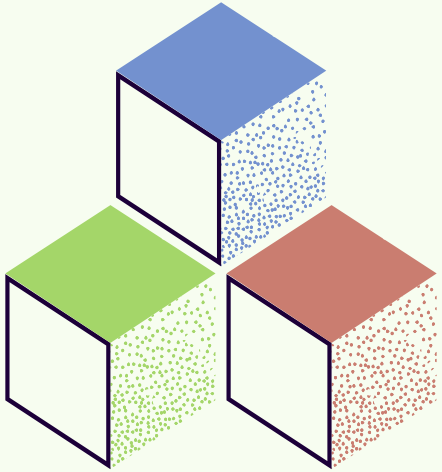
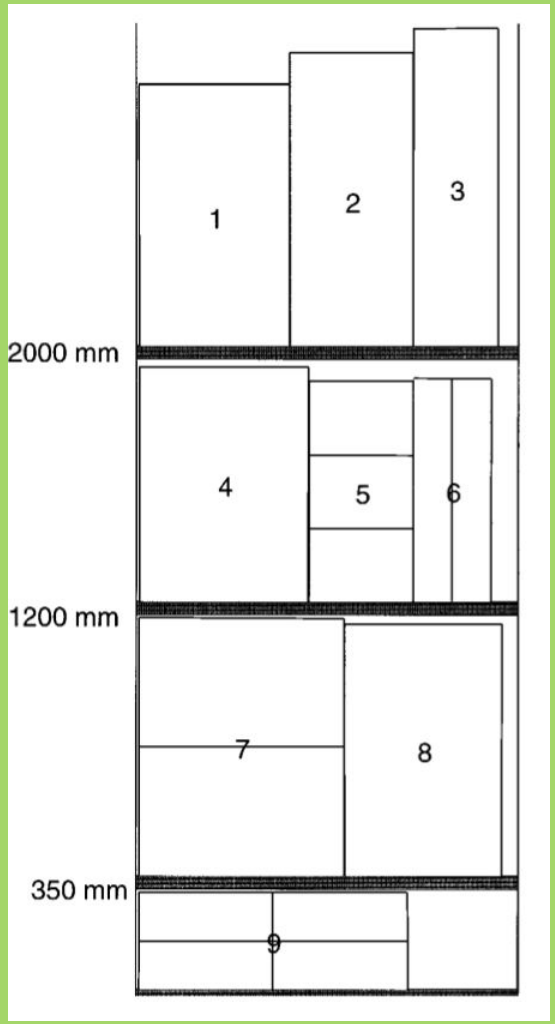


Boxes on Shelves

CLP - PROJECT 22/23

Amanda Silva up201800698
Adilson Silva up202212352

Description

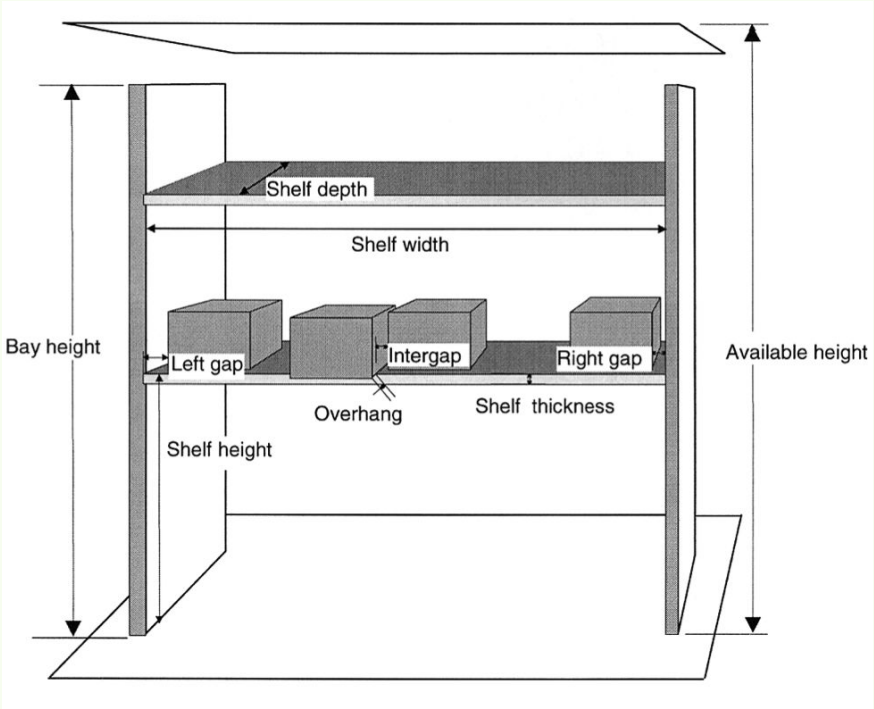


Problem

Place boxes on shelves in order to minimize the space used.

Bays & Shelves

A bay is the term we use for a set (rack) of shelving which occupies a rectangular area on the stockroom floor.



Inputs

Products

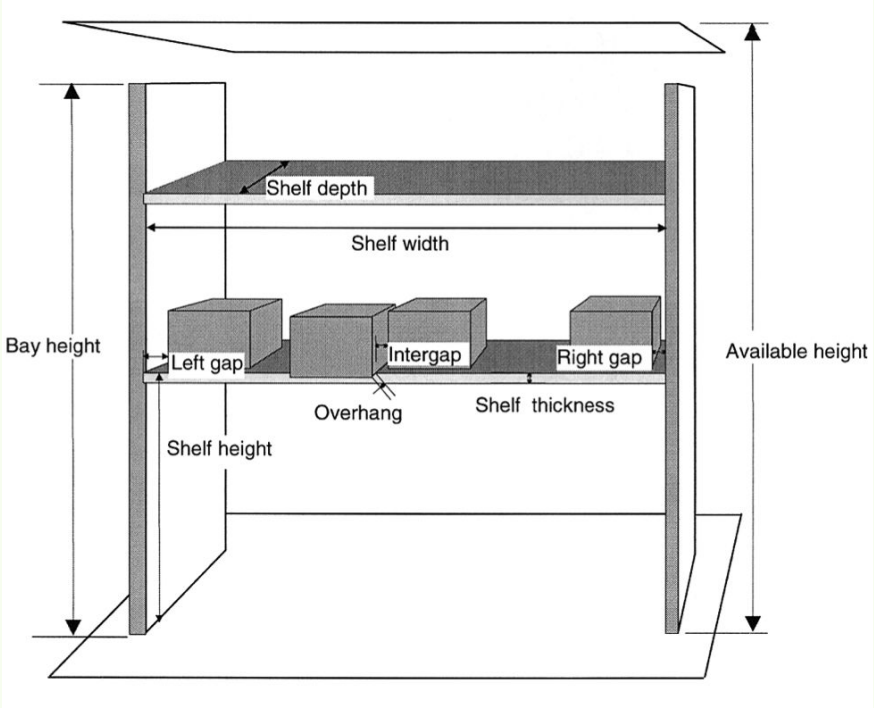
Family, quantity, length, width, height

Bays

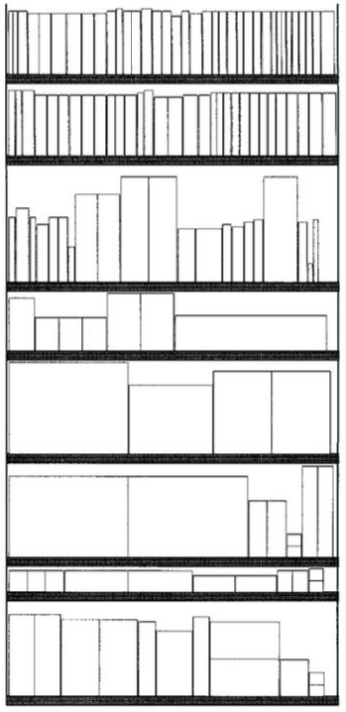
Width, height, depth, available height

Shelves

Number, thickness, position. Top, left and right gap



Output



Bay’s layout
Shelves allocation

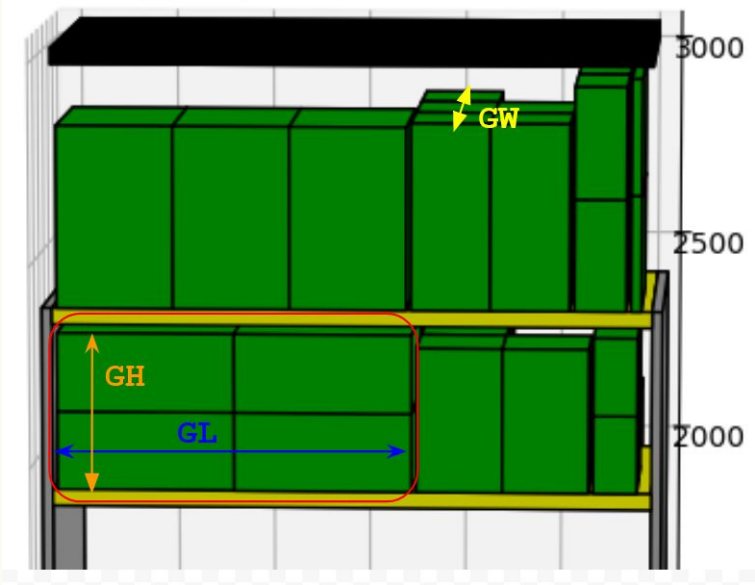
Organization of the products on the shelves

Approaches

Let's solve this problem!

Approaches:
"Paper" and "Cumulative" (Prolog)

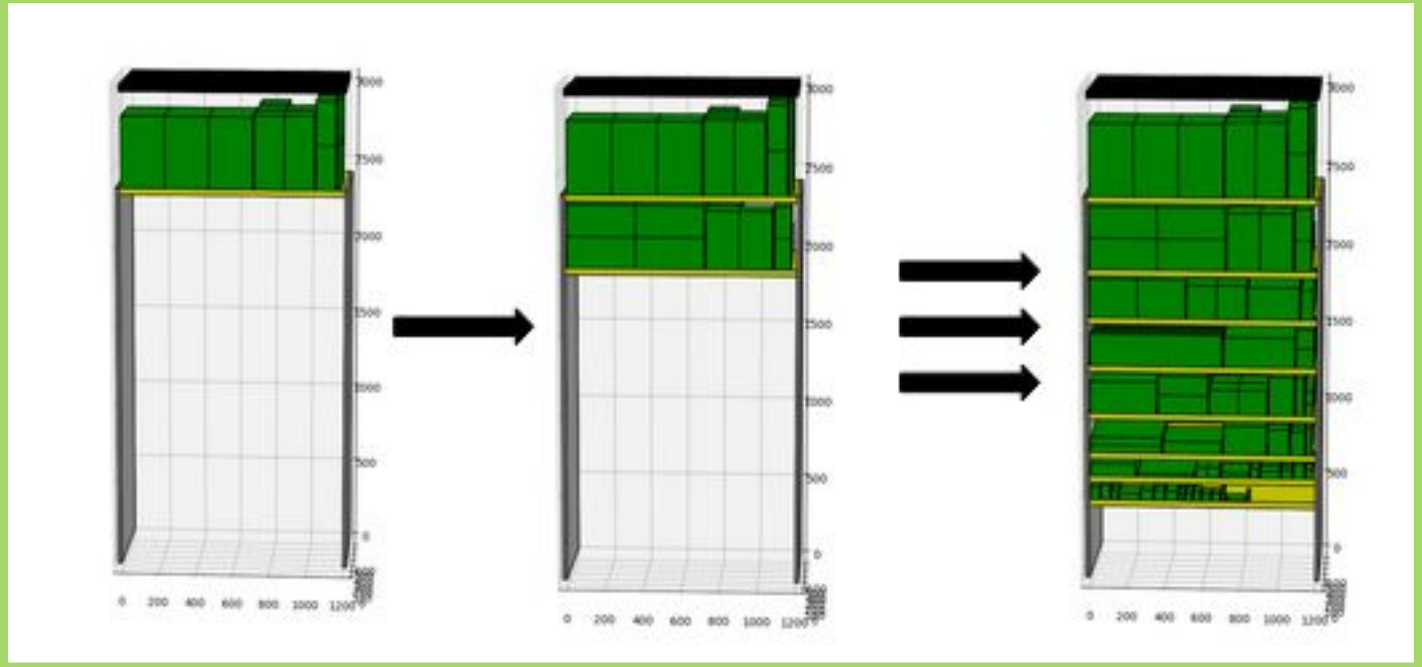
How to choose the products orientation ?



