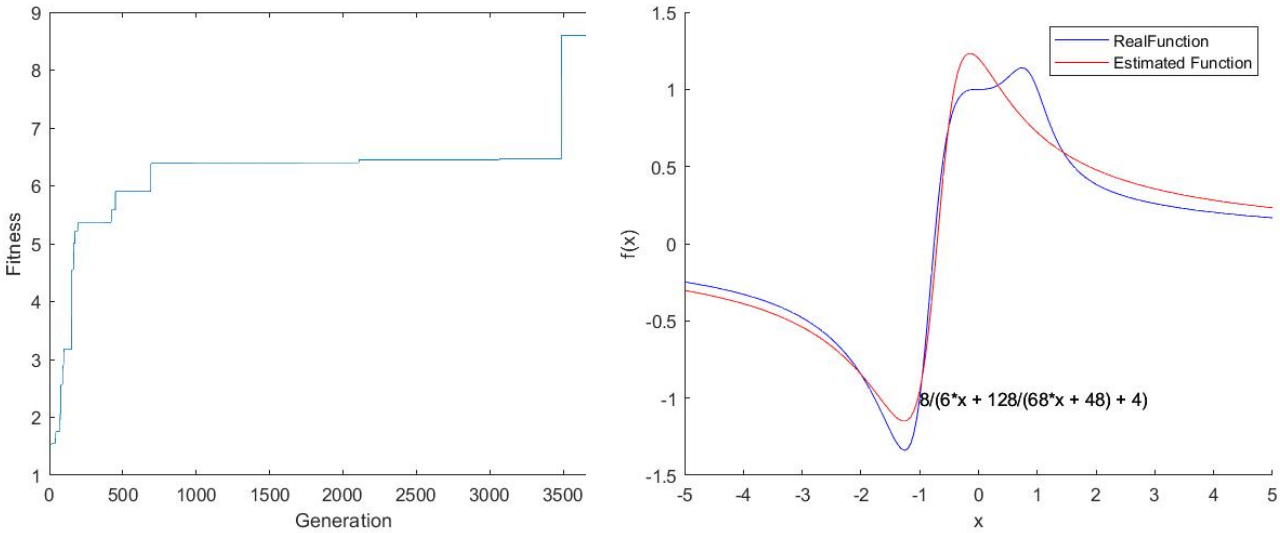

Figur 4: How model's maximum fitness changed with each generation

# 4 Problem2.4 Function fitting using LGP

The LGP algorithm implemented includes regular GA structure (but with 2-way crossover points) and uses 3 variable registers, and 3 constants =[1,2,4], and 4 operators = [+,-,*,/]. A single fitness multiplier was used: If a chromosome were larger than 150 genes the fitness was halved. To avoid premature convergence different

things were tested, such as increasing the mutation probability while stuck, change mutation probability depending on diversity, replacing chromosomes that were identical, however it did not seem to have changed anything and were thus removed from the code. The best chromosome's fitness per generation can be seen in Figure 5a, and it's estimated function can be seen in Figure 5b, as well as the equation below. The estimated error is 0.1163.

$$\widehat{f(x)} = \frac{8}{6x + \frac{128}{68x+48} + 4} = \frac{68x + 48}{3 \cdot 17x^2 + 70x + 40}$$




(a) max fitness per generation

(b) estimated function

Figur 5: estimate function alongside the real function