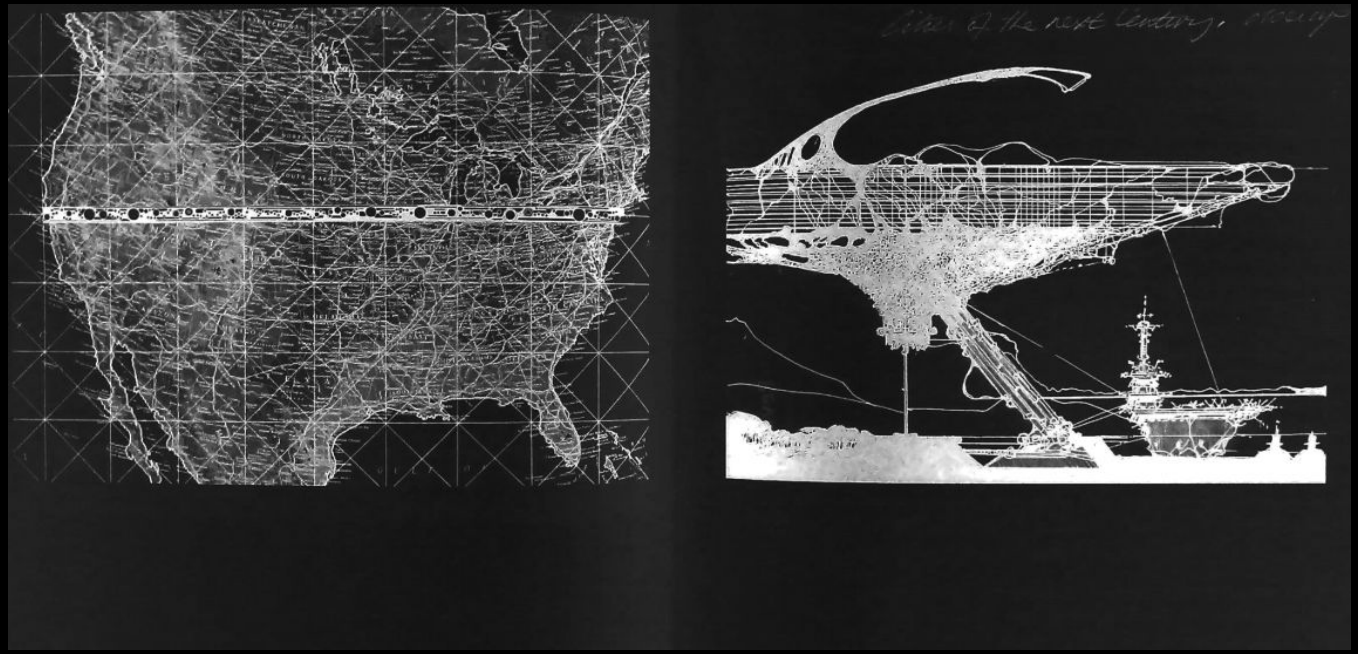


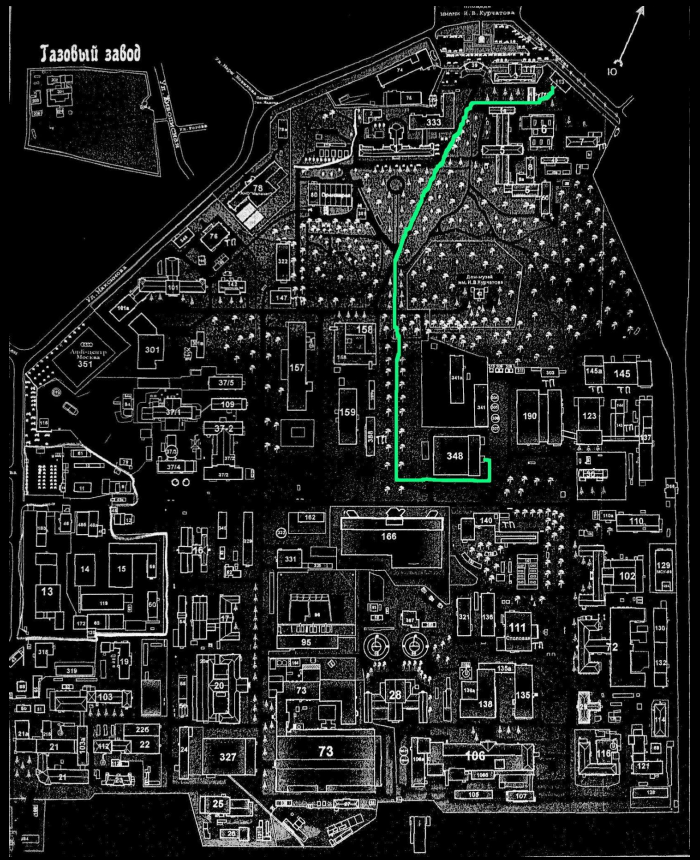
Decoding the city: Data, Future Cities, Megapolises, and Urbanism

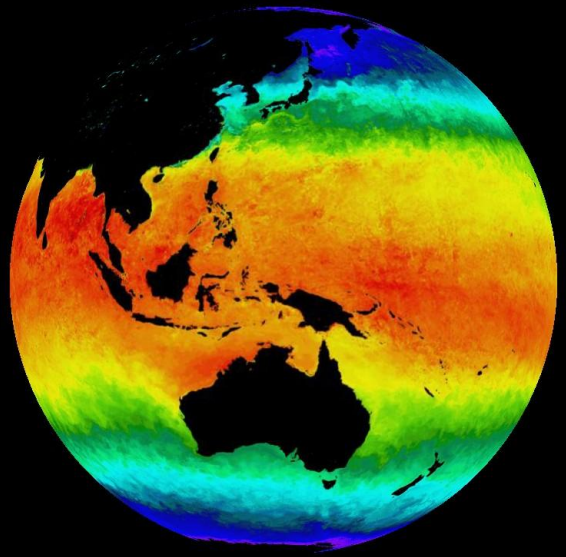
Liubov Tupikina
LPI, Paris, France, Bell labs

Who am I?
Researcher at CRI Paris France, BellLabs
#mathematics #physics #computer science
Phd in Theoretical physics

Cofounder City Interaction lab,
Lecturers without borders lewibo.org
CorrelAid Paris, Interaction data lab (at cri-paris.org)
Lecturer at digital masters (LPI Paris)

