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Algorithm A: Genetic Algorithm

The Genetic Algorithm follows these steps: create the population (a collection of tours, i.e., a collection of individuals), determine fitness, select the mating pool, breed, mutate, repeat. The initial population is created by randomly generating a collection of routes. Individuals in a population are ranked with regards to their fitness, that is the inverse of the route. Selection of the mating pool is done by using fitness proportionate selection (i.e., use the fitness of each individual relative to the population to assign a probability of selection). Breeding is done by using ordered crossover, that is randomly selecting a subset in the first parent string, then fill the remainder of the tour with genes from the second parent in order in which they appear, without duplicating any genes from the first parent. Mutation is done by using swap mutation, meaning that with specified low probability two cities will swap places in the tour. These steps are repeated so that we can iterate trough as many generations as we wish.

Algorithm B: Best First Search with heuristic data

The heuristic *h* used in the algorithm is: given a state $t = x_1x_2\ldots x_r$, $h(t)$ is defined as the minimal step-cost of moving to a state $t' = x_1x_2\ldots x_rx_{r+1}$ (i.e., always move to the nearest legal city from where you are). The idea of Best First Search is to use this evaluation function to decide which adjacent node to explore. In order to sort the cost of moving from one step to another, a priority queue is used, which is implemented as a heap. Thus, this algorithm is a variation of Breadth First Search, but using a priority queue (sorted according to the heuristic) instead of a regular queue.

Description of enhancement of Algorithm A:

Elitism is used as an improvement of the basic algorithm. That is, when selecting the mating pool and breeding, best performing individuals from a population automatically carry over to the next generation so as the most successful individuals persist.

Description of enhancement of Algorithm B:

In order to obtain a better tour, the 2-opt algorithm is implemented. This takes as parameter the route found by Best First Search. The basic principle of the algorithm is: remove two edges from the tour and reconnect the two paths created, if the new tour will be shorter. Continue doing this until no such improvements can be found. The new tour is called 2-optimal.