Sharing cars to get to work: A Local Search approach

Artificial Intelligence

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Once the representation of the solution state has been defined, the generation of the initial solution state and the operators on which we are going to work, we proceed into analysing the heuristic function.

In order to solve the two solution criteria stated in the statement of the wording (nse com dir-HO), we must perform two different heuristics, because the final result that must be returned has different priorities. The heuristic function that will solve the first criterion will be called Heuristic Function 1, and the one that resolves the second, Heuristic Function 2.

8.1 Heuristic Function 1

The criterion that this function must follow is quite simple, the objective is to minimize the sum of all the distances that each car has to do.

To follow this criterion, we...

8.2 Heuristic Function 2

For the second heuristic we have added another criterion in order to minimize also the number of cars that are driving.

9 Experiment 1

In this experiment we will decide which is the best operator of the different ones we have created. In order to perform it, we have set the initial state generator for all the samples performed. The initial state generates a set of cars....

10 Experiment 2

We did this experiment in order to know which was the most suitable way to generate our initial solution. In this experiment we will use the ALGO operators we have discussed in the previous experiment which as we have shown are the best ones...

11 Experiment 3

A really important part about this project is to be able to determine the parameters thata are going to be used for the **Simulated Annealing algorithm**, so that its results are the best possible, that is, the minimum number of cars driving the shortest amount of distance and everybody getting to their workplace in a reasonable execution time.

The algorithm works with 4 parameters:

1. **Steps**: The total number of iterations that the algorithm will perform.

2. **Number of iterations for each temperature change**: Whenever there is a temperature change, a constant number of iterations will be made in which the probability of choosing a worse successor is kept.
   Each time this number of iterations is executed, the probability of choosing a worse state decreases.

3. **k**: parameter of the state acceptance function that affects the probability of choosing a worse succesor state. We know that the higher the value of the parameter, the longer it takes for the probability of staying with a worse successor state to decrease.

4. λ Another parameter of the state acceptance function that affects the probability of choosing a worse successor. The higher the value of λ, the less it will take to decrease the probability of accepting a worse successor state.

12 Experiment 4

13 Experiment 5

14 Experiment 6

15 Experiment 7

16 Especial Experiment

At this point we have degined the best initial state, its operators, the heuristic algorithm and Hill Climbing and Simulated Annealing with the most appropiate parameters, so we can proceed to compare algorithms.

16.1 Hill Climbing

The experiment was made configuring our environment with 200 people, 100 drivers and seed 1234.

We would like to add that these results are a valid solution because no car drives more than 30 km and there is not any moment where a car carries more than 2 people.

	Time
#1	6054 ms
#2	3258 ms
#3	2896 ms
#4	3561 ms
#5	4529 ms
#6	3788 ms
#7	3817 ms
#8	3503 ms
#9	3356 ms
#10	3589 ms

Table 1: Hill Climbing execution time

Mean Time	**Nodes expanded**	**Cars**	**Distance**
3835 ms	17	92	1834.3 km

Table 2: Results of our experiments with Hill Climbing

16.2 Simulated annealing

The experiment was made configuring our environment with 200 people, 100 drivers and seed 1234.

	Time	**Cars**	**Distance**	**Solution**
#1	2596 ms	62	1671.3 km	Yes
#2	1218 ms	64	1678.2 km	Yes
#3	1044 ms	67	1753.3 km	Yes
#4	1088 ms	65	1734.8 km	Yes
#5	1058 ms	63	1731.1 km	No
#6	1131 ms	65	1685.2 km	Yes
#7	1029 ms	65	1720.5 km	Yes
#8	1067 ms	66	1777.1 km	Yes
#9	1088 ms	64	1657.6 km	Yes
#10	2596 ms	65	1688.5 km	Yes

Table 3: Results of our experiments with Simulated Annealing

The mean time of our executions using Simulated Annealing is 1709.76 ms.