Social media X: @luyibov

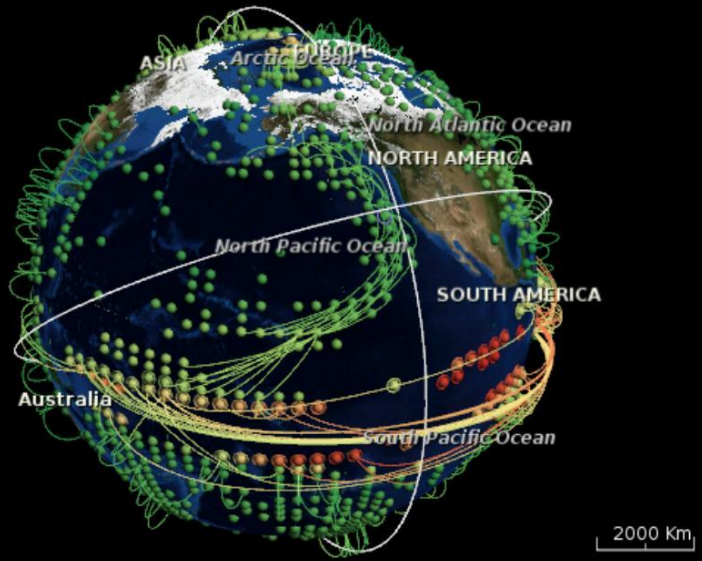


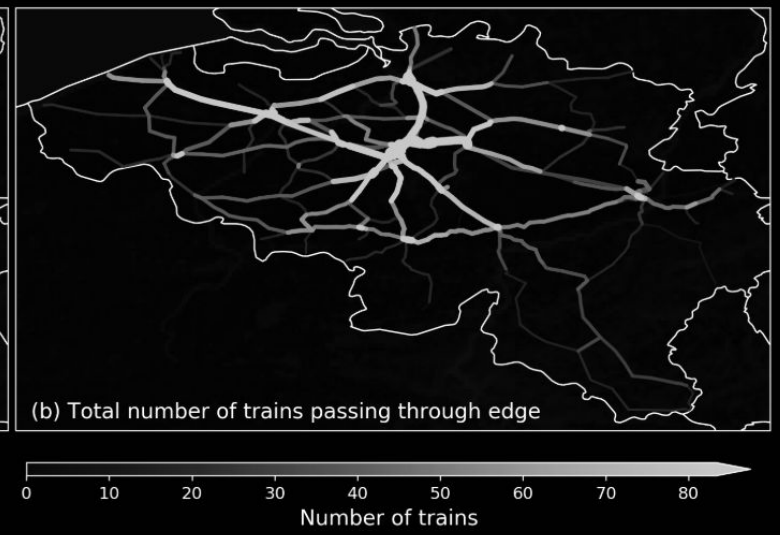


Research path?

Moscow State University - Humboldt University, Potsdam Climate Institute -

Complex Systems Institute, Mallorca, Spain - Utrecht University - Ambrosys, Germany - Uruguay University - Polytechnique, France





Transport in networks Nature Comm. (2020)

Modelling railway delay https://arxiv.org/abs/2105.061

City evolution in time
C.Lagesse, L.Tupikina, P.Bauman

Shared bike systems
https://github.com/Liyubov/bike-sharing

Citizen science city analysis
https://github.com/correlaid-paris/citizen_science_ina
ralist

Analysis of innovations in science
cri-paris.org

Closed cities ZATOs
https://theterraforming.strelka.com/

Your background?

