

Transportation of Company workers for the reduction of traffic and pollution

***Felipe Ríos López
Santiago Gil Zapata
Medellín, 16/05/2019***

Data Structures

	1	2	3	4	5
1	0	5	4	3	2
2	5	0	13	21	1
3	4	13	0	20	2
4	3	21	20	0	7
5	2	1	2	7	0

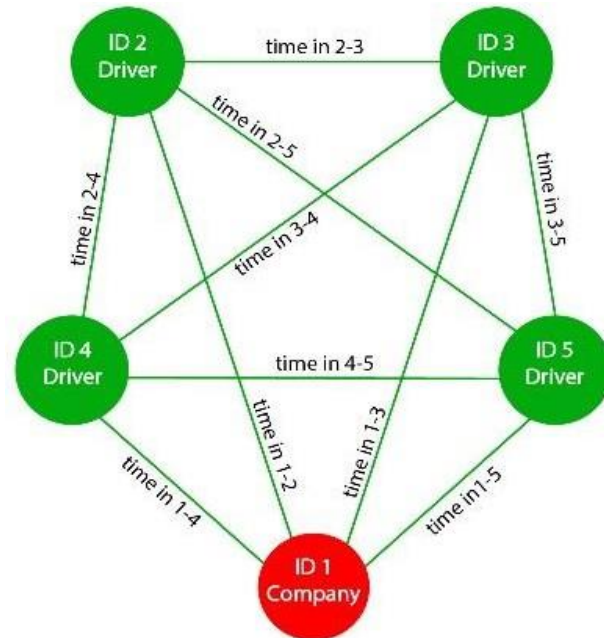


Figure 1: A matrix with the weights of the paths.

Figure 2: Structure of a complete graph

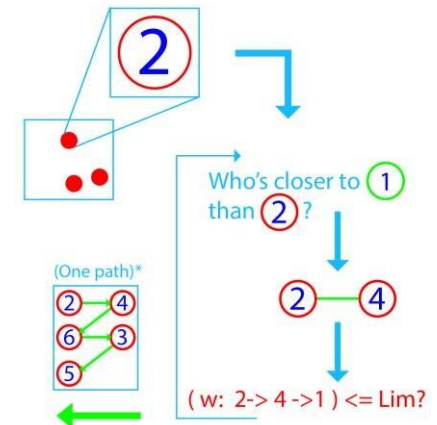
Algorithm and Complexity

```
332 Algorithm assign (Graph, initial, increment)
333   assigned cars = new List
334   Successors = new List in range(2, size of Graph) |
335   ordered successors = sort(Successors)
336   While ordered successors not empty do
337     driver = last from ordered successors
338     car = new List
339     time limit = increment * get Weight(Graph, driver, initial)
340     closest from driver = sort(ordered successors)
341     for every successor in closest from driver do
342       if size of car = 5 then
343         stop
344       end if
345       if can take (successor, car, time limit, Graph) then
346         push(successor, car)
347         erase(successor, ordered successors)
348       end if
349     end for
350     push(car, assigned cars)
351   end while
352   return assigned cars
353 end
```

Method	Complexity
Graph creation	$O(n^2)$
Sorting	$O(n^2)$
Erase	$O(n)$
canTake	$O(n)$
Assign	$O(n^3)$
-----	-----
Total =	$O(n^3)$

Algorithm design criteria

- It is fast
- Only uses the related data, and that reduces completely the needed storage.
- Reduces the traffic in a 69.5% for the worst case $P=1.1$



Execution

```
gzsan@Santiago-s-PC ~/otras_materias/datos2/finalProject
$ ./carsMobility -n 11 -p 1.3
For a set U with size = 11 and P = 1.3, there have been assigned 4 cars.

gzsan@Santiago-s-PC ~/otras_materias/datos2/finalProject
$ ./carsMobility -n 11 -p 1.2
For a set U with size = 11 and P = 1.2, there have been assigned 4 cars.

gzsan@Santiago-s-PC ~/otras_materias/datos2/finalProject
$ ./carsMobility -n 11 -p 1.1
For a set U with size = 11 and P = 1.1, there have been assigned 4 cars.

gzsan@Santiago-s-PC ~/otras_materias/datos2/finalProject
$ ./carsMobility -n 205 -p 1.3
For a set U with size = 205 and P = 1.3, there have been assigned 50 cars.

gzsan@Santiago-s-PC ~/otras_materias/datos2/finalProject
$ ./carsMobility -n 205 -p 1.2
For a set U with size = 205 and P = 1.2, there have been assigned 52 cars.

gzsan@Santiago-s-PC ~/otras_materias/datos2/finalProject
$ ./carsMobility -n 205 -p 1.1
For a set U with size = 205 and P = 1.1, there have been assigned 61 cars.

gzsan@Santiago-s-PC ~/otras_materias/datos2/finalProject
$ |
01      Assignations a = Assignations();
02      a.execute(205, 1.1f);
03      return EXIT_SUCCESS;
04  }
05
06  void usage(const char *progName)
07  {
08      cerr << "Parameters: ? x? ? on vertices"
09           << "\n";
10  }
```

Time and Memory Consumption

j) Time: 0.456 seconds

Memory consumption: 3.4 MB

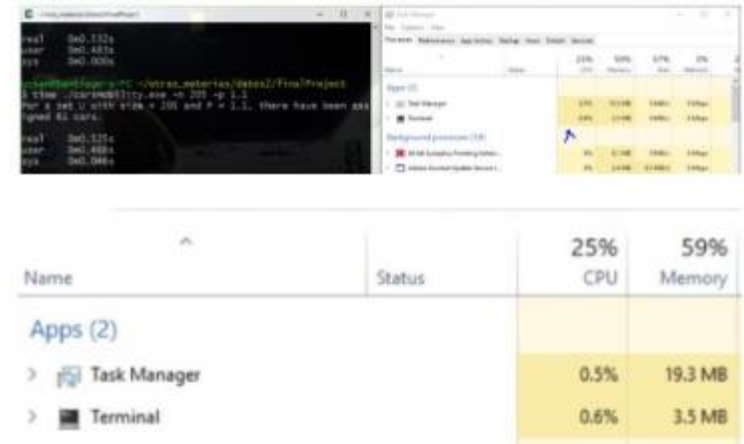
```
E:\otras_materias\datos2\FinalProject
$ make
g++ -c -o main.o main.cpp
g++ -c -o Assignations.o Assignations.cpp
g++ -c -o Digraph.o Digraph.cpp
g++ -o carsMobility main.o Assignations.o Digraph.o -Wall

gzsar@Santiago-s-PC ~/otras_materias/datos2/FinalProject
$ time ./carsMobility.exe -n 205 -p 1.1
For a set U with size = 205 and P = 1.1, there have been assigned 61 cars.

real    0m0.568s
user    0m0.437s
sys     0m0.061s

gzsar@Santiago-s-PC ~/otras_materias/datos2/FinalProject
$ time ./carsMobility.exe -n 205 -p 1.1
For a set U with size = 205 and P = 1.1, there have been assigned 61 cars.

real    0m0.578s
user    0m0.453s
sys     0m0.046s
```



Structure complexity: $O(N^2)$
In the biggest dataset= $(32*205)^2 = 43.033.600$ bits
Algorithm complexity: $O(N)$
In the biggest dataset= $(32*205) = 6560$ bits