Article Presentation: Air Ambulance

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Introduction

City of Ontario , 13 million residents spread over 1 million km²

Governmental organizations want to provide advanced medical transportation

Ornge

Capable of transporting 19,000 patients per year

Two types of calls happen:

A . Scene calls

B. Interfacility Calls:

10-20 requests daily

Objective: minimize cost

Problem: Schedule a route with available aircrafts

IP Model provided for the solution

Dial - a – ride problem with nonhomogenous vehicles and multiple depots

Request parameters

Origin, Destination, Pickup after, Drop off before, Level of care, Stretchers, Escorts, Solitary, Maximum Time

Aircraft parameters

Base, Level of care, stretchers (patients), Escort capacity, Airspeed, Fuel cost, charter cost, Routes and costs Parameters

Fuel cost, Charter cost, Detention cost

A route cannot last longer than a specific time

A route cannot carry a patient more than a specific time and station number

Improvement

	Flight Planners	Optimized Plan	Difference
Flights	312	305	7
Hours	1,417	1,253	164
Distance (km)	481,381	417,156	64,225
Empty legs (%)	35.5	32.8	2.7

Method

r : Number of requests

p : Number of airplanes

At most 4 requests can be assigned to an airplane!

The formula :

p ((r,1) + (r,2) + (r,3) + (r,4))

Every possible scenario is a binary variable, X_i.

For r = 30, p = 40, there are 1.2M binary variables in the model. However, 450 thousand of them are infeasible! Infeasibility of the variables are not eliminated by the model.

Parameters to be Used:

Aij : 1 If request i is included in the scenario j, 0 otherwise

Bij : 1 If plane i is included in the scenario j, 0 otherwise

Cj : Cost of applying scenario j.
For all scenarios, $k!\,3^{k-1}$ orderings are enumerated.

Model

min $C.X$

subject to $A.X = 1$

$B.X \leq 1$

x binary

A Model to Determine Feasibility

Max $\sum_1^n x_n$

s.t.

$x_n . pa_i \leq A_{in} . ppt_{in}$ (pa: requested pickup-after time of the patient i,
ppt: planned pickup time of patient i with plan n, for all i, n)

$x_n . pdt_{in} \leq db_i . A_{in}$ (db :requested drop-before time of the patient i,
pdt: planned dropping time of patient i with plan n , for all i, n)

$l_i \leq lp_{in} x_n$ (l: required care level for patient i
lp: planned level care for patient i for plan n , for all i, n)

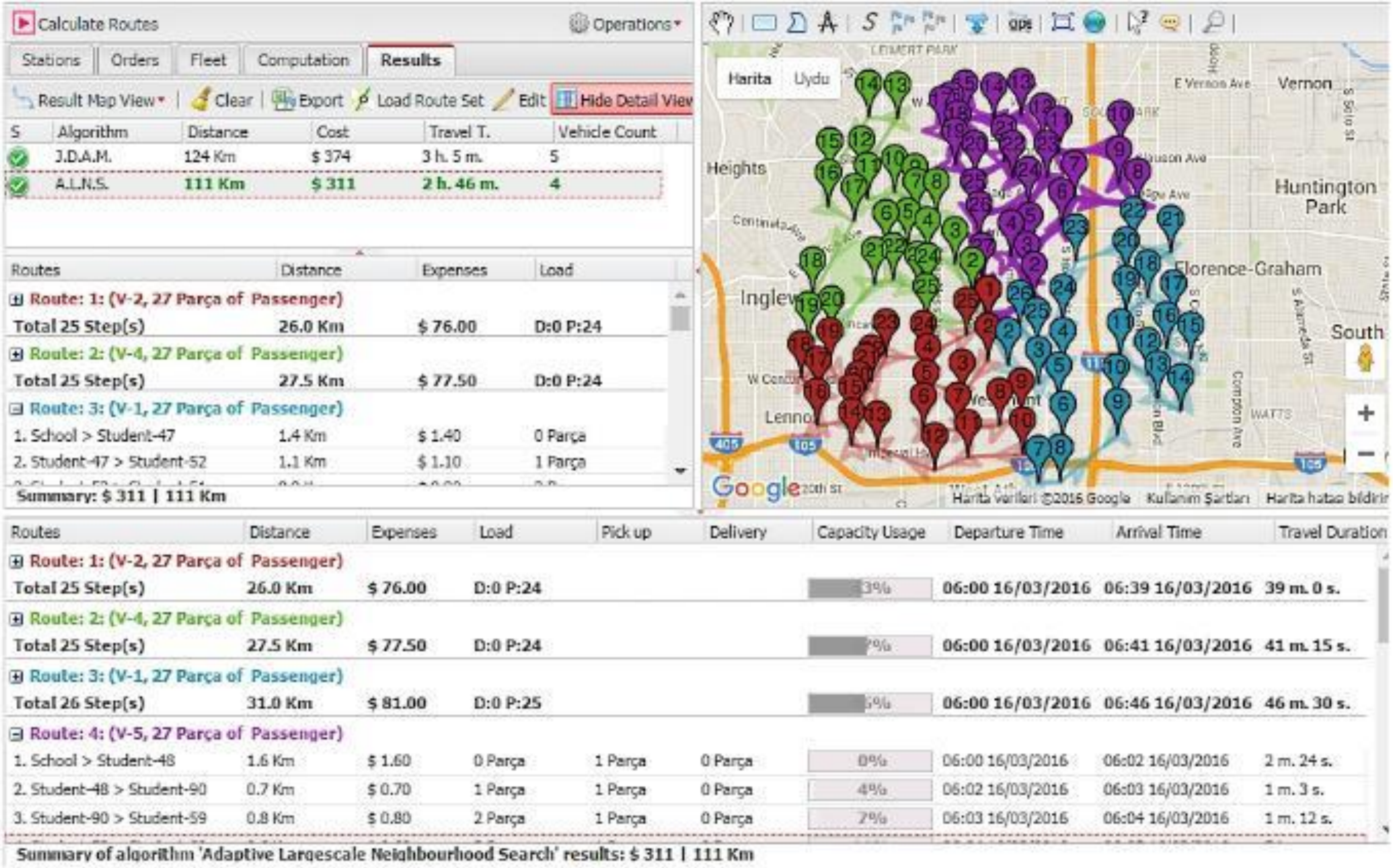
$pdt_{qn} \leq ppt_{sn}\ x_n$ or $pdt_{sn} \leq ppt_{qn} x_n$ (q: infected patients, s: normal patients , for all q, s and n)

Additional Example – Logvrp

Logvrp is a **multiple stop, multiple destination, multiple location** route planner.

Efficient routing optimization for transportation logistics

Calculates cheapest, shortest, optimum routes


Calculate Routes
Operations
Stations
Orders
Fleet
Computation
Results
Result Map View
Clear
Export
Load Route Set
Edit
Hide Detail View
S Algorithm Distance Cost Travel T. Vehicle Count
J.D.A.M. 124 Km $ 374 3 h. 5 m. 5
A.L.N.S. 111 Km $ 311 2 h. 46 m. 4
Routes Distance Expenses Load
Route: 1: (V-2, 27 Parça of Passenger)
Total 25 Step(s) 26.0 Km $ 76.00 D:0 P:24
Route: 2: (V-4, 27 Parça of Passenger)
Total 25 Step(s) 27.5 Km $ 77.50 D:0 P:24
Route: 3: (V-1, 27 Parça of Passenger)
1. School > Student-47 1.4 Km $ 1.40 0 Parça
2. Student-47 > Student-52 1.1 Km $ 1.10 1 Parça
Summary: $ 311 | 111 Km
Harita
Uydu
Heights
Inglewood
Lennox
Florence-Graham
Huntington Park
Vernon
South
Harita verileri ©2016 Google
Kullanım Şartları
Harita hatası bildirin
Routes Distance Expenses Load Pick up Delivery Capacity Usage Departure Time Arrival Time Travel Duration
Route: 1: (V-2, 27 Parça of Passenger)
Total 25 Step(s) 26.0 Km $ 76.00 D:0 P:24 06:00 16/03/2016 06:39 16/03/2016 39 m. 0 s.
Route: 2: (V-4, 27 Parça of Passenger)
Total 25 Step(s) 27.5 Km $ 77.50 D:0 P:24 06:00 16/03/2016 06:41 16/03/2016 41 m. 15 s.
Route: 3: (V-1, 27 Parça of Passenger)
Total 26 Step(s) 31.0 Km $ 81.00 D:0 P:25 06:00 16/03/2016 06:46 16/03/2016 46 m. 30 s.
Route: 4: (V-5, 27 Parça of Passenger)
1. School > Student-48 1.6 Km $ 1.60 0 Parça 1 Parça 0 Parça 0% 06:00 16/03/2016 06:02 16/03/2016 2 m. 24 s.
2. Student-48 > Student-90 0.7 Km $ 0.70 1 Parça 1 Parça 0 Parça 4% 06:02 16/03/2016 06:03 16/03/2016 1 m. 3 s.
3. Student-90 > Student-59 0.8 Km $ 0.80 2 Parça 1 Parça 0 Parça 7% 06:03 16/03/2016 06:04 16/03/2016 1 m. 12 s.
Summary of algorithm 'Adaptive Largescale Neighbourhood Search' results: $ 311 | 111 Km

Air Ambulances in Turkey

19 helicopters at 17 points

Provided by THK

References

https://logvrp.com/logvrpsite/en/about.html

http://www.thk.org.tr/biz_ne_yapiyoruz/itemlist/category/168-hava_ambulans

Thank you.