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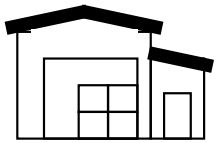
Lunch talk

A capacitated Vehicle Routing Problem with pickups, time windows and packing constraints in the context of city logistics

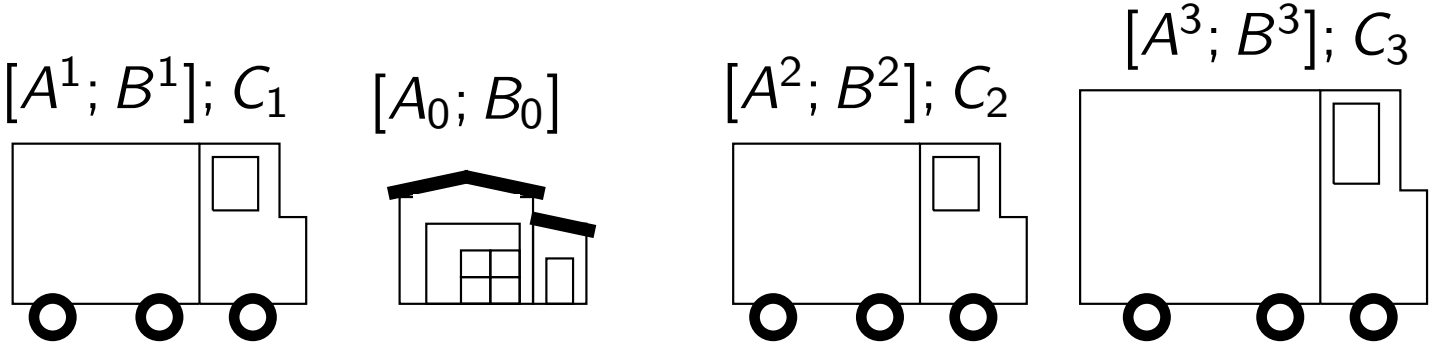
Plan

Parameters

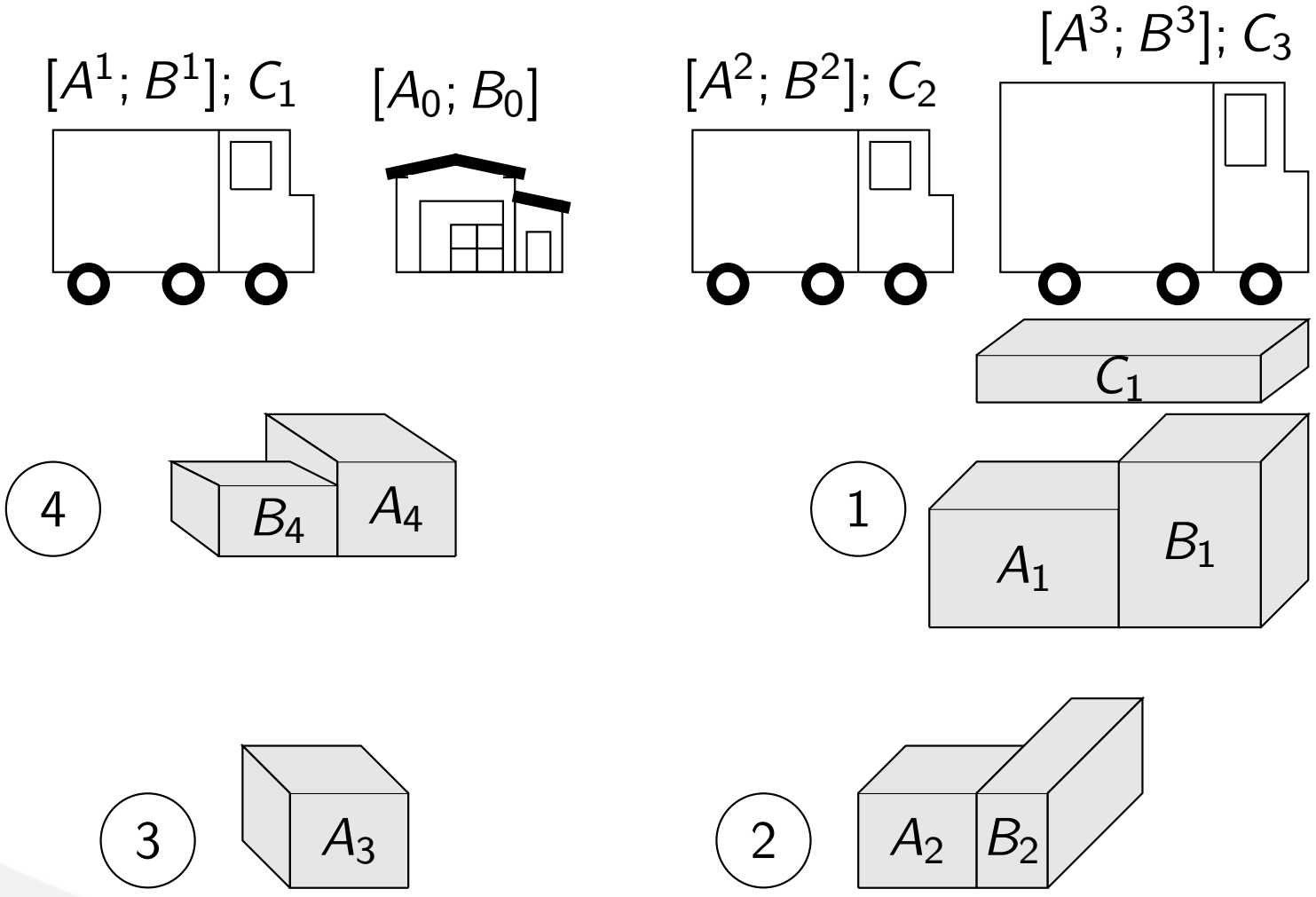
$[A_0; B_0]$



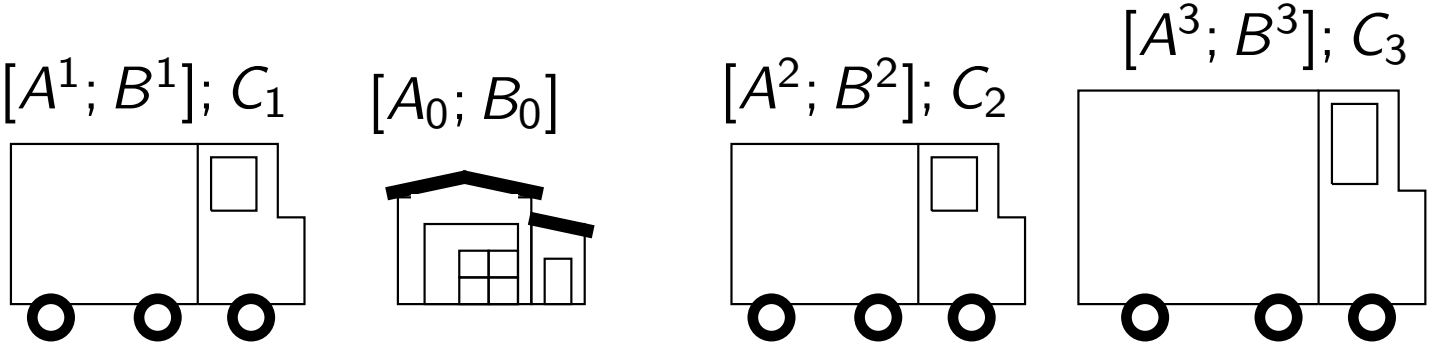
Parameters



Parameters



Parameters



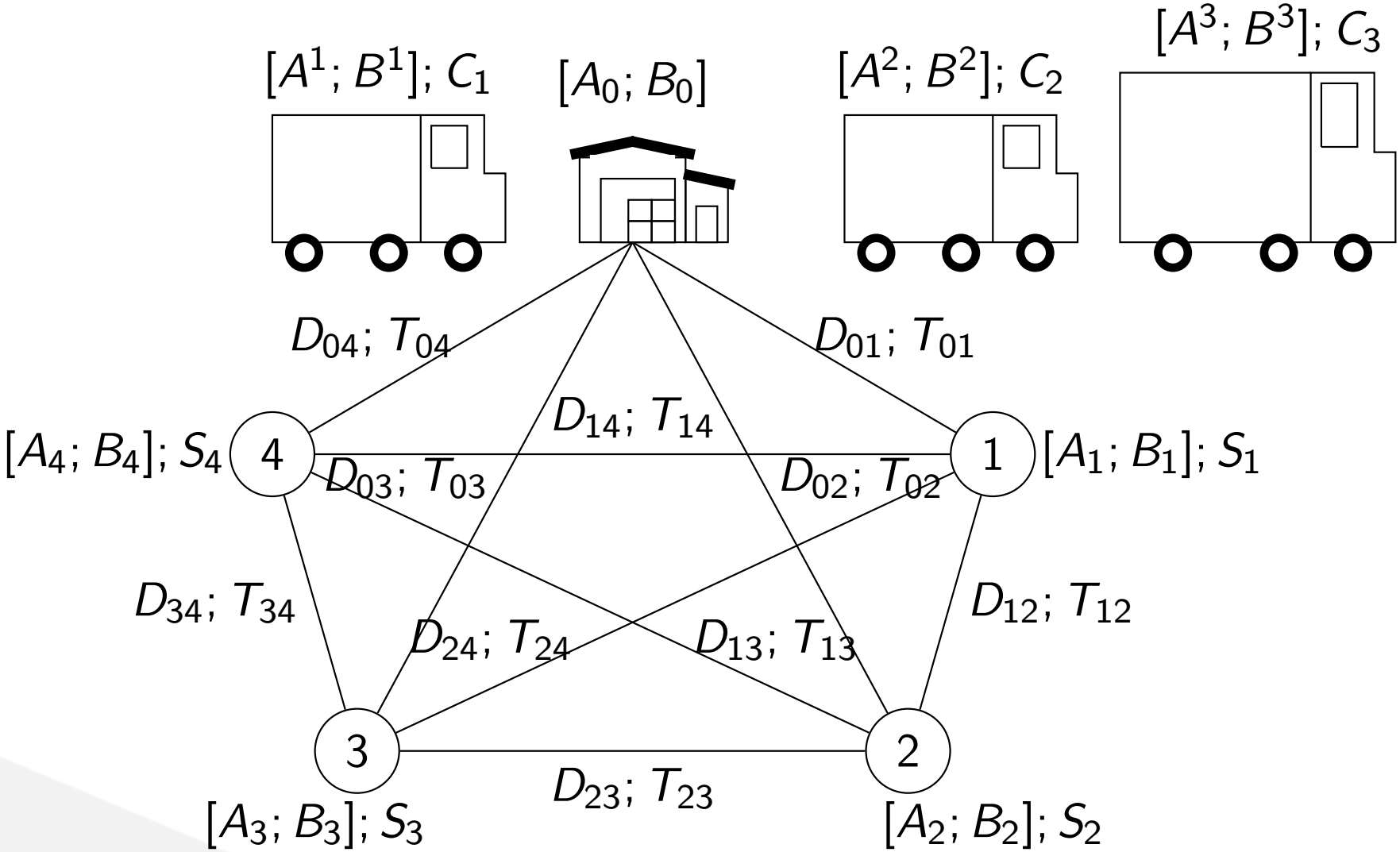
$[A_4; B_4]; S_4$ (4)

(1) $[A_1; B_1]; S_1$

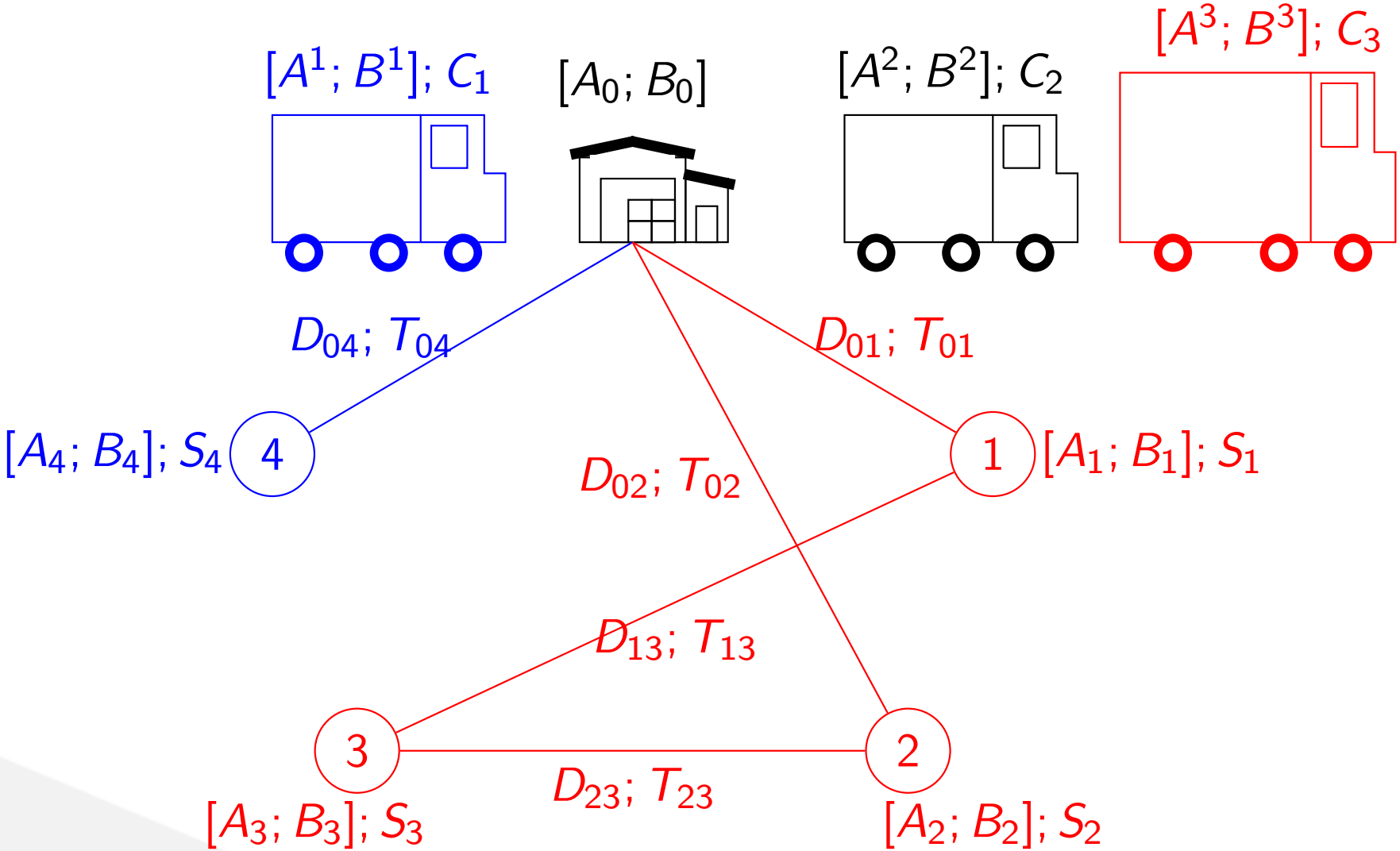
(3)
$[A_3; B_3]; S_3$

(2)
$[A_2; B_2]; S_2$

Parameters

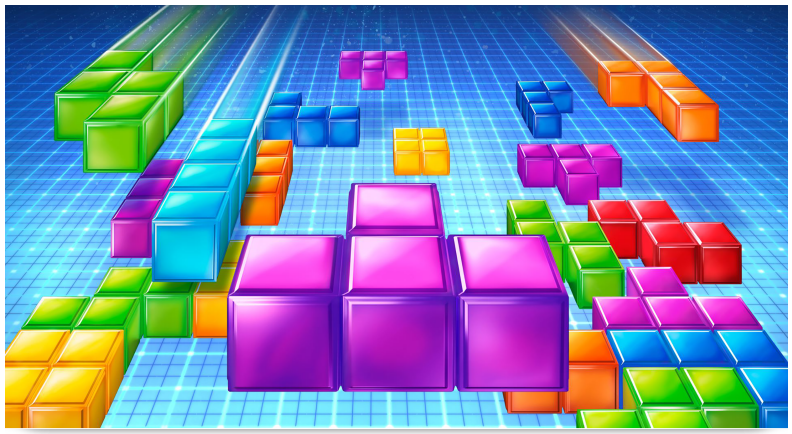

$[A^1; B^1]; C_1$
$[A_0; B_0]$
$[A^2; B^2]; C_2$
$[A^3; B^3]; C_3$
$D_{04}; T_{04}$
$D_{01}; T_{01}$
$D_{14}; T_{14}$
$[A_4; B_4]; S_4$
4
1
$[A_1; B_1]; S_1$
$D_{03}; T_{03}$
$D_{02}; T_{02}$
$D_{34}; T_{34}$
$D_{12}; T_{12}$
$D_{24}; T_{24}$
$D_{13}; T_{13}$
3
2
$D_{23}; T_{23}$
$[A_3; B_3]; S_3$
$[A_2; B_2]; S_2$

Aim

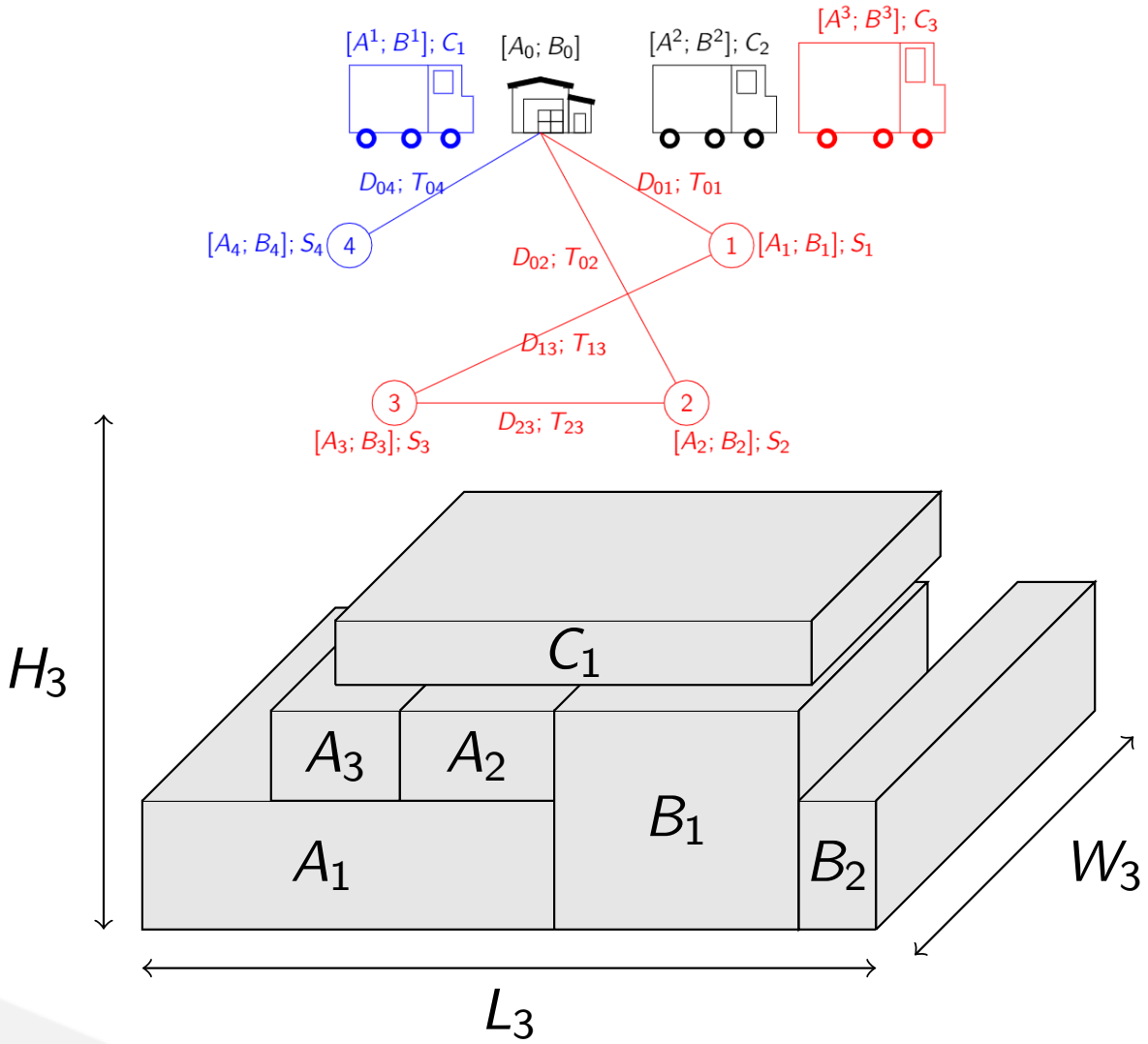

$[A^1; B^1]; C_1$
$[A_0; B_0]$
$[A^2; B^2]; C_2$
$[A^3; B^3]; C_3$
$D_{04}; T_{04}$
$D_{01}; T_{01}$
$[A_4; B_4]; S_4$
4
1
$[A_1; B_1]; S_1$
$D_{02}; T_{02}$
$D_{13}; T_{13}$
3
2
$D_{23}; T_{23}$
$[A_3; B_3]; S_3$
$[A_2; B_2]; S_2$

Packing

- Each box is completely inside the vehicle transporting it
- No overlap between boxes in a same vehicle
- Stability of boxes (i.e. the box is on the ground or its four corners are supported by other boxes)
- Rotations
- Fragility (in the sense of non stackability) of boxes



Final packing



Issues

- Split pickup vs no split pickup
- Reloading vs no reloading
- Homogeneous vs heterogeneous vehicles
- Time windows vs no time window
- Selection of boxes vs all boxes
- Selection of customers vs all customers

Summary

- Homogeneous fleet of vehicles
- A vehicle leaving the depot ends up at the depot
- Travel duration does not exceed the maximal travel duration
- Trips occurs within the different time-windows
- Each customer is visited by exactly one vehicle
- All customers' boxes are loaded
- All vehicles' capacities are respected
- Each box is completely inside the vehicle transporting it
- No overlap between boxes in a same vehicle
- Stability of boxes (i.e. the box is on the ground or its four corners are supported by other boxes)
- Rotations
- Fragility (in the sens of non stackability) of boxes

Literature

- Combination of two difficult problems
- Heuristics

							Stability						
Authors	Year	Homogeneous fleet	Time Window	Positionning LIFO	Orientation	Stacking	4 sides	Area	Reloading	Heuristics	Exact algorithm	Static	Dynamic
Junqueira et al.	2013	X			X	X		X			X	X	
Gendreau et al.	2006	X		X	X	X		X		Construction of a packing solution for a single vehicle (order of customers is given)		X	
Moura & Oliveira	2009	X	X	X	X	X	X + horizontal		X	Hierarchical method: routes are build and then packing		X	
Bortfeld et al.	2013	X	X	X	X	X		X		X		X	
Tao & Wang	2015	X		X	X	X		X		X		X	
Pace et al.	2015		X	X	?	X	?	?		X		X	
Emeline		X	X	X	X	X (fragile)	X			X		X	X

Based on the article by Pollaris, Braekers, Caris, Janssens, and Limbourg (2015)

Dynamic version of the problem

Dynamic i.e. last moment changes:

- the dimensions of the boxes vary from what was mentioned
- the weights of the boxes vary from what was mentioned
- a customer cancels (can change the packing solution)
- some boxes are missing (can change the packing solution) or some boxes are added
- a new client arrives during the day
- time windows of one or several customers are modified (boxes not ready,...)
- there is unexpected traffic jam

Pickup vs delivery

- Limited impact on the deterministic and static part of the problem
- Allow to change the plan in the dynamic version of the problem

Applications

bulky home application

ideas are welcome (enterprises, etc)

Thanks for your attention!