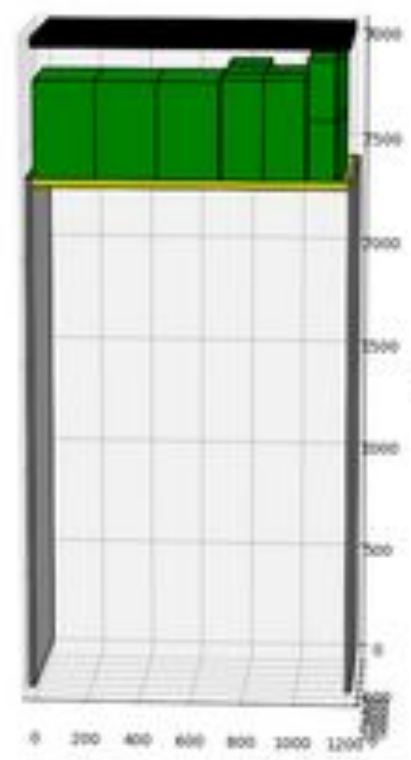
Grouped products boxes

Variables	Domain
IL,IW,IH	1..3(distincts)
RL,RW,RH	{L,W,H}
NL,NW,NH	1..Q
GL,GW,GH	positive

Model - Paper approach



Model - Paper approach



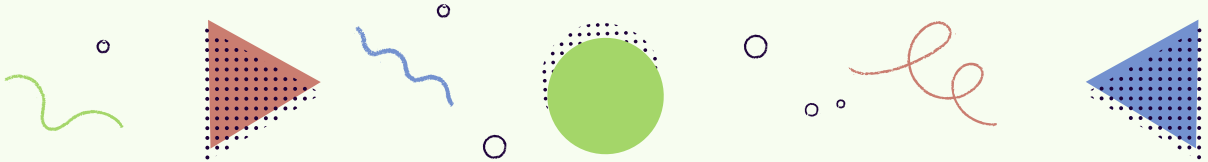
Variables	Domain
Chosen (Cs)	{0,1}
MaxH	{0,50,100...2950, 3000}
MaxL	{0..1200}

$$\sum_{i=1}^{n} Cs_i * GL_i = MaxL$$

Model - Cumulative approach

- Grouped products
- Two “cumulative”
  - `task(Shelf, 1, _, GL,1)`
    `limit = 1200`
  - `task(Bay, 1, _, MaxH, 1)`
    `limit = 3000`

Variables	Domain
`MaxHs`	`{0,50,100…2950,3000}`
`Shelves`	`{1..size}`
`Bays`	`{1..100}`



