

The background features a complex network of thin grey lines and dots, forming a web-like structure. Scattered throughout are various triangles of different sizes and orientations, some with solid black dots at their vertices. The overall aesthetic is minimalist and geometric.

# ZOHO's Pearl

---

BK7083 - '20/'21

Jirri van den Bos (4801792)

Milou Mulder (4833813)

Nancy Nguyen (4785029)



# Preliminary investigation

- Metronetwerk
- Resident stories
- Matrix
- Flowchart
- Design Goals
- Analysis on the site
- Brief
- Sound producing
- Bubble diagram

01

# Voxelization

- Flowchart
- Voxel size
- Code
- Kangeroo

02

# TABLE OF CONTENTS



03

# Sun analysis

- Shadowcasting
- Flowchart
- Pseudocode

04

# Generative relations: MCDA

- Flowchart
- Pseudocode



# 01

## Preliminary investigation

---

# Design goals



**Optimise the building for Sunlight and Sound Pollution**



**Develop a layout that suits the residents**

**Create a pleasant Living Environment**



**Add possibilities to the Rotterdamse Maakkwartier**



# Future residents



**Starters**

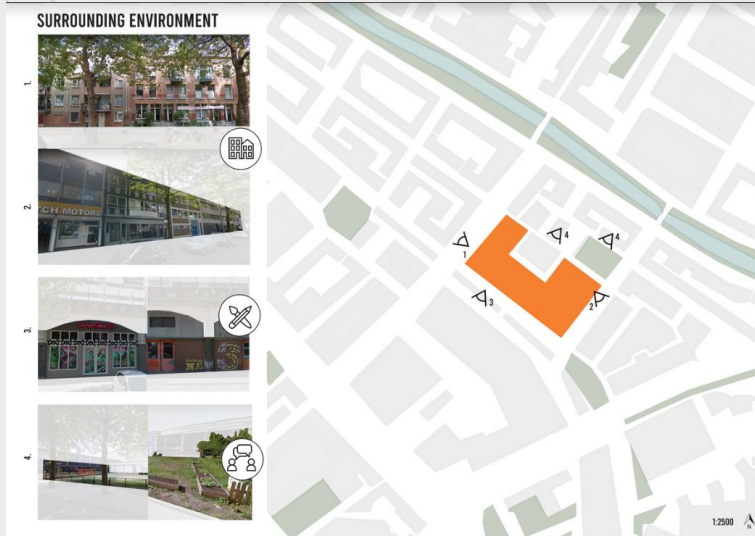


**Assisted living**

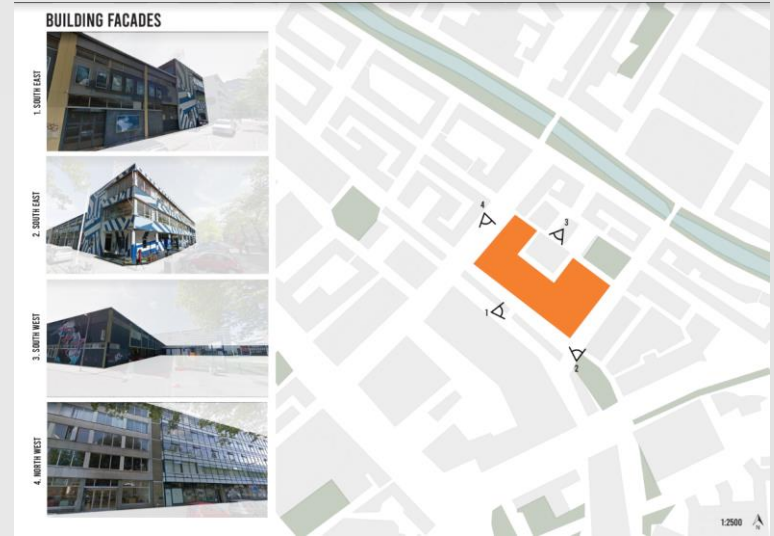


**Students**

# Captures of the site



Surrounding environment



Building facades

# Analysis on the site



Accessibility



Building heights in the near environment

## An abstract geometric pattern consisting of a network of thin, dark grey lines that intersect to form various sized triangles and polygons. Four solid dark grey dots are placed at specific vertices of the network. The background is a light, neutral grey.

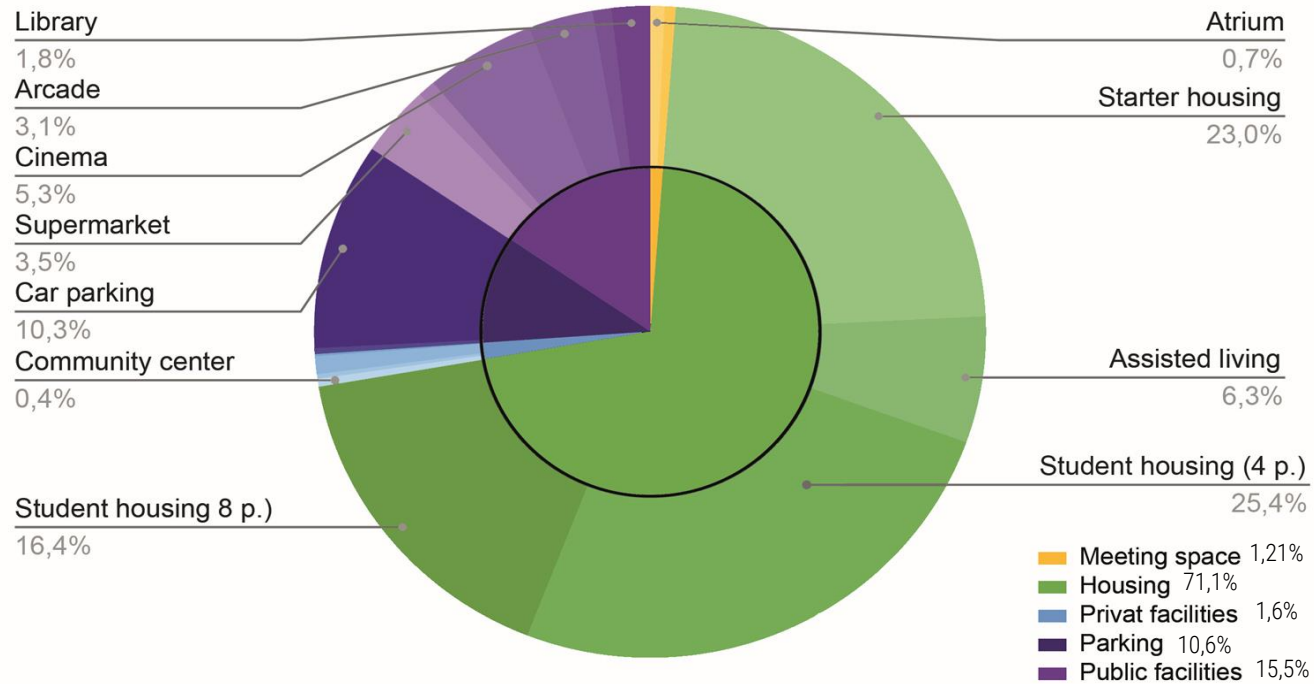


A network diagram consisting of several nodes (dots) connected by lines (edges). One node is highlighted with a larger, darker circle, indicating it is the central node of interest.