Today's course topics

Complexity science

theory

Data science and network theory used in urbanism and architecture

Projects on city systems: participatory practice with citizens

practice

Discussions about papers

Course topics

Complexity Science

self organised transport, systems thinking, city as a complex system Paper 1

Data Science for cities, and its limitations Paper 2

OECD report: participatory governance

Report link

Part 1
Complexity science

Complexity science

1. Complex system: introduction to basic concepts and properties

2. Modeling complexity

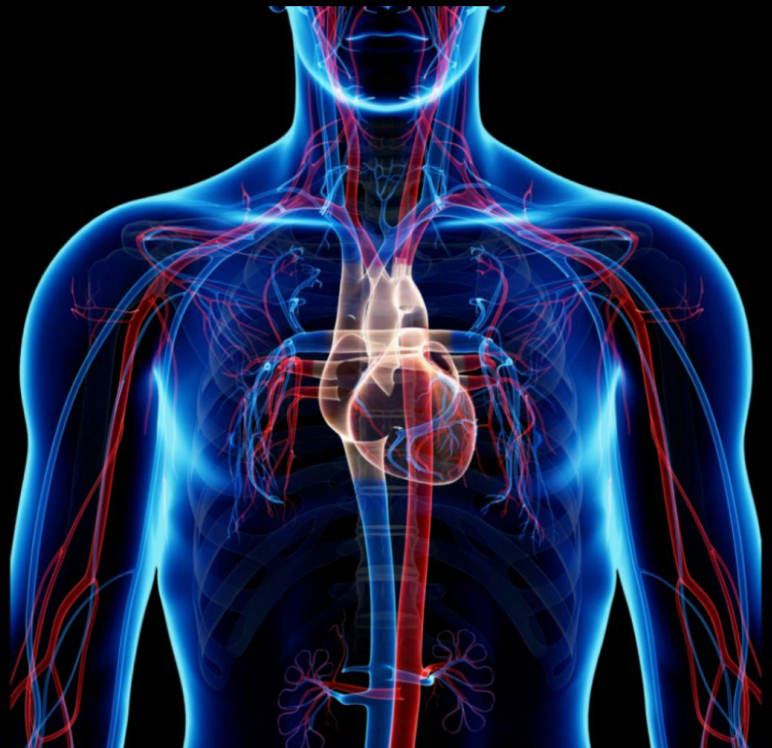
3. Tackling complexity with AI

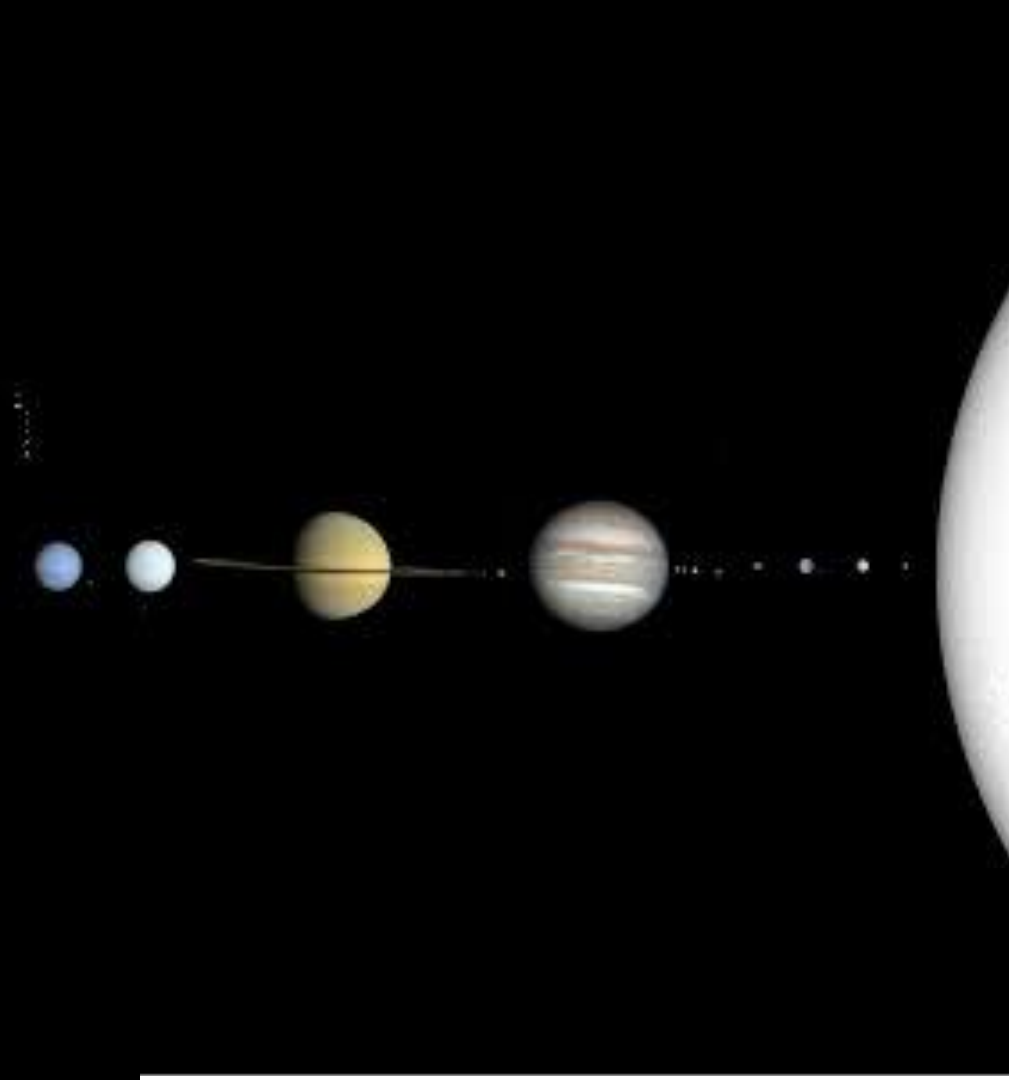
1. Complex system: introduction to basic concepts and properties

