Graph Optimization
Lab Project

(Due June 9 2021)

Surname		First name		student ID	
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Consider a directed graph $G = (N, A)$, where each node can host a facility. A set of requests for treatment K is given: each request k originates in a node $o_k \in N$ and has a demand for treatment d_k. The whole demand of k must be treated by one and only one facility, and a single path must be selected from the origin node o_k to the facility to which k is assigned.

Opening a facility in node $i \in N$ costs c_i and a facility opened in i can treat an overall demand cap_i.

Each arc of the graph has a limited capacity uu. Arc capacity is the same for all the arcs. For each demand that uses arc (i, j) a cost g_{ij} must be paid.

Many requests can originate in the same node but they can be assigned to different facilities and can be routed on different paths even if they are assigned to the same facility.

The problem consists in deciding where to open the facilities, to which facility each request is assigned, and the routing on a single path of each request, with the aim of minimizing the sum of the costs.

1. Write a formulation of the problem and its continuous relaxation.
2. Propose a relaxation different from the continuous relaxation.
3. Propose valid inequalities and a cutting plane approach to improve the relaxation.
4. Propose a randomized rounding heuristic for the problem.
5. Propose a greedy heuristic for the problem.
6. Propose a local search heuristic for the problem (possibly based on a k-opt neighborhood).
7. Describe in details all the above models and methods.
8. Code in AMPL all the above models and methods, apply them to the instances and fill the table. Discuss the results, reporting the gap for all the heuristics.

Submit all the .run and .mod files, named as `surname_ID_method`, into a single .zip file, named `surname_ID.zip`, in the `submission` directory of `Lab Project`. For groups, use one of the surnames of the group members.

instance	integer optimum	time	continuous relaxation (CR)	gap	(CR)with added inequalities	alternative relaxation	time	randomized rounding	time	greedy	time	LS	time
ABR													
AB1													
ATR													
ATBP													
NORR													
NORROUT													
NORBP													
NORBP2													
NORROUT1													
NORROUT2													