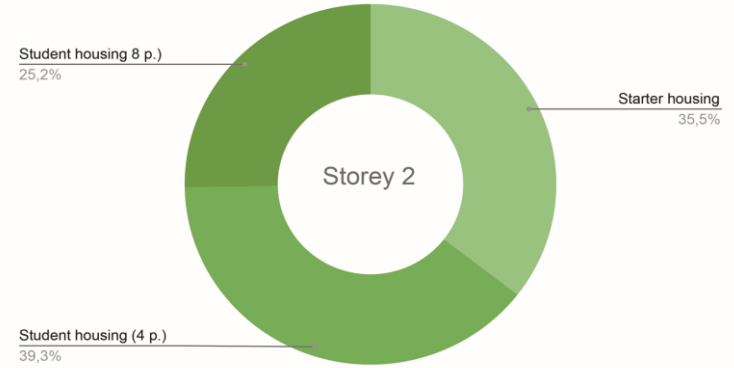
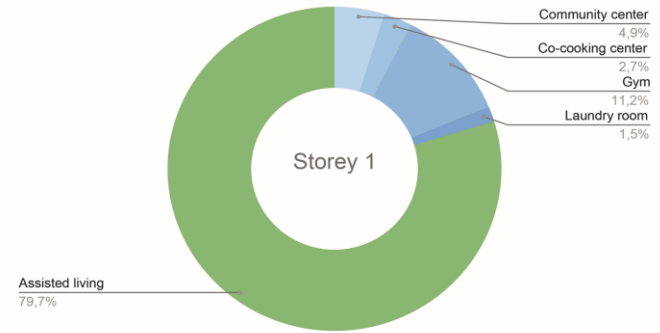
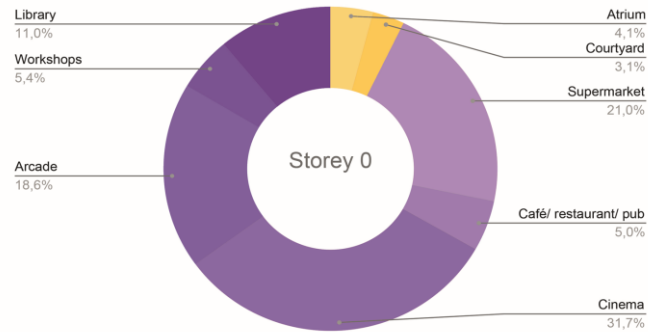
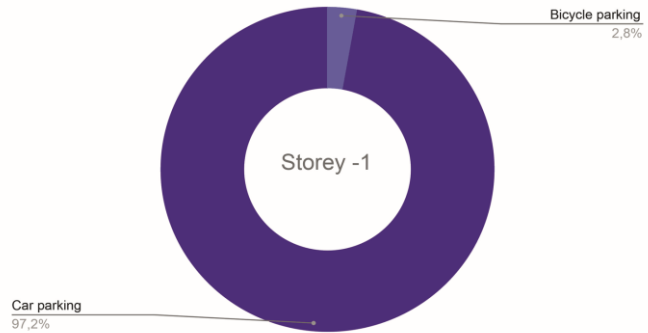
# Programme of requirements

		m² w/o m.s.	+ % movement space	m² per element	voxels (x, y)	amount	m²	voxels (x, y)	floors	voxels (x, y, z)	storey
Atrium		200	1%	202	62	1	202,00	64	2,00	256	0
Courtyard		150	1%	152	48	1	151,50	48	2,00	192	0
Starter housing (2p.)	-	62,15	8%	67	20	100	6712,20	2072	1,00	4144	2
Assisted living (2p.)	-	56,5	8%	61	18	30	1830,60	566	1,00	1132	1
Student housing (4 p.)	-	168,67	10%	186	54	40	7421,48	2292	1,00	4584	2
Student housing (8 p.)	-	109,5	9%	119	34	40	4774,20	1474	1,00	2948	2
Community center		101,37	10%	112	32	1	111,51	36	1,00	72	1
Co-cooking center		58	8%	63	18	1	62,64	20	1,00	40	1
Gym	<a href="#">p.v.e changing room</a>	233	10%	256	72	1	256,30	80	1,00	160	1
Laundry room	-	33,4	5%	35	12	1	35,07	12	1,00	24	1
Bicycle parking	<a href="#">stagerikken</a>	81,95	5%	86	26	1	86,05	28	1,00	56	-1
Car parking	neufert	2907,2	3%	2.994	898	1	2994,42	926	1,00	1852	-1
Supermarket	<a href="#">p.v.e</a>	891,12	15%	1.025	276	1	1024,79	318	1,00	636	0
Café/ restaurant/ pub	-	232,37	6%	246	72	1	246,31	78	2,00	312	0
Cinema	<a href="#">PVE</a>	1408,89	10%	1.550	436	1	1549,78	480	4,00	3840	0
Arcade	-	788,89	15%	907	244	1	907,22	282	2,00	1128	0
Workshops	-	80,16	10%	88	26	3	264,53	82	1,00	164	0
Library	<a href="#">PVE</a>	468,89	15%	539	146	1	539,22	168	3,00	1008	0
		4161,74		8.688	1286		24637,96			15460	

