A Bi-objective Model for Handicapped Transportation

Joaquín Pacheco
Universidad de Burgos

Irma García
Universidad Autónoma de Coahuila

Madrid, November 28 2016

Introduction

- A Bi-objective model
- Description of objectives function
- References about (Dial A Ride Problem) DARP
- Solutions Approach

- Transportation of a set of handicapped people (clients), from the corresponding homes to the destinations (cultural centers, hospitals, etc.)

- Design of routes following the DARP. This model incorporates the “human perspective” (Cordeau, 2003)

Cordeau 2003: Tabu

Cordeau 2006: Formulation

Cordeau and Laporte (2007): revision of models and approaches

Mauri and Lorena (2006): A multi-objective model

Paquette el at. (2012), (2013): Real problem in Canada, involves quaility of service, and use of Tabu

Chevrier et. al. (2012): A three objectives model

Guerriero et al (2014): 2 objectives, total time and waiting time

Muelas et al (2015): Large size problems with VNS

Ritzinger et al (2016): Large Neighborhood Search

Chassaing et al (2016): Evolutive Local Search

Molenbruch et al (2017):Total time and total distance

Two objectives:

- Minimization Transport Costs
- Maximize the level service (minimizing “over” time)

Set of clients $W = \{w_1, w_2, w_3, \dots, w_n\}$

Initial points $P = \{ 1, 2, 3, \dots n \}$

Destinations $D = \{ n+1, n+2, \dots, 2 \cdot n \}$

$V = P \cup D \cup \{ 0 \}$

Lmax : Maximum travel time by vehicle

m : number of vehicles

Q : Capacity, C : Vehicle Cost

t_{ij} , d_{ij} : time and distances matrices

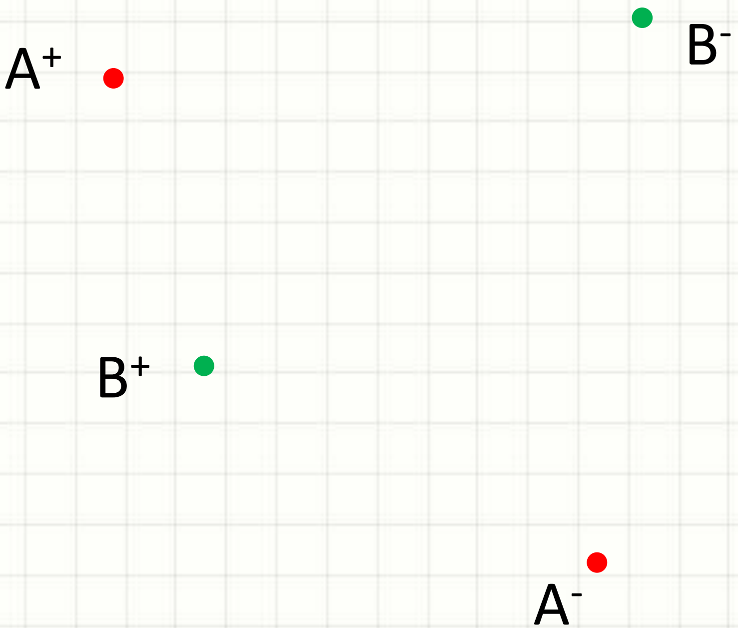
Economic objective

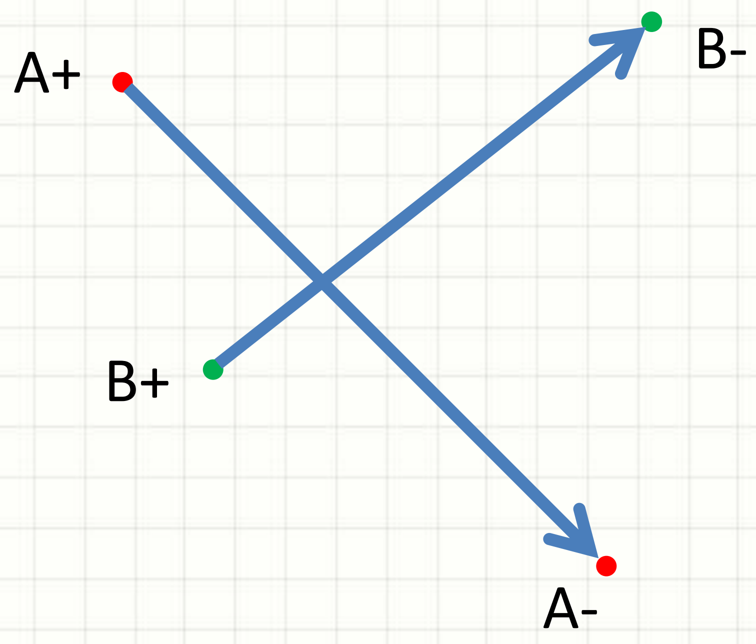
Used Vehicles·C + Total distance

Social objective

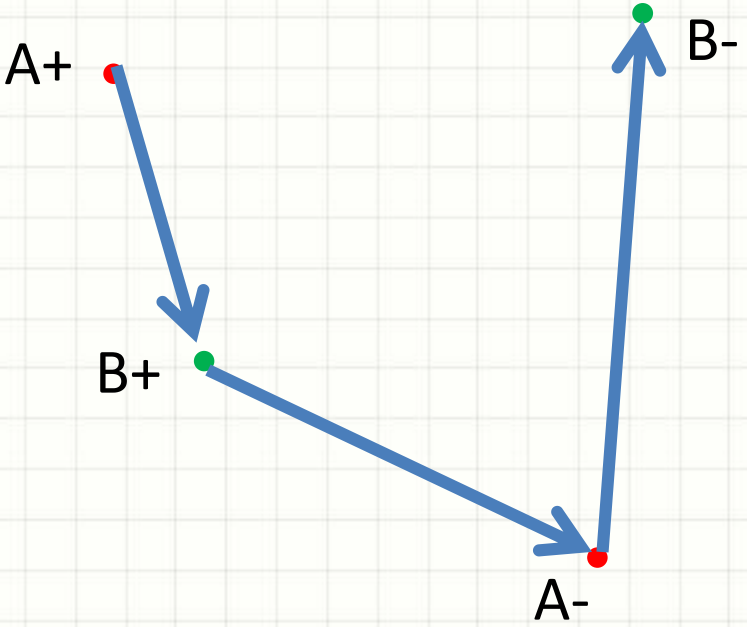
$$\min \max \{ |T_i - t_{i\,n+i}| : i \in \{1,2,..n\} \}$$