SEARCH STRATEGIES

Search strategies - Paper

Variable	Value		Time	Bays
order	options			
Gs, Cs, MaxH leftmost (default)	step (default)	up (default)	1.07	2
		down	0.52	2
	enum	up (default)	2.63	2
		down	0.46	2
	bisect	up (default)	0.79	2
		down	**0.11**	2
Gs, Cs, MaxH ff	step (default)	up (default)	311.88	3
		down	90.09	1
	enum	up (default)	335.16	3
		down	90.11	1
	bisect	up (default)	310.21	3
		down	90.04	**1**

Variable	Value		Time	Bays
order	options			
Gs, Cs, MaxH impact	step (default)	up (default)	0.43	2
		down	0.32	2
	enum	up (default)	30.4	2
		down	0.49	2
	bisect	up (default)	0.3	2
		down	**0.1**	2
Gs, Cs, MaxH ffc	step (default)	up (default)	313.66	3
		down	90.09	1
	enum	up (default)	335.13	3
		down	90.11	1
	bisect	up (default)	310.86	3
		down	90.06	**1**

Familie 1: 50 products. **Minimize(MaxH + (1200 - MaxL))**

Search strategies - Paper

Variable	Value		Time	Bays
order	options			
(Weaving) GL1,GW1,GH1,C1 … GL50,GW50,GH50, C50, MaxH leftmost (default)	step (default)	up (default)	0.07	1
		down	-	-
	enum	up (default)	0.10	1
		down	-	-
	bisect	up (default)	0.05	1
		down	-	-

Familie 1: 50 products. **Minimize(MaxH)**

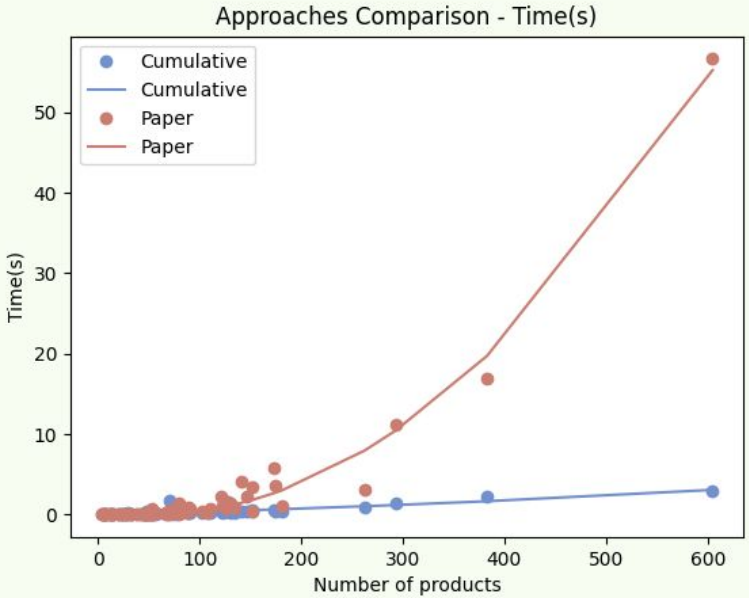
Search strategies - Cumulative

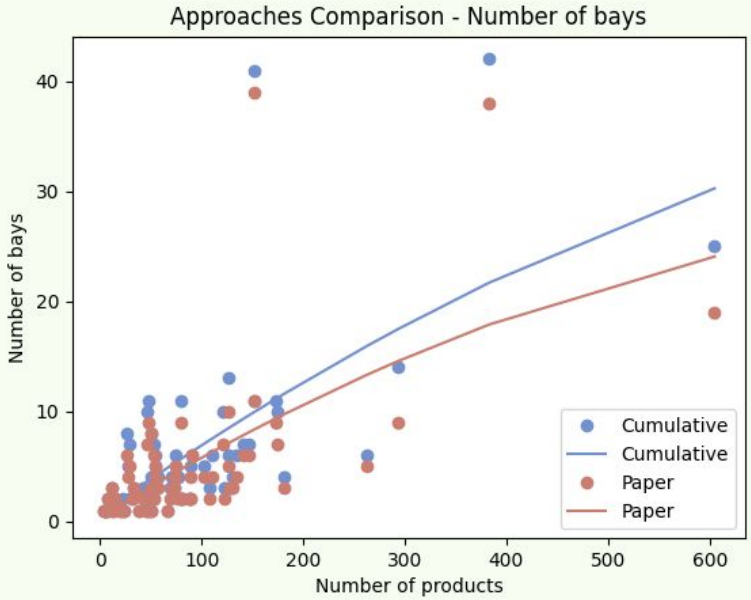
Variable order	Value options		Time	Bays
`leftmost (default)`	step (default)	up (default)	0.09	1
		down	-	-
	enum	up (default)	0.09	1
		down	-	-
	bisect	up (default)	0.31	1
		down	-	-
`impact`	step (default)	up (default)	0.09	1
		down	-	-
	enum	up (default)	0.09	1
		down	-	-
	bisect	up (default)	3.86	1
		down	-	-

