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amsmath algorithm, algorithmic Input: Output: array url

document Project 2: Capacitated Arc Routing Problems

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Preliminaries This project is an implementations of Path-Scanning and Dijkstra's algorithm to solve the capacitated arc routing problems(CARP). CARP is the most typical form of arc routing problem, which has many application in real world, such as urban waste collection, post delivery. 1 In the case of waste collection, some stresses of city has waste, cars with limit capacitated will carry the these waste start from depot and return again when car is full. A solution with less cost will be perfect.

CARP can be represented formally as follows: a mixed graph $G = (V, E, A)$, with a set of vertices denoted by V , set of edges denoted by E and a set of arcs denoted by A , is given. There is a central depot vertex $dep \in V$, where a set of vehicles are based. A subset $E_R \supseteq E$ composed of all the edges required to be served and a subset A . The objective of CARP is to determine a set of routes for the vehicles to serve all task with minimal costs while satisfying: a) Each route must start and end at dep b) The total demand serviced on each route must not exceed the vehicle's capacity Q ; c) Each task must be served exactly once (but the corresponding edge can be traversed more than once).

CARP is NP-hard, various heuristics and metaheuristics are used, such as Augement-Merge, Path-Scanning. Here I successfully implemented Path-Scanning.

Software This project is written by Python 3.7 with editor Atom and Vim. Numpy library and sys library are used.

Algorithm Using Dijkstra's algorithm to calculate the closest pathway between two vertex. Path-Scanning is used to find out task sequence for CARP. I defined three group of functions in order to find out optimal service sequence, including one function to generate cost graph and demand graph between vertex and vertex from provided txt file, two functions to generate shortest distance and pathway dictionary by Dijkstra algorithm, other are control flow and output format function. Function *Better* break the balanced status.

Methodology CARP is NP-hard. Path-Scanning provide a reasonable heuristic method to reduce the total cost. Firstly, edge with required was copy to a new list. Car begin its service from depot(vertex 1). Then the shortest pathway away from now service vertex will be choose as new service vertex while the car is not full and here still are required edges. Repeat above produce to clean up all required edges.

Representation Some main data are maintain during process: capacity, graph_dm , graph_ct. Others data would be specified inside functions, shortest_dist should noticed.

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capacity: The car's capacity, generated from input file.

graph_dm: The graph of edge with demand and their demand, generated from input file.

graph_ct: The graph of edge with cost and their cost, generated from input file.

shortest_dist: A dictionary of shortest distance and pathway between two vertexes.