

# INF3490 Mandatory Assignment 1

## Travelling Salesman Problem

Name: Haiyue Chen

Username: haiyuec

### Instructions on how to run my programs:

All my programs are written for python 3.31 and above.

- Exhaustive search:

```
python exhaustive_search.py [number_of_cities]
```

Provide the number of cities you would want the algorithm to compute as the command line argument, starting from the beginning of the european\_cities.csv file.

- Hill climbing:

```
python hill_climber.py [number_of_cities] [number_of_attempts]
```

Provide the number of cities you would want the algorithm to compute as the first command line argument, then the number of hill climbing attempts that you would like the program to compute as the second command line argument.

- Genetic algorithm:

```
python genetic_algorithm.py [number_of_cities] [number_of_generations]  
[population_size]
```

Provide the number of cities you would want the program to compute as the first command line argument, then the number of generations you would want the population to evolve, and at last the population size.

PS:

The results of the programs are not showing the last part of the tour, e.g. the route from A to B to C and back to A is: [A,B,C]. The last part from C to A is not shown but the distance is calculated with the last part of the tour.

## Questions and implementation explanation

### Exhaustive search:

I used the itertools python library to generate all the possible permutations of cities in the form of lists, and used another function to calculate the distance of each route.

#### 1. What is the shortest tour among the first 10 cities?

The shortest tour among the first 10 cities is:

Copenhagen -> Hamburg -> Brussels -> Dublin -> Barcelona -> Belgrad -> Istanbul -> Bucharest -> Budapest -> Berlin -> Copenhagen

The tour distance is 7486.31km.

#### 2. How long would you expect it to take with all 24 cities?

It took about 209 seconds for the program to compute for the first 10 cities. There are 362880 possible routes with 10 cities and  $6.204484 \times 10^{23}$  routes within 24 cities. I estimate the running time for 24 cities with exhaustive search would be about  $1.2 \times 10^{13}$  years.

### Hill climber: