## Waste collection vehicle routing problem with ant colony

1. Introduction

We are presented with difficult vehicle routing problem. In this case, problem includes some real world constraints, that makes it more difficult to navigate through solution space.   
I found it hard enough to sensibly generate possible solutions. Limiting factors being, missing node connections, one directional and capacity constraining edges and multiple vehicles with different route lengths. Also at the other hand each solution has to be quickly checked for it's value. I have decided to treat each garbage type as separate problem, though some routes and even whole solutions might work for other types also.  
I have decided for an ant colony based algorith.

1. Algorithm

Starting off, parsing each Node into table, nodes are linked with edges for quick navigation. Solution generating starts in first node, looking at avaiable vertexes and picking one at random. Random chances are determined by amount of pheromones. Edges with more pheromones being more likely to be picked. At first all edges have same base amount of pheromones.   
Picking vertexes and continuing until either route gets invalidated, or it ends up back at starting depot node. In case route is valid, by all constrains, it's edges get marked with pheromones for next passing ant.   
New ants are more likely to follow the path and discover similar, but perhaps better routes. When there are no good routes nearby, pheromones evaporate globaly, in order to allow wider search for better solutions.  
When set of viable routes, collecting all garbage along the way, is found and validated against all contraints, it is determined as possible solution, for which cost can be calculated.

1. Results

There are positive results in some easier cases, but in harder ones, with many vertexes, it get's really hard to find initial solution, since there are insane amount of route combinations.

1. Improvements

There are few improvements that I'd like to implement. Each viable route, should be tested for loops. Removing loops is expected to produce better route without additional generating. Pheromon trail could be directed in direction from and to depot. This way garbage truck is directed back to base, once capacity is reached. At last, all three garbage types, could be expored at once, as they share some solution space.

Jan Aleksandrov, 63140001  
Source code: https://github.com/Niproblema/Waste-disposal-optimization