REPORT ASSIGNMENT 1: GENETIC ALGORITHMS

1.1 Research plan

The main goal of this research is to find the best parameters of the Genetic Algorithm for the given PCB problem. We will try to find the optimum *populationSize*, *crossoverRate, mutationRate, selectionMode* (Roulette or tournament) and *maxNumberGenerations* (iterationsCount).

1.2 Datasets

The given datasets to study our Genetic Algorithm and his parameters are *zad0.txt*, *zad1.txt, zad2.txt* and *zad3.txt.*

1.3 Research environment

The enviroment to study this practice has been a MacBook Air 13” with a processor Intel Core i5 (1,8 GHz).

1.4 Measures

The measure used to optimize the solution is a fitnessFunction. The result of the fitnessFunction is calculated like this:

*fitnessValue = 10 * numberOfIntersections + 3 * totalPathLength + 3 * totalSegmentCount;*

1.5 Experiments

Experiment 1

Goal: Study the optimum value for the parameter *populationSize*.

Assumptions:

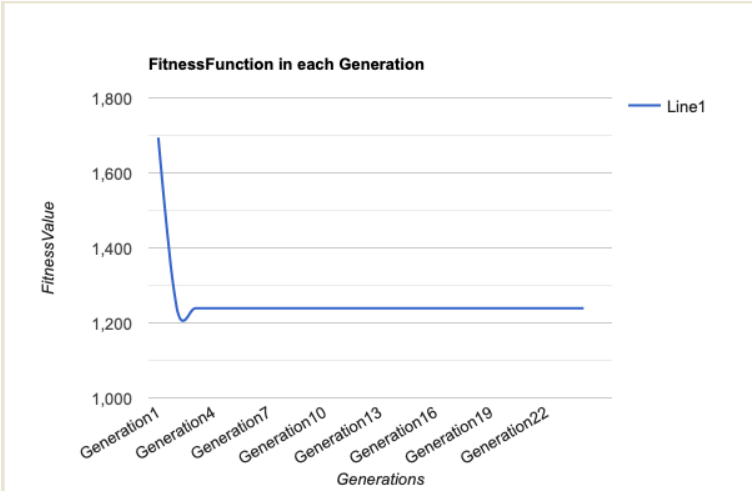
Constants:
- crossoverRate: 0.95
- mutationRate: 0.05
- selectionMode: 1
- maxNumberGenerations: 200

Variables:
- populationSize
- Input file (*zad0.txt*, *zad1.txt, zad2.txt* and *zad3.txt*)

Results:

Experiment 1.1

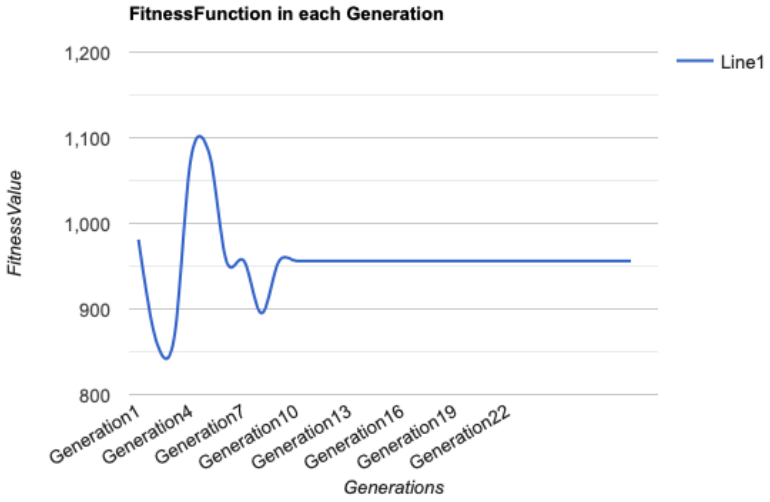
- populationSize = 5
- zad1.txt



Best FitnessValue = 1200
Last FitnessValue = 1238

Experiment 1.2

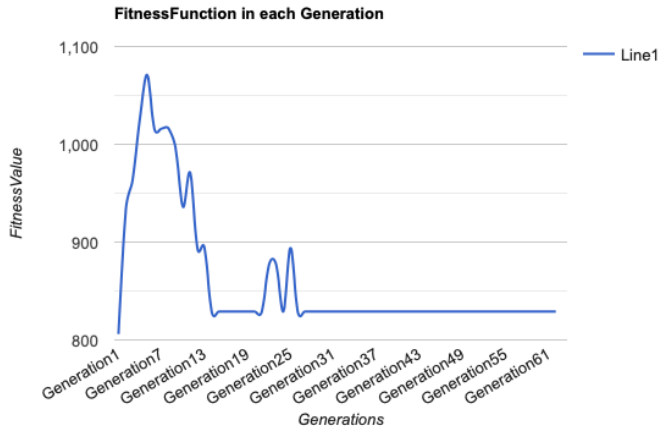
- populationSize = 25
- zad1.txt



Best FitnessValue = 840
Last FitnessValue = 956

Experiment 1.3

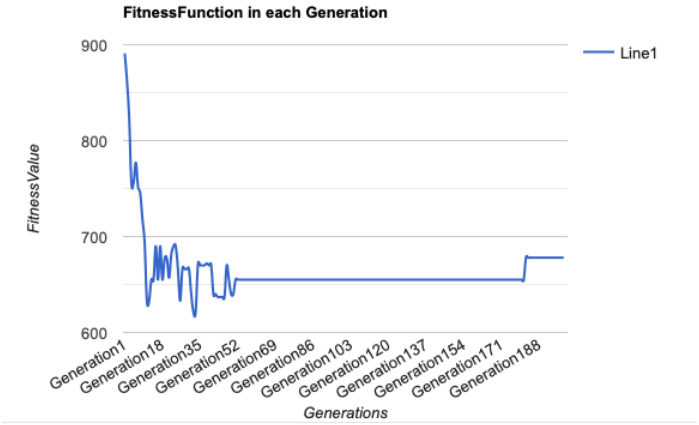
- populationSize = 50
- zad1.txt



Best FitnessValue = 806
Last FitnessValue = 829

Experiment 1.4

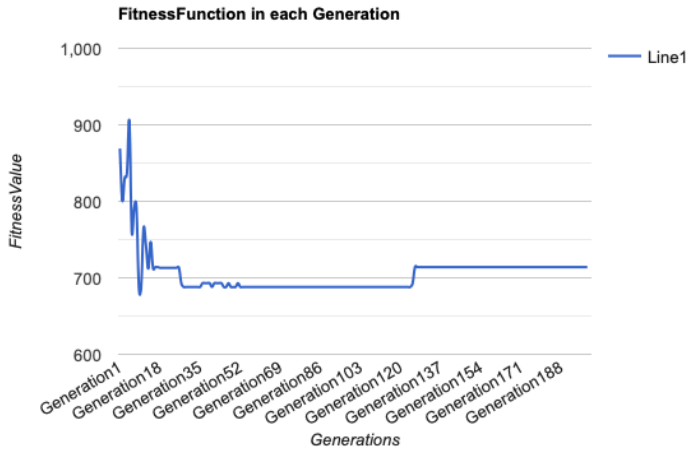
- populationSize = 100
- zad1.txt



Best FitnessValue = 633
Last FitnessValue = 678

Experiment 1.5

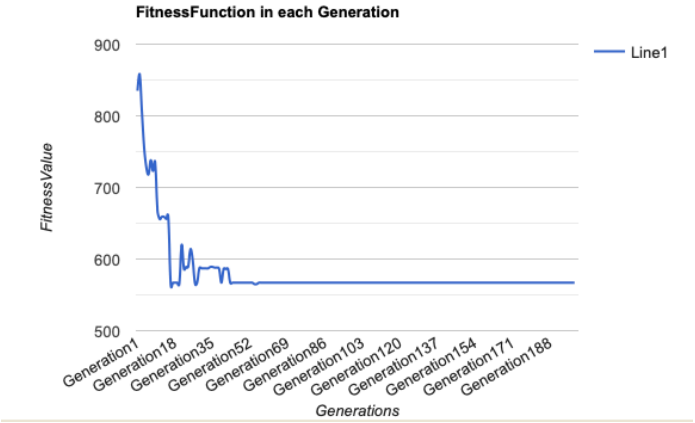