T_i : Time of travel of client w_i in a solution S

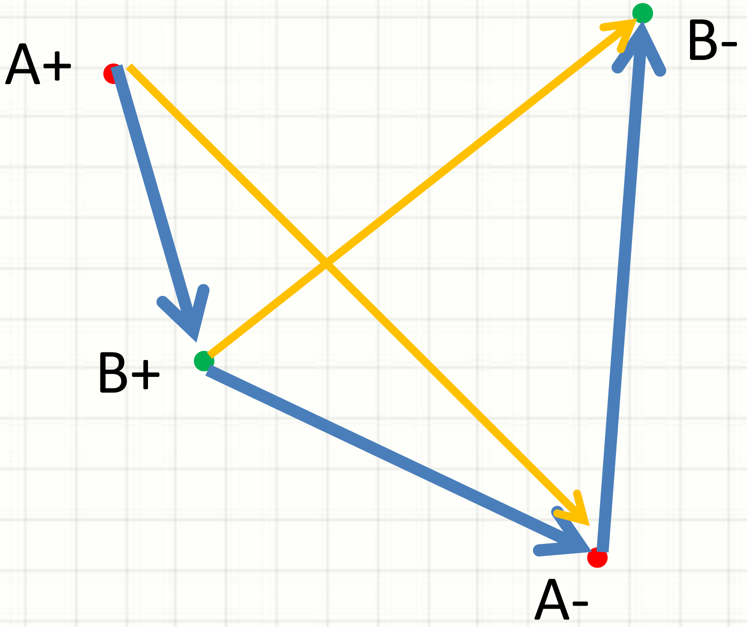

A+
B-
B+
A-

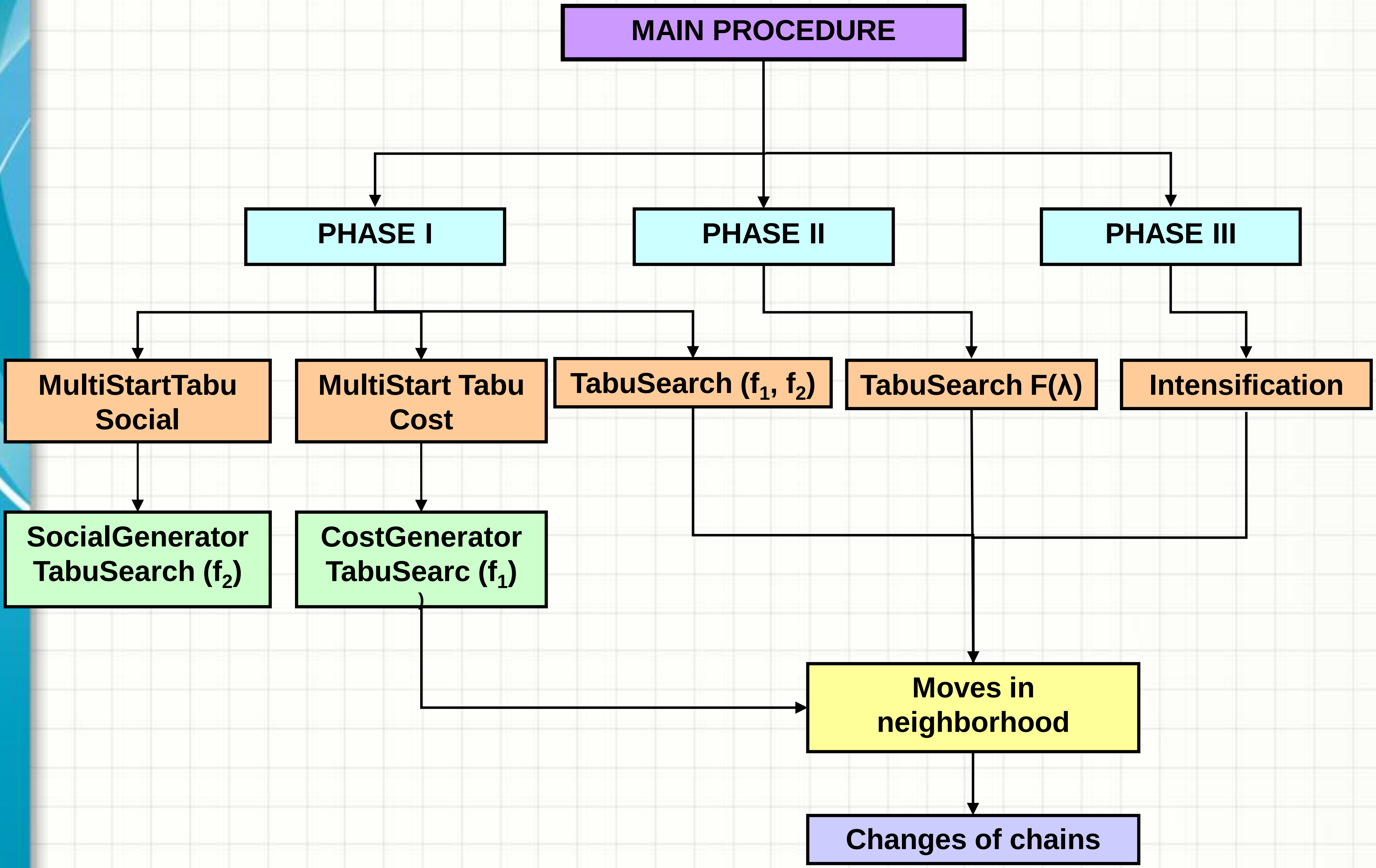


Social solution: $T_A = t_{A+\,A-}$ *and* $T_B = t_{B+\,B-}$



Economic solution: 1 vehicle


A+
B-
B+
A-


MAIN PROCEDURE
PHASE I
PHASE II
PHASE III
MultiStartTabu Social
MultiStart Tabu Cost
TabuSearch (f_1, f_2)
TabuSearch F(λ)
Intensification
SocialGenerator TabuSearch (f_2)
CostGenerator TabuSearc (f_1)
Moves in neighborhood
Changes of chains