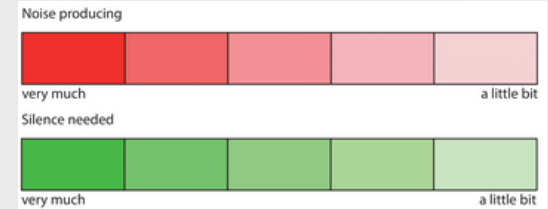
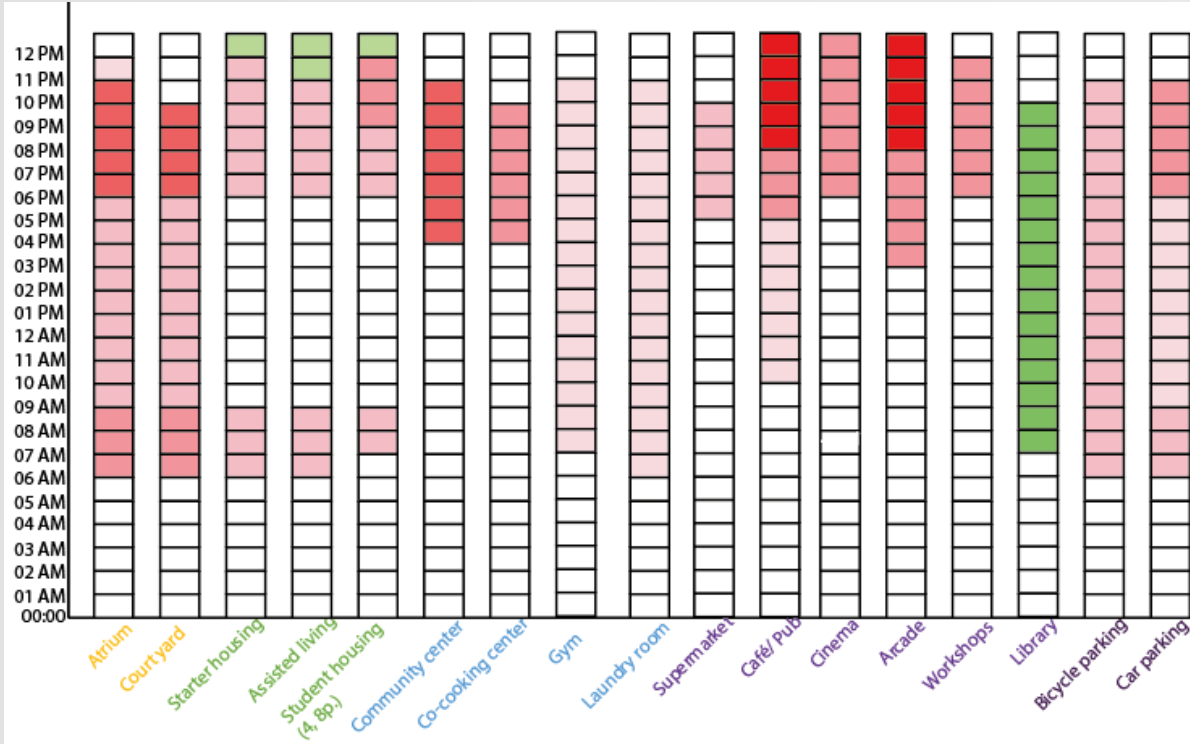
# Programme



# Programme

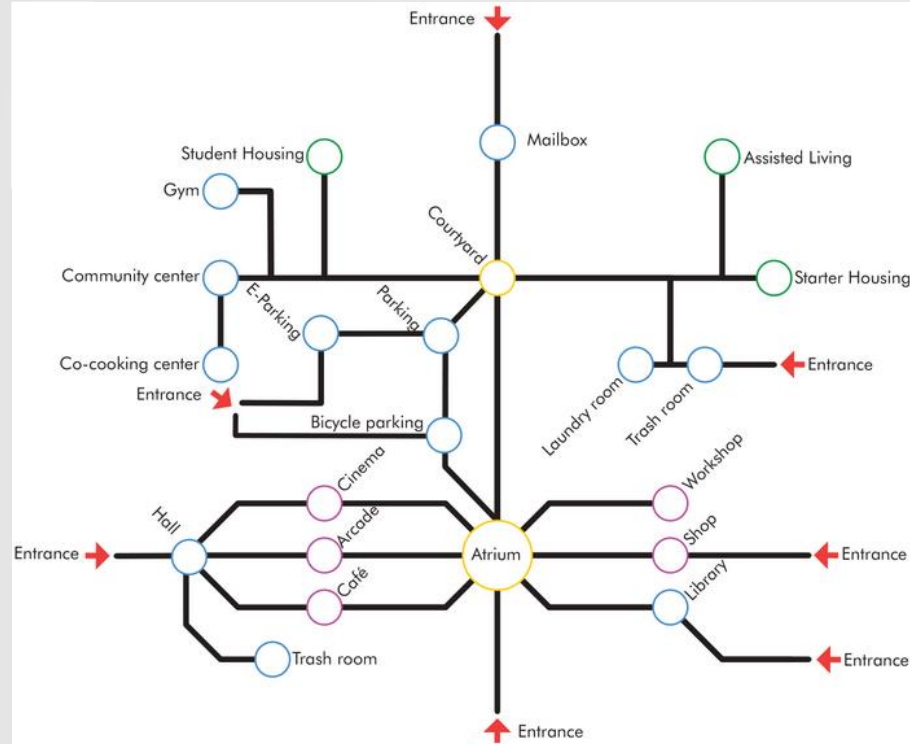


# Sound producing

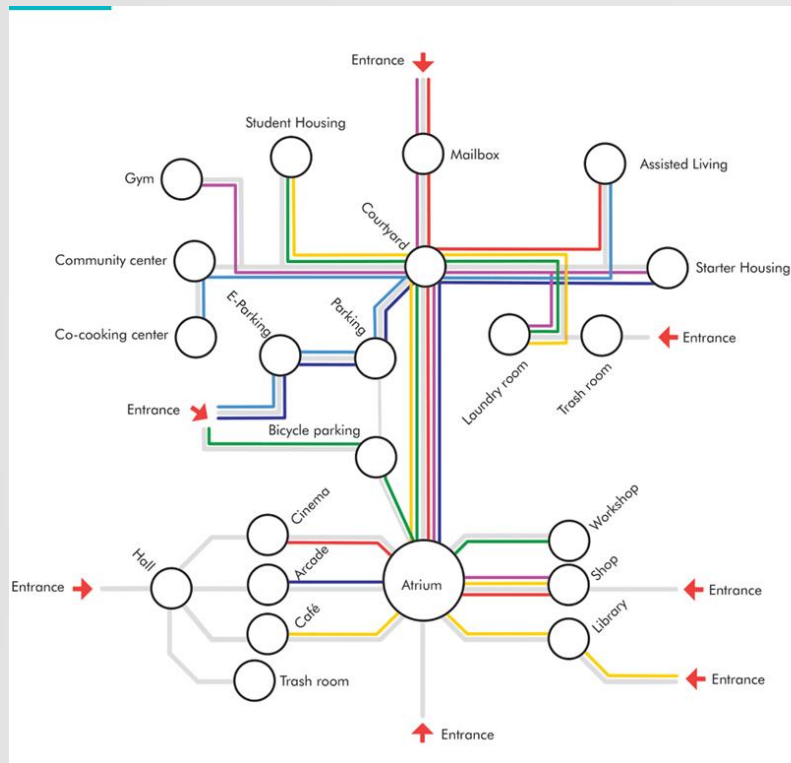




# Metronetwerk



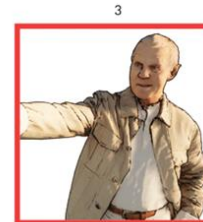
# Resident stories



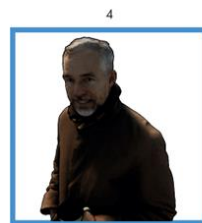
Chunlin, 26, is an Arts student who enjoys social contacts and working with different forms of art. He gives workshops to other residents and outsiders to pay the bills.



