ISOBENEFIT CITIES - STEPPING INTO THE URBAN GROWTH LAB

LAIDLAW FOUNDATION RESEARCH PROGRAMME

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BACKGROUND

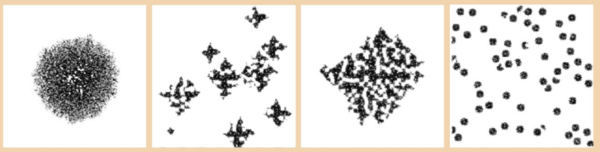
Cellular automata, the catalyst for this project, are mathematical models that consist of a grid of cells, where each cell's state changes over discrete time steps based on predefined rules determined by its neighboring cells.

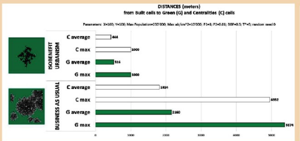
Given the unprecedented speed and scale of global population growth and urbanization, it is now more crucial than ever to understand urban morphogenesis, which this tools helps to do.My research project, 'Stepping Into The Urban Growth Lab,' centres on the application of the isobenefit code to simulate potential evolutionary trajectories of urban growth in cities. through adjusting rules whether a block could be built due to set parameters which reflect real-life conditions.

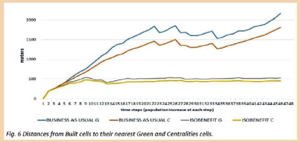
CONCEPT

White points: centralities Black:15,000pop/km2 Light Grey: 150pop/km2 White Area: green land

(Typical urban growth model vs Isobenefit Urbanism Model)







(Comparitive statistics from Luca S. D'Acci's and Michele Voto's description of the Morphogenesis of Isobenefit Urbanism)

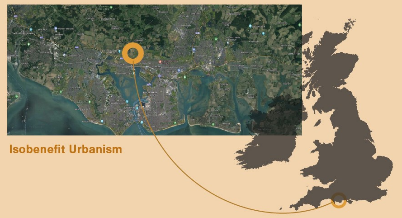
UNDERSTANDING PARAMETERS

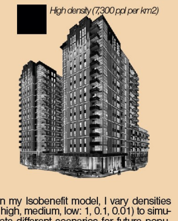
The isobenefit Python code produces simulations of Isobenefit urban morphogenesis, where natural land, shops, amenities, services and places of work can become more reachable by modifying the densities, surface, population size, random factors and built probabilities.

- **Centrality point** *(Shops, Restaurants, School, Libraries, Important Community Spaces*
- **Non-buildble areas** *(Not nature)*
- **Already built areas** *(Neighbours)*
- **Buildable Nature**
- **Non -buildable Nature** *(Parks, local greenery)*

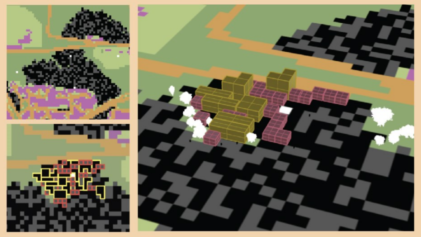
QUESTION

The focus was applying this code to an actual area to create hypothetical balanced and optimal urban growth simulations. The outcomes would be a conversation seed to design cities which would serve the actual communuties in the given area, by using paramaeters within the code based on authentic population and geographical statistics.

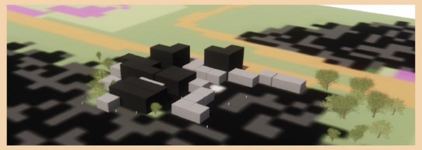




In my Isobenefit model, I vary densities (high, medium, low: 1, 0.1, 0.01) to simulate different scenarios for future population growth. Each map cell adjusts in size according to the map's scale.

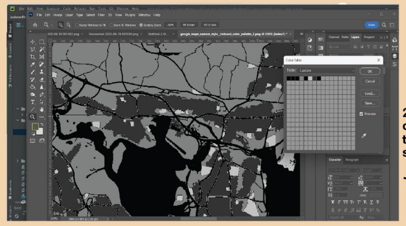


Flexible zoning is crucial when dealing with concentrated population densities. It enables adaptable land use regulations that evolve with urban needs, fostering dynamic, inclusive communities through mixed-use development.