- S : Feasible solution
- $f_1(S)$ = Cost in S
- $f_2(S)$ = Social function in S
- f_1^{min} y f_1^{max} : Min and max values for f_1 in Set of No-dominated solutions
- f_2^{min} y f_2^{max} : the same for f_2

$$F_\lambda(S) = \max\left\{\lambda \cdot \frac{f_1(S) - f_1^{min}}{f_1^{max} - f_1^{min}}, (1-\lambda)\cdot\frac{f_2(S) - f_2^{min}}{f_2^{max} - f_2^{min}}\right\}$$

Calculate $d_{0i^+} + d_{i^+i^-} + d_{i^-0}$

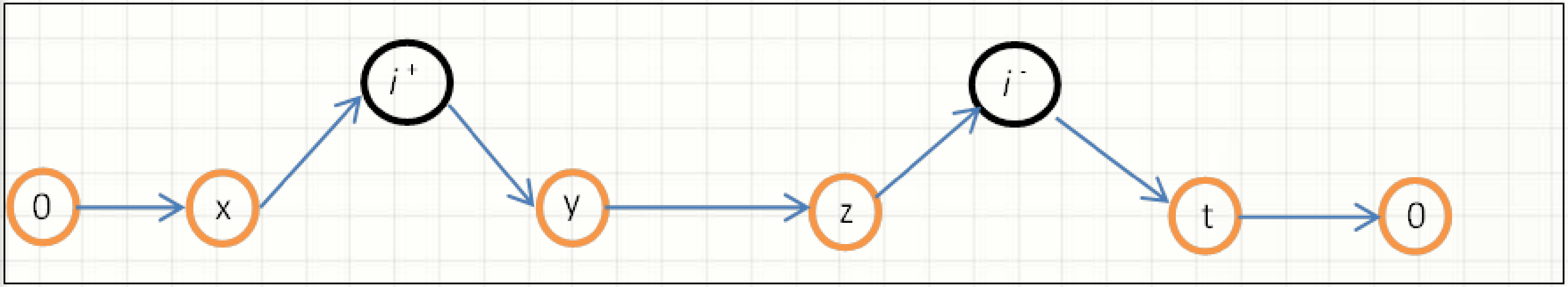
In every iteration take the next client *i*