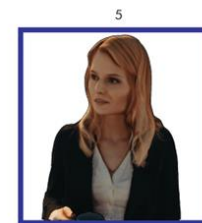
Mila, 20, is an international student who usually studies in the library and goes for a cup of coffee in the café. She uses the shop to buy lunch and groceries.



Robert, 79, is retired after a career in construction. After a recent knee operation he moved into assisted living. Since his greatest passion is movies he is often found in the buildings cinema



Fabien, 70, is a retired widower who enjoys social contacts with his fellow residents. He can often be found cooking in the co-cooking center for anyone who likes to join.



Helen, 34, is a motivated starter who is anxious about covid-19 and therefore only works at home and uses the sports and shopping facilities in her building.



Sharron, 26, is a young video game developer at the start of career with great prospects. She enjoys spending time in the Arcade and drives her electric car to work.



# Matrix

		atrium	courtyard	gym	community center	co-cooking center	library	laundry room	bicycle parking	car parking	starter housing	assisted living	student housing	supermarket	cinema	café / pub	arcade	workshops
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	Atrium		5	X	X	X	1	X	3	3	X	X	X	3	1	2	1	1
1	Courtyard	5		1	3	X	X	2	3	3	3	4	3	X	X	X	X	X
2	Gym	X	1		1	X	X	X	X	X	X	X	3	X	X	X	X	X
3	Community center	X	3	1		4	X	X	X	X	X	X	2	X	X	X	X	X
4	Co-cooking center	X	X	X	4		X	X	X	X	X	X	X	X	X	X	X	X
5	Library	1	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	Laundry room	X	2	X	X	X	X		X	X	3	2	X	X	X	X	X	X
7	Bicycle parking	3	3	X	X	X	X	X		3	X	X	X	X	X	X	X	X
8	Car parking	3	3	X	X	X	X	X	3		X	X	X	X	X	X	X	X
9	Starter housing	X	3	X	X	X	X	3	X	X		1	X	X	X	X	X	X
10	Assisted living	X	4	X	X	X	X	2	X	X	1		X	X	X	X	X	X
11	Student housing	X	3	3	2	X	X	X	X	X	X	X		X	X	X	X	X
12	supermarket	3	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
13	Cinema	1	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
14	Café / pub	2	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
15	Arcade	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
16	Workshops	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

0 not important/ does not care worst  
 0.2 barely important  
 0.4 slightly important  
 0.6 important  
 0.8 very important  
 1 extremely important/ cares a lot best



# Matrix

0	not important/ does not care	worst
0.2	barely important	
0.4	slightly important	
0.6	important	
0.8	very important	
1	extremely important/ cares a lot	best



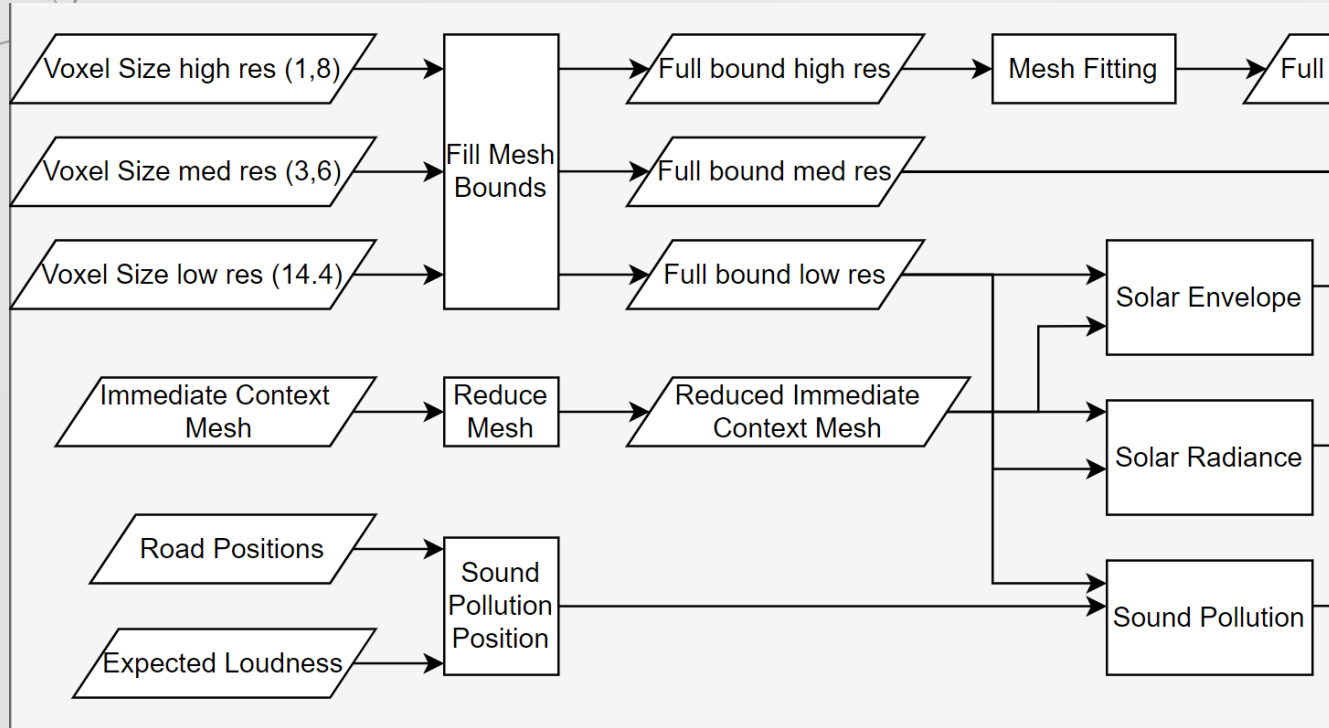


# 02

## Voxelization

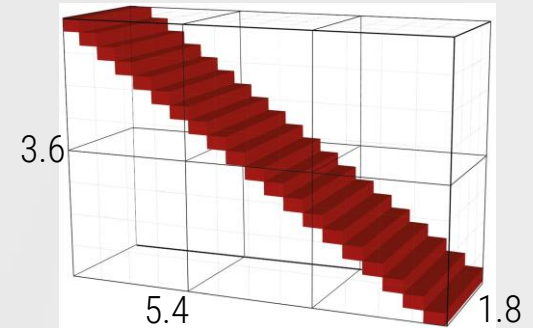
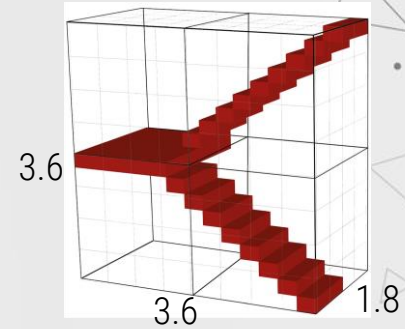
---