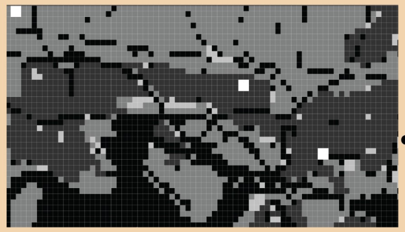


3D visualisation of types of residential buildings in the urban fabric:
Yellow- high density buildings; Red- medium density buildings

1. Find area and translate to simple vector.



2. Convert it to a monochrome, pixelated image to be readable by the software.



3. Input image into code through the function "Reading From Image".

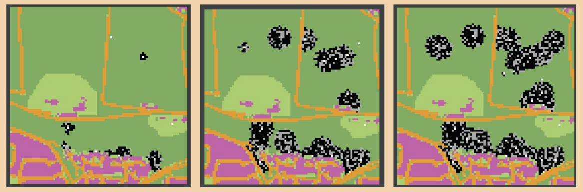
APPLICATION OF CODE + VISUAL TRIALS

METHODOLOGY

Code explanation : conditions
A type of block is built depends of what rules are set in order for this to happen. Here is an example of a condition being able to host a centrality;

```
else:
if np.random.rand() < self.neighboring_centrality_probability:
if True:  # self.nature_stays_extended(x, y):
if self.nature_stays_reachable(x, y):
block.centrality = True
block.built = True
block.nature = False
block.set_block_population(self.block_pop, 'empty', self.population_density)
added_centrality += 1
```

RESULTS



Case Study A

In this example, a 60-meter distance between amenities and residential areas is suggested. This is particularly beneficial for areas with young families or elderly residents who require easy access to services and shops. Additionally, areas with higher population density may benefit from a smaller T* for increased accessibility to amenities in a concentrated space.

Max. Pop	Build Probability	Neighbouring-Centrality-probability	Random Seed	T*	Max-ab - km2	Probability Distribution	Walkable distance
10,000	0.7	5e-3	43	6	5100	(0.7, 0.3 ,	60m

Case Study B

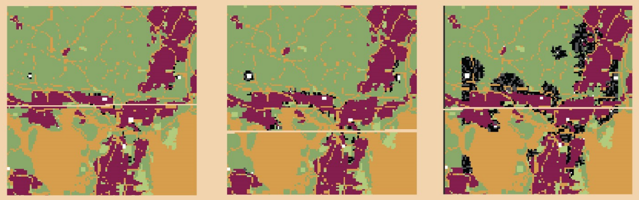
The high density input with a low probability of centrality points results in larger clusters, which would require more transportation for good connections. This suggests a strategy for urban planners: distribute residential buildings in areas abundant with amenities, but lacking sufficient housing.

Max. Pop	Build Probability	Isolated-Centrality-probability	Neighbouring-Centrality-probability	Walkable distance	T*	Max-ab - km2	Probability Distribution (Density) high/med/low	Random seed
10,000	0.75	0.5	5e-3	400m	40	5100	(0.6, 0.4, 0))	7

Comparing these two simulations, I have experimented with the max populations and the green space and amenities distances. The top simulation gives more spread out and simulations that encourage green corridors to weave through the urban fabric.

Walkable distance; 500m (8min city)- Map context
This is an interesting example of a more optimal urban spread, with the blend of different densities, helping the city to breathe and find balance. This is due to the isolated centrality probability, allowing the building clusters to be spread out more.

Simulation shown on a bigger scale of Portsmouth. Although T = 10, one block covers a much larger area, so different-leveled-density regions would be discussed, rather than individual buildings.*
Max Population = 200,000
Density distribution (High, Medium, Low) = (1, 0.1, 0.01)
Density Probability (High, Medium, Low) = (0.7, 0.3, 0)



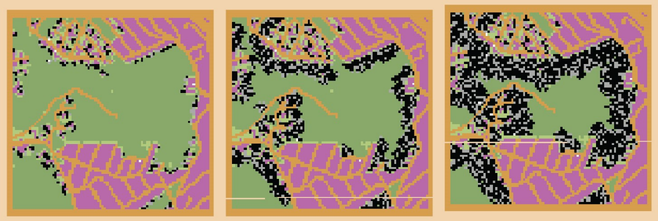
CONCLUSION

The isobenefit model is an invitation to conversations for more more community-centred and ecological designs of cities. By further experimentation, introduction of parameters and complex conditions, this tool has to potential to nuture truely more walkable and liveable cities.

NEXT STEPS

However, it is important to always consider the geographical, economical and social situation of a given area, and adjust the simulations accordingly.

It is also vital to establish what is meant by the cell types, for example, what counts as a green space and how to proportion it equally.
This could be the future of desinging cities, diverging from a "one-size-fits-all" approach to more considerate design.



IMPACT

This software opens up new research avenues, exploring how small-scale growth connects to larger patterns and why the same rules yield diverse outcomes. It significantly enhances our understanding of sustainable urban forms and their creation by allowing manipulation of crucial parameters.

Welcome to reach out! - zcftnkw@ucl.ac.uk
"Future Urban Growth Lab"

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