Familie 1: 50 products. **Minimize(NBays)**

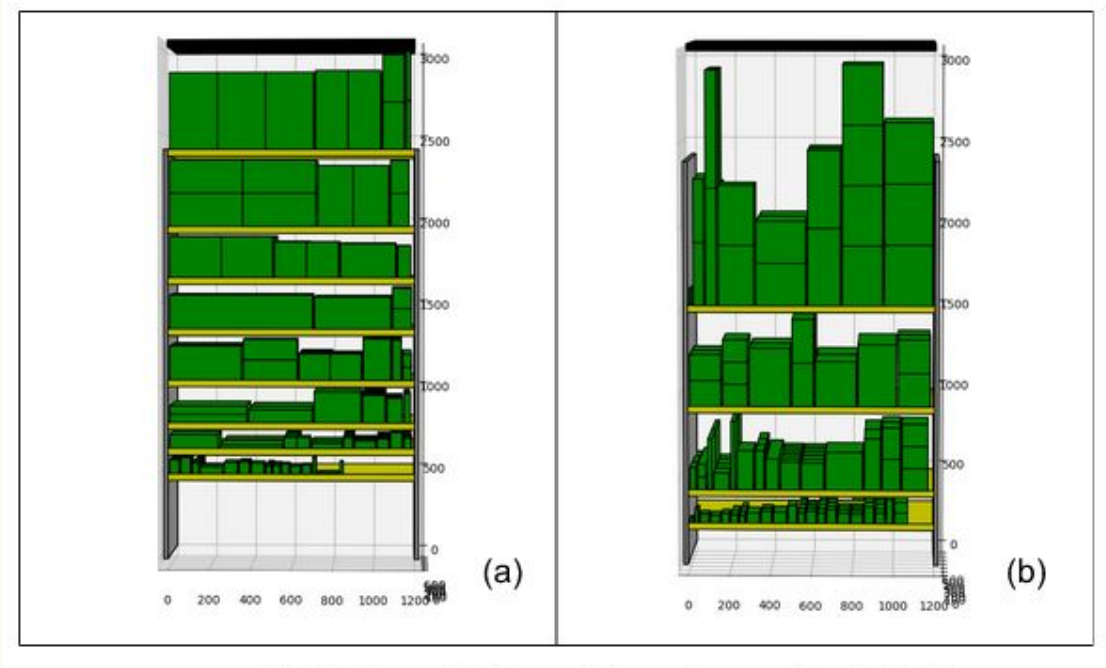
Results and conclusions

Results


Approaches Comparison - Time(s)
Cumulative
Cumulative
Paper
Paper
Time(s)
Number of products
0
10
20
30
40
50
0
100
200
300
400
500
600


Approaches Comparison - Number of bays
Number of bays
Number of products
Cumulative
Cumulative
Paper
Paper
0
10
20
30
40
0
100
200
300
400
500
600

Results



Paper

Cumulative

DEMO TIME !

Thanks!

Any questions?