# Flowchart

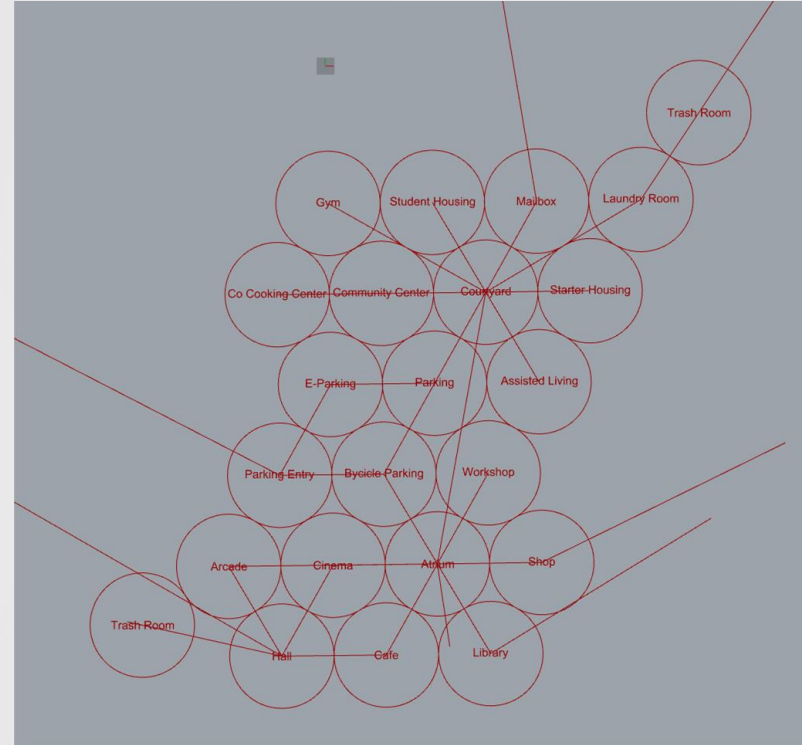
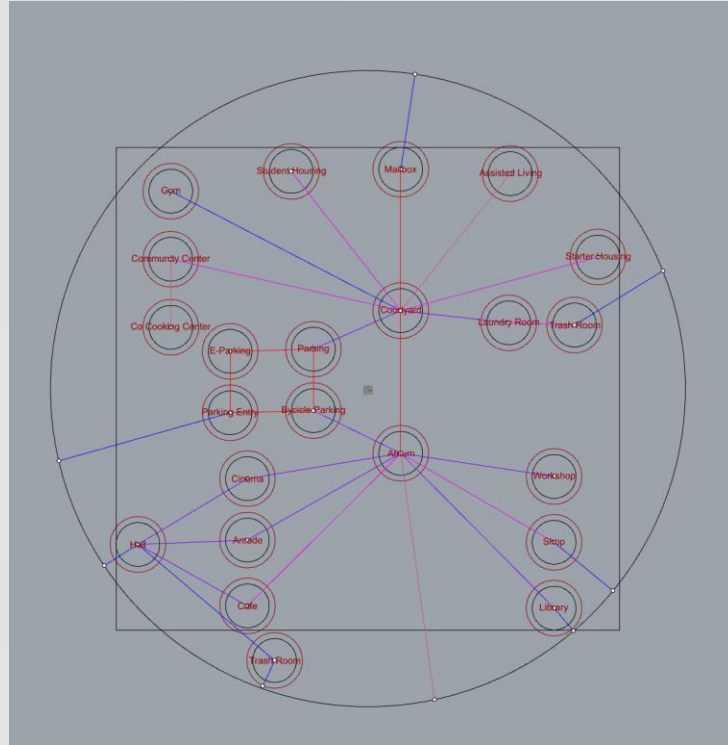


# Voxel size

Stair No.	Voxelsize	Staircase type	Voxels in x, y, z	meters in x, y, z	Steps	Height of step	Angle of staircase
Stair 1	1.8	Straight	1, 2, 2	1.8, 3.6, 3.6	18	0.2	45°
Stair 2	1.5	Straight	1, 2, 2	1.5, 3.0, 3.0	15	0.2	45°
<b>Stair 3</b>	<b>1.8</b>	<b>Bordes</b>	<b>1, 2, 2</b>	<b>1.8, 3.6, 3.6</b>	<b>20</b>	<b>0.18</b>	<b>31°</b>
Stair 4	1.5	Bordes	1, 2, 2	1.5, 3.0, 3.0	17	0.2	32.1°
<b>Stair 5</b>	<b>1.8</b>	<b>Straight</b>	<b>1, 3, 2</b>	<b>1.8, 5.4, 3.6</b>	<b>20</b>	<b>0.18</b>	<b>33.7°</b>
Stair 6	1.5	Straight	1, 3, 2	1.5, 4.5, 3.0	17	0.176	33.7°
Stair 7	1.8	Bordes	1, 3, 2	1.8, 5.4, 3.6	24	0.15	23.4°
Stair 8	1.5	Bordes	1, 3, 2	1.5, 4.5, 3.0	20	0.15	23.7°