1. Definitions and methodologies
2. Basal laws and predictability
3. Emergence of complexity out of simplicity: When simple laws leads to unpredictability
4. Emergence of stability out of complexity
5. Tipping points
6. Resilience
7. The place of systems science across academic disciplines

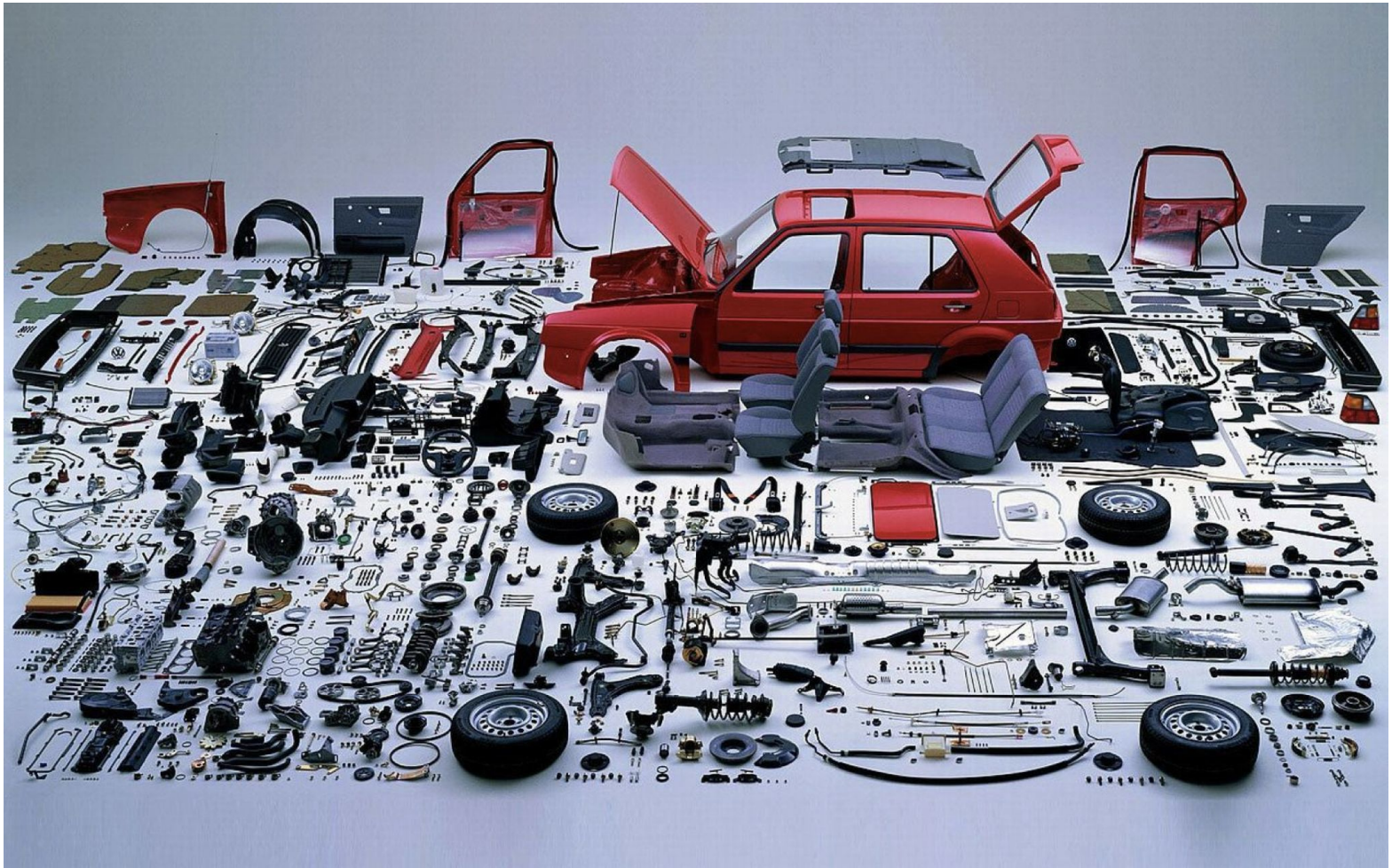
“