- populationSize = 200
- zad1.txt



Best FitnessValue = 688
Last FitnessValue = 714

Experiment 1.6

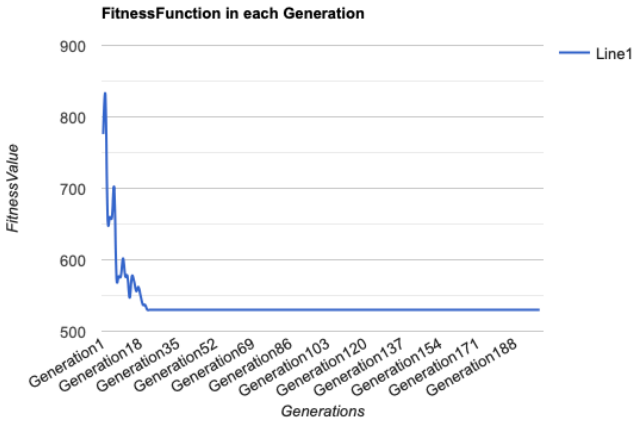
- populationSize = 500
- zad1.txt



Best FitnessValue = 567
Last FitnessValue = 567

Experiment 1.7

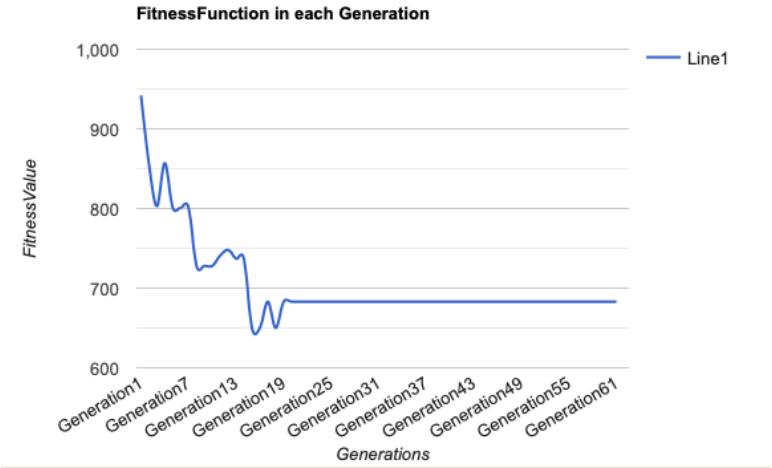
- populationSize = 1000
- zad1.txt



Best FitnessValue = 530
Last FitnessValue = 530

Experiment 1.8

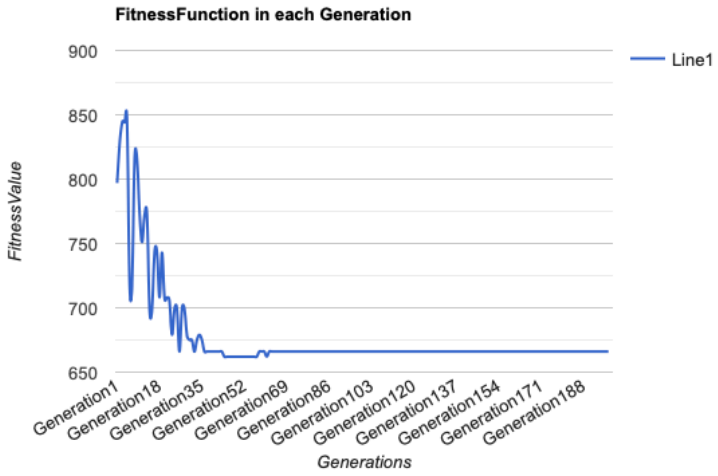
- populationSize = 100
- zad2.txt



Best FitnessValue = 650
Last FitnessValue = 683

Experiment 1.9

- populationSize = 200
- zad2.txt



Best FitnessValue = 665
Last FitnessValue = 670

Comments:

As we can observe if we increase the number of individuals the last FitnessValue improves. It's also interesting to see that in the first generations the best fitness value varies a lot but it arrives one moment that it's constant and it's really difficult to optimize more. The algorithm is converging. There are sometimes that the best solution is not the last best one, so, probably we should change the selection function to save the best one ever.

Experiment 2

Goal: Study the optimum value for the parameter *maxNumberGenerations*.

Assumptions:

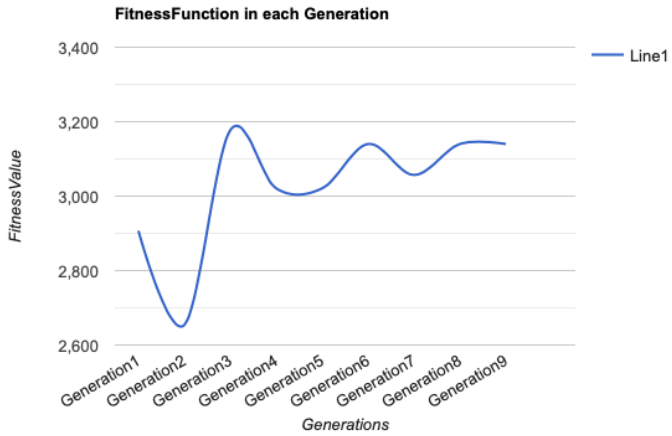
Constants:
- crossoverRate: 0.95
- mutationRate: 0.05
- selectionMode: 1
- populationSize: 100

Variables:
- maxNumberGenerations
- Input file (*zad0.txt*, *zad1.txt, zad2.txt* and *zad3.txt*)

Results:

Experiment 2.1

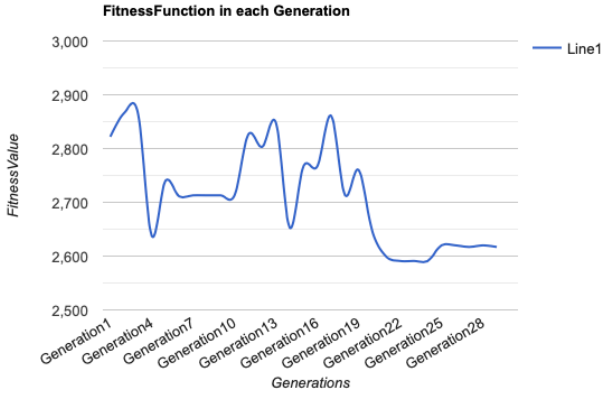
- maxNumberGenerations = 10
- zad3.txt



Best FitnessValue = 2654
Last FitnessValue = 3140

Experiment 2.2

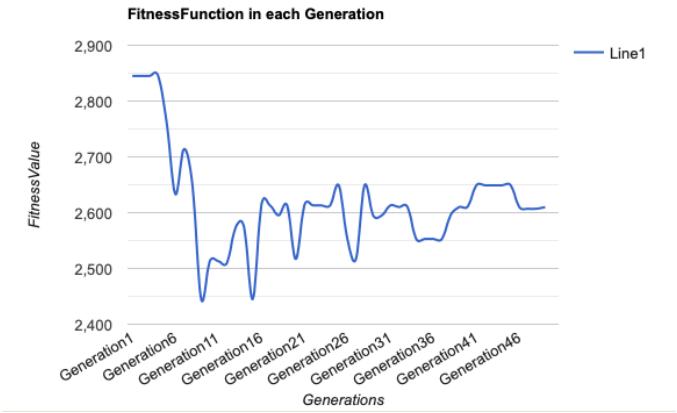
- maxNumberGenerations = 30
- zad3.txt



Best FitnessValue = 2591
Last FitnessValue = 2617

Experiment 2.3

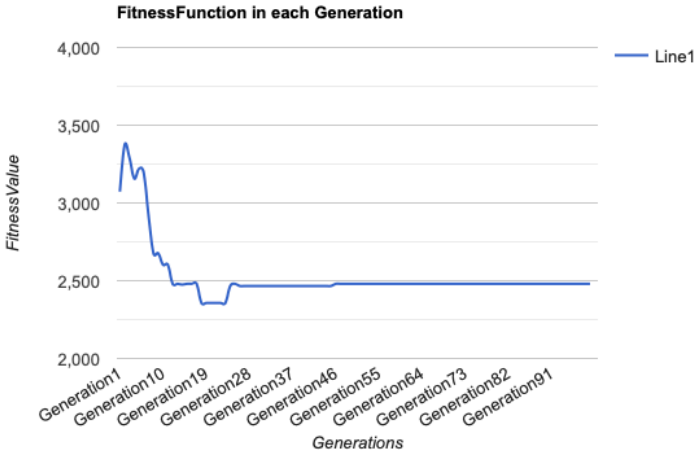
- maxNumberGenerations = 50
- zad3.txt



Best FitnessValue = 2445
Last FitnessValue = 2610

Experiment 2.4

- maxNumberGenerations = 100
- zad3.txt



Best FitnessValue = 2357
Last FitnessValue = 2480

Comments:

As we can observe if we increase the maximum number of generations the fitness values tends to be constant but if it's little, it not converges and is not a good value of the parameter. If we increase a lot the number of maximum generations, it will not change because usually converges in the first 150 generations. Moreover, it clearly depends on the input problem.

Experiment 3

Goal: Study the optimum value for the parameter *crossoverRate*.

Assumptions:

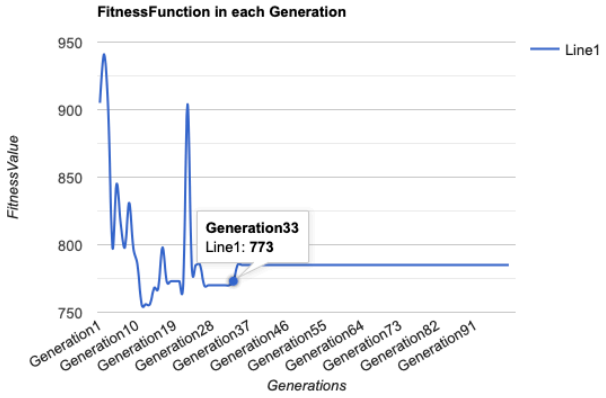
Constants:
- maxNumberGenerations: 100
- mutationRate: 0.05
- selectionMode: 1
- populationSize: 100

Variables:
- crossoverRate
- Input file (*zad0.txt*, *zad1.txt, zad2.txt* and *zad3.txt*)

Results:

Experiment 3.1

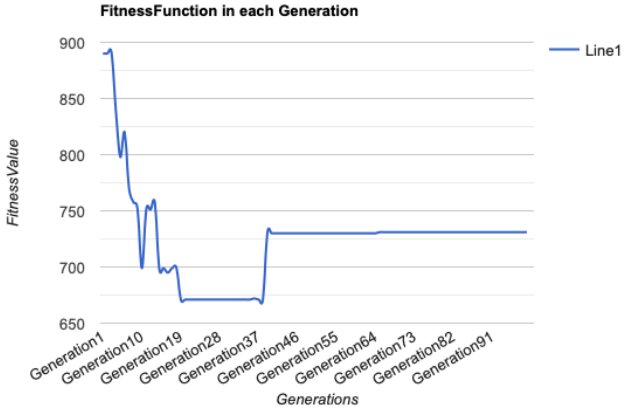
- crossoverRate = 0
- zad2.txt



Best FitnessValue = 756
Last FitnessValue = 780

Experiment 3.2

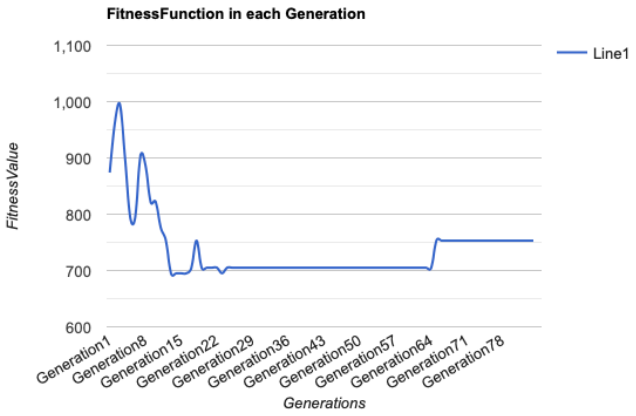
- crossoverRate = 0.2
- zad2.txt



Best FitnessValue = 671
Last FitnessValue = 731

Experiment 3.3

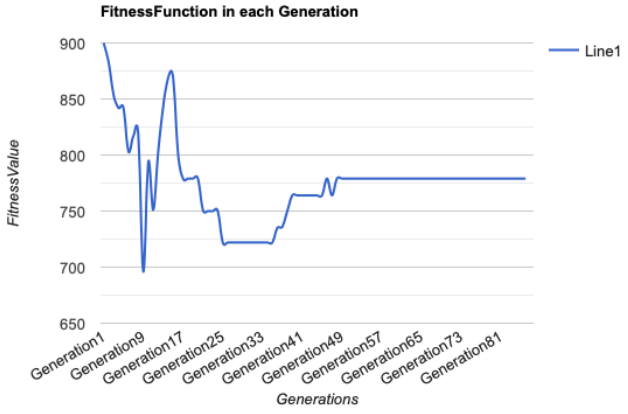
- crossoverRate = 0.5
- zad2.txt



Best FitnessValue = 695
Last FitnessValue = 753

Experiment 3.4

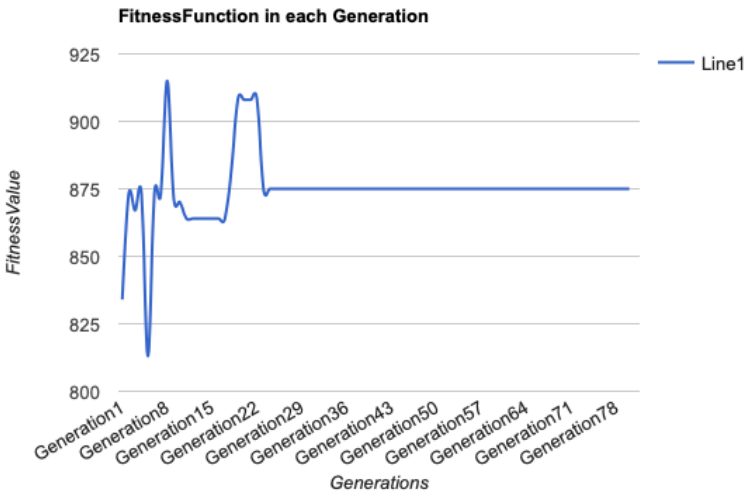
- crossoverRate = 0.8
- zad2.txt



Best FitnessValue = 722
Last FitnessValue = 779

Experiment 3.5

- crossoverRate = 1
- zad2.txt



Best FitnessValue = 864
Last FitnessValue = 875

Comments:

As we can observe if we increase the crossoverRate it improves the fitnessValue but if we put the crossoverRate as 1 it decrease the best solution. So the best crossover studied in this problem is between 0.6-0.95.

1.6 Final comments

The generation of initial solutions, crossover and mutation are totally personal ideas, so maybe it could be difficult to understand some parts, so I'm available to answer any of it. I really would like to make more experiments documented but I had no more time. Honestly, the mutation is implemented but I think is not working perfectly. It has been a hard assignment.