

## Assignment 3

Assignment 3 is divided into 2 parts:

- **Part 1:** TSP - GA (Maximum of 3 points)
  - o Pre-requisites: None
- **Part 2:** TSP - ACO (Maximum of 2 points)
  - o Pre-requisites: Minimum of 2 points in knapsack problem

### PART 1

The Travelling Salesman Problem (TSP) is one of the most well known optimization problems. This problem originally is described as follows:

Given a list of cities and the distance between each other, which is the shortest route to travel across all the cities?, such that, you visit all the cities once and you start and finish in the same city.

We now consider the problem with a set of locations inside a city (you can find the document in canvas with the name "Berlin52.tsp"). Two coordinates (x and y) as illustrated in the table below represent these locations:

Location ID	X	Y
1	565	575
2	25	185
3	345	750
...	...	...

The distance between two locations is the Euclidean distance between the two locations:

$$\text{Distance}(P1, P2) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

**What to do:** Your assignment now is to apply Genetic Algorithm to search for the shortest route. You need to visit all the locations once and the starting and ending point must be the location number 1. **(1 point).**

**Pre-conditions in order to present your code:**

- The maximum distance allowed is 9000. If the distance is greater, you have to change the parameters of the algorithm or implement a different version of GA.
- A maximum of 250000 fitness calculations are allowed.

**Your report has to cover the key parts as follows (2 points):**

1. Explain the important operations of the employed algorithm. (0.5)
2. Explain the representation of the individual, a solution to the problem, in your algorithm (0.5)
3. Give the equation of the fitness function used by your algorithm. (0.25)
4. Give the parameters used in your algorithm. Examples: Population size, crossover rate ... (0.25)
5. Illustrate how the performance of the population evolves with generations (with a figure.) Write text with the figure as well. (0.5)

## **PART 2**

Same TSP problem

**What to do:** Your assignment now is to apply Ant Colony Optimization (ACO) to search for the shortest route. You need to visit all the locations once and the starting and ending point must be the location number 1. **(1 point).**

**Your report has to cover the key parts as follows (1 point):**

1. Explain the important operations of the Employed algorithm. (0.25)
2. Illustrate how the performance of the population evolves with generations (with a figure.) Write text with the figure as well. (0.25)
3. Compare the results found by this algorithm with the results found with GA. Analyse the differences between the algorithms and the difference in the performance between both. (0.5)

**Pre-conditions in order to present your code:**

- The maximum distance allowed is 9000. If the distance is greater, you have to change the parameters of the algorithm.

### **Conditions to approve the assignment 3**

In order to receive the points for the code, you need to submit the report and have more than half of the points. Example: If a report have 1 point, then you need to have a minimum of 0.5.

- Score to pass part 1: 2 points.
- Score to pass part 2: 1 point.
- Minimum score to pass assignment 3: 3 points.

### **SCORES 3-5**

- Your score < 3: U
- $3 \leq \text{your score} \leq 3.75$ : 3
- $3.75 < \text{your score} < 4.75$ : 4
- $4.75 \leq \text{your score}$ : 5

### **SCORES A-F**

- Your score < 3: F
- $3 \leq \text{your score} < 3.4$ : E
- $3.4 \leq \text{your score} < 3.8$ : D
- $3.8 \leq \text{your score} < 4.2$ : C
- $4.2 \leq \text{your score} < 4.6$ : B
- $4.6 \leq \text{your score}$ : A

## **SUBMISSION DETAILS**

**Maximum Score:** 5 points.

**I will not consider a submission without the following format:**

File names for the submission:

StudentName\_StudentLastName\_Assignment3\_Part1\_Code.zip (Only by email)

StudentName\_StudentLastName\_Assignment3\_Part1\_Report.pdf (Only in canvas)

StudentName\_StudentLastName\_Assignment3\_Part2\_Code.zip (Only by email)

StudentName\_StudentLastName\_Assignment3\_Part2\_Report.pdf (Only in canvas)

Email subject for the submission:

[DVA340] StudentName StudentLastName Assignment3 Part1 Code

[DVA340] StudentName StudentLastName Assignment3 Part2 Code

## **ADDITIONAL INFORMATION!**

You are allowed to send each part of the assignment a maximum of three times. When you approve the assignment, you are not allowed to submit the assignment again.

Before defending the code to Miguel Leon, you have to send the code by email to [johan.hjorth@mdu.se](mailto:johan.hjorth@mdu.se)

Before submitting the report, you should present this assignment first to Johan Hjorth. After that, and only if everything is correct, you are able to submit the report in canvas.

You cannot get the points of the report without presenting the code first.