# Kangaroo



# 03

## Sun analysis

---



# Current shadow-casting through the year (roughly)



15 January, 12:00



15 February, 12:00



15 March, 12:00



15 April, 12:00



15 May, 12:00



15 June, 12:00



15 July, 12:00



15 August, 12:00



15 September, 12:00



15 October, 12:00

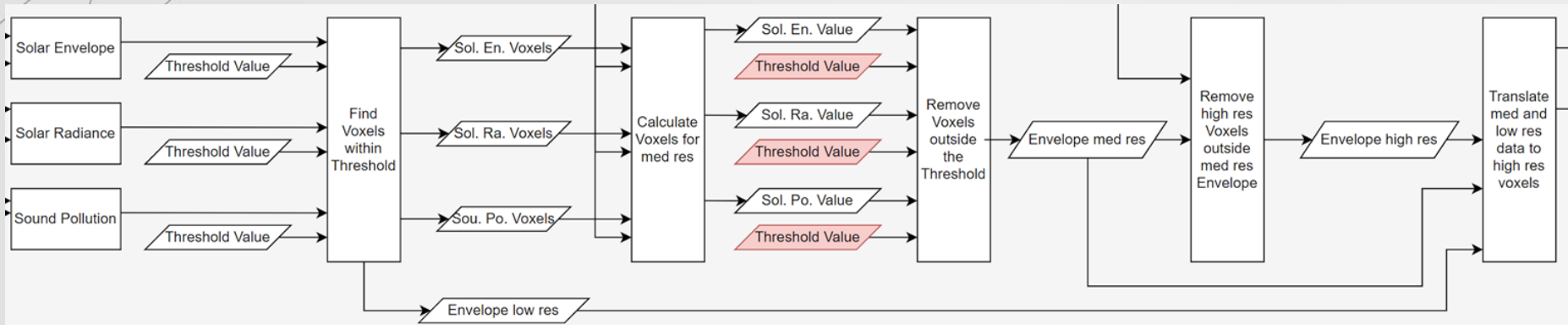


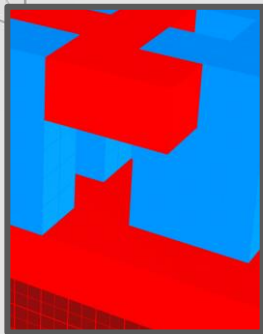
15 November, 12:00



15 December, 12:00

# Flowchart





#Initialize Variables

voxel sizes:

current  
required  
final

Threshold values:

low bound  
high bound

#Initialize Envelope CSV

import: current size solar Envelope

read shape via lattice

read data with csv.reader

CSV useable:

Convert strings to int where possible

Remove empty lists

Arrange in Lattice shape

#Use Thresholds to split data

For each voxel

if the envelope value is between the Thresholds

Scale voxel to the required size and add to keep\_coords

elif the envelope value is between 0 and high bound (only after pass 1)

Scale voxel to the required size and add to rest\_coords

elif the envelope value is greater than the high bound

Scale voxels to the required size and add to remove\_coords

#Find the min and max of keep\_coords per x,y coordinate

For each x y in keep\_coords

if voxel is in keep\_coords

add z to temp\_list

find min and max in temp\_list add with x y to min\_max\_list

# Pseudocode

#Establish separate lists for x y and min max

For each list in min\_max\_list

add x y to min\_max\_coords

add min max to min\_max\_values

#Fill any voxel between the max and min

For each list in min\_max\_list

For each z value between min and max

add coordinates to calculate\_coords

#Use a list of all voxels under the high bound to find which to keep

establish full\_coords as combination of keep\_coords and rest\_coords

for each voxel in full\_coords

if x y is in min\_max\_values

find the index of x y in min\_max\_values

use index to find min max

if z is greater than the min value

remove this voxel from full\_coords

establish final\_coords as full\_coords with remove\_coords

remove\_coords

Scale the final\_coords voxels to the final size

#Use the largest size voxel csv as basis for translation

Import the CSV

read data with csv.reader

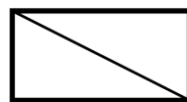
CSV useable:

Convert strings to int where possible

Remove empty lists

Place top lines into top\_csv

Place rest of the lines into rest\_csv



#Use final\_coords to create a list of final size voxels to print after this pass

For each top\_csv lines

set both the shape and size correct

Scale the rest\_csv voxels into the final size

Set each boolean to false

For each voxel in final\_coords

if the voxel is also in rest\_csv

set the boolean to True

Establish final\_result as the combination of top\_csv and rest\_csv

#Repeat this process for the voxels in calculate\_coords

For each top\_csv lines

set both the shape and size correct

Scale the rest\_csv voxels into the final size

Set each boolean to false

For each voxel in final\_coords

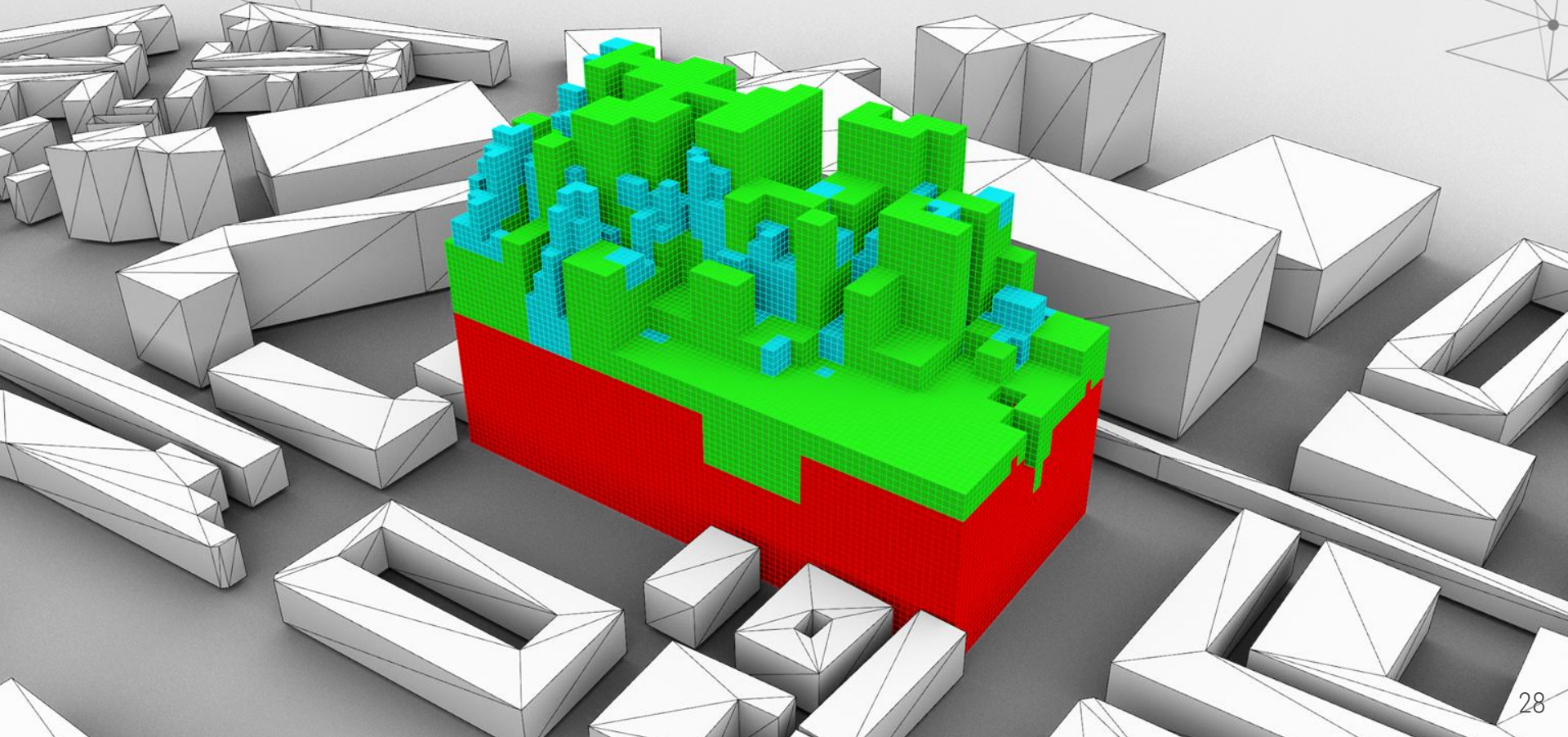
if the voxel is also in rest\_csv

set the boolean to True

Establish calculate\_result as the combination of top\_csv and rest\_csv

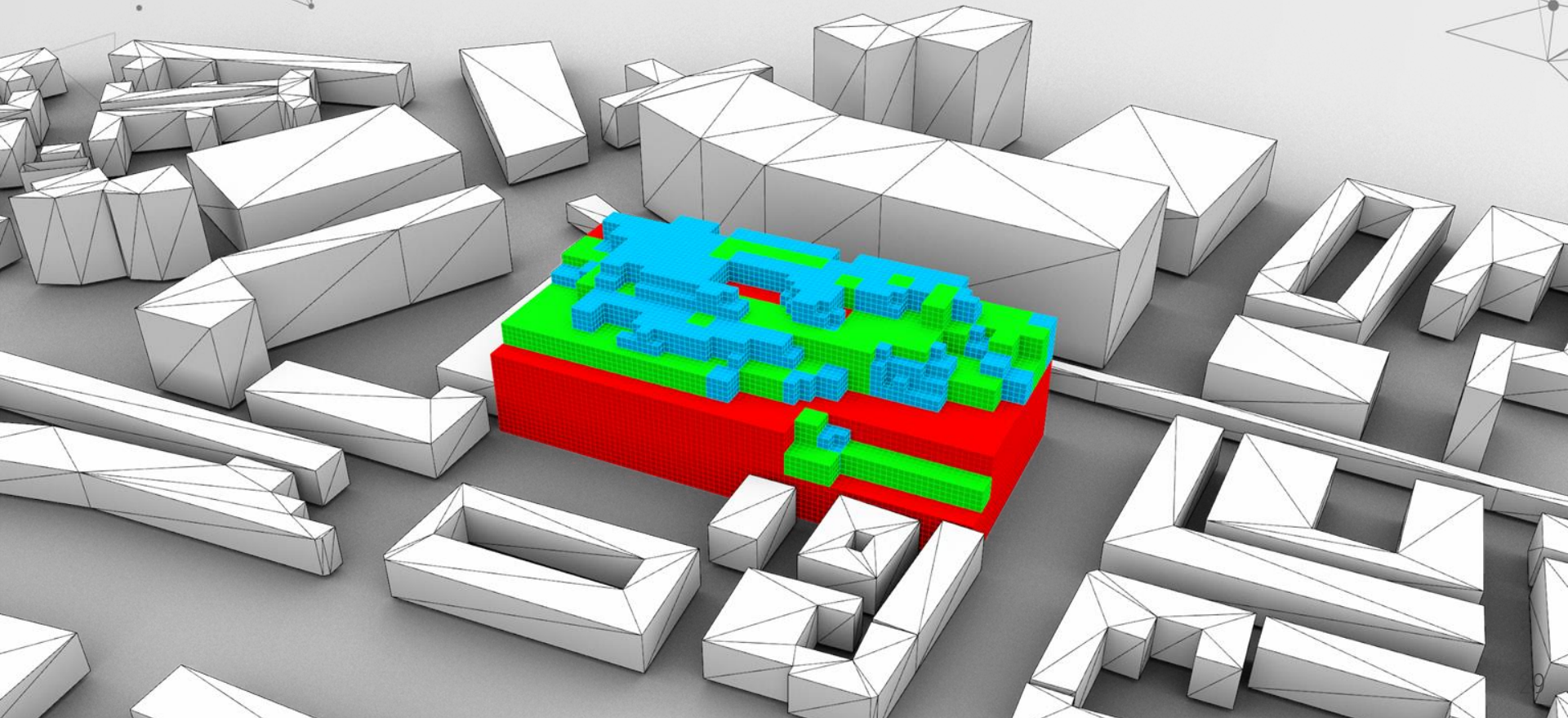
#Write both results to proper CSV file with double enters

# Version 1





## Version 2





# 04

## Generative relations: MCDA

---

# flowchart

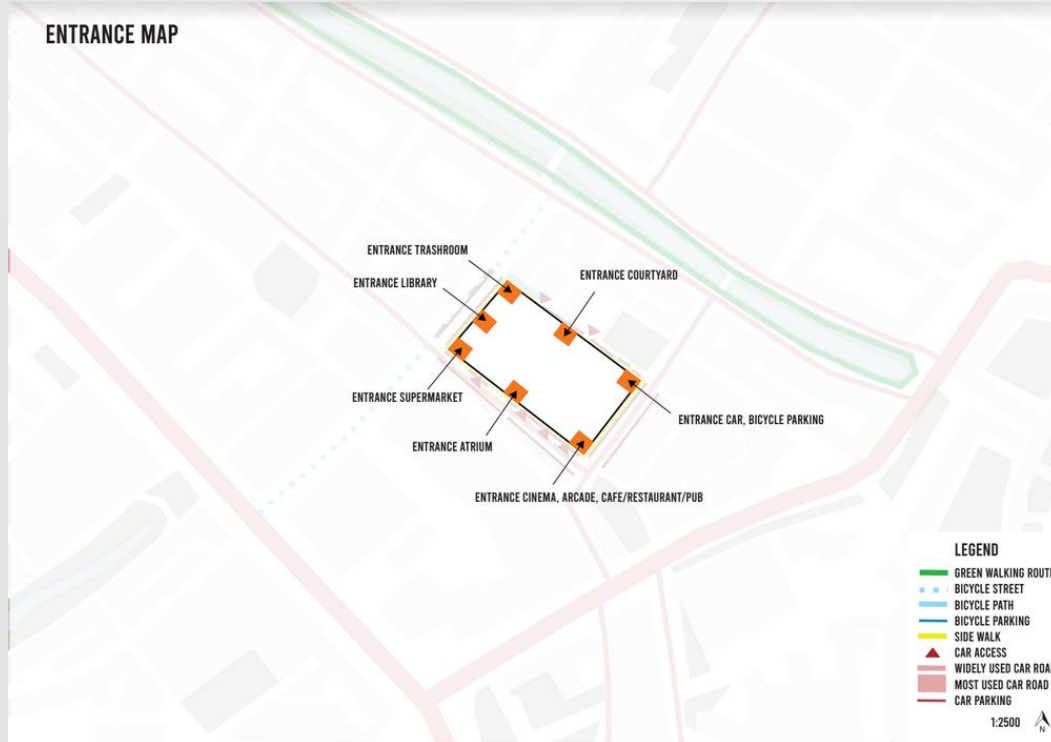


# Matrix

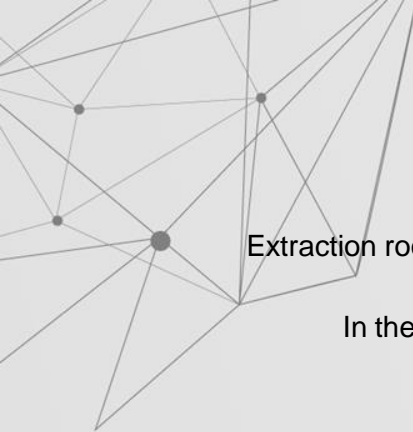
0	not important/ does not care	worst
0.2	barely important	
0.4	slightly important	
0.6	important	
0.8	very important	
1	extremely important/ cares a lot	best



# Entrance map



# Pseudocode



Extraction room area, initial location

In the table agent\_info use every row and only the 29th column (room area)

In the table agent\_info use every row and only the 30th column (initial location)

Procedure initialization location entrance

if initial location == -1 then

the origin of the agent will be computed

else the flat initial location of the entrance array will convert into a tuple of coordinate arrays that have been specified.

Procedure grow to assigned amount of voxels

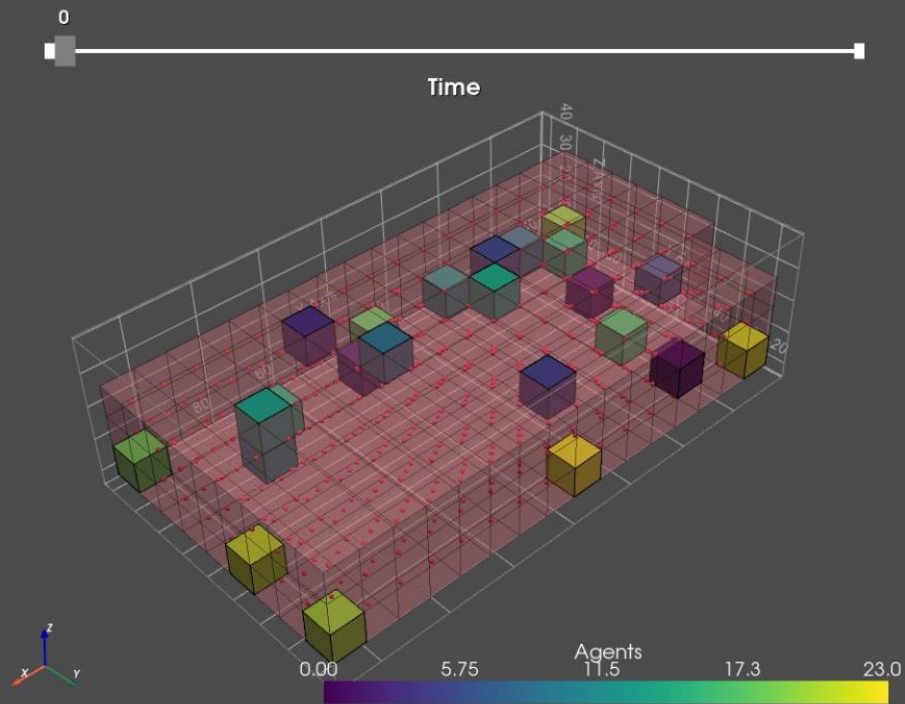
while time < max assigned agent area

keep running the simulation

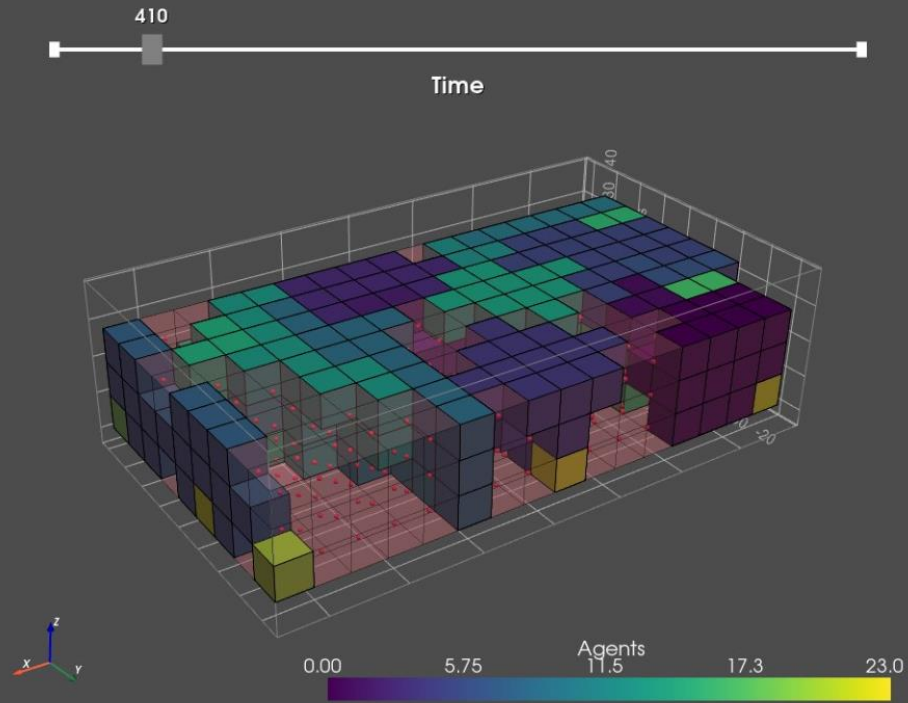
for every agent if length of agent location is smaller than the assigned agent area

keep running the simulation

# Visualisation



Initial location



Growing model



# The next steps

- Voxelization
- Agents





# THANKS

Does anyone have any questions?

[https://MilouMulder.github.io/spatial\\_computing\\_project\\_template/](https://MilouMulder.github.io/spatial_computing_project_template/)

Jirri van den Bos,  
Milou Mulder,  
Nancy Nguyen