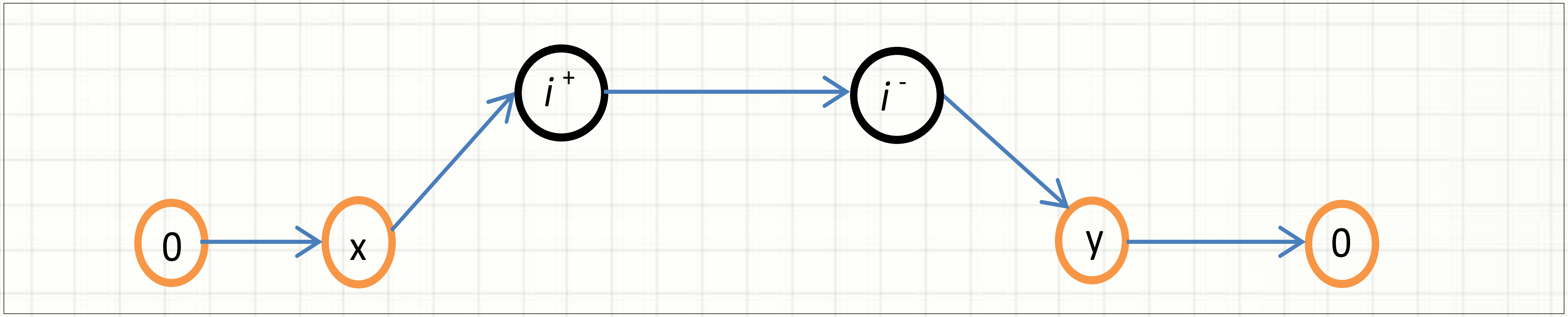
Built the set *L* of all feasiables insertions of *i*

Calculate $\Delta d(ins)$ and $\Delta f(ins) : ins \in L$

$$val(ins) = \beta\left(\frac{\Delta d(ins) - min\Delta d}{max\Delta d - min\Delta d}\right) + (1-\beta)\left(\frac{\Delta f(ins) - min\Delta f}{max\Delta f - min\Delta f}\right)$$

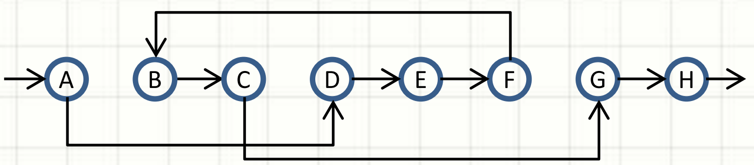
Built *ListCandidate* with the *ins* corresponding with the minimun *val*(*ins*) values


0
x
i +
y
z
i -
t
0

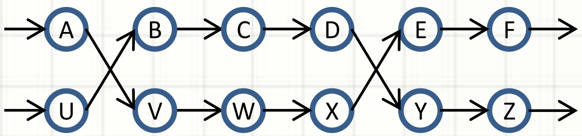

0
x
i +
i -
y
0

TABU SEARCH : MOVES

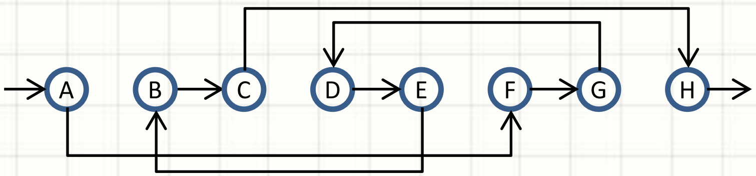
Or Exchange



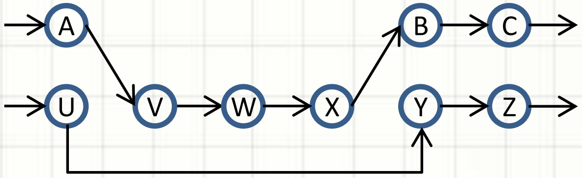
CROSS



Generalized Or Exchange



Insertion



Check the feasibility:

Total time
Capacity
Preferences: A+ before A-

Auxiliar Variables that are updated afer each move

TimeAc(i) : Acumulated distance after visiting i
Qac(i) : Acumulated passangers after visiting i
List of chains that can be moved in Inter-routes

List of moves that can be performed (Intra Routes)

max_desp("chain") :
maximum numer os positions that chain can be moved ahead (forward)

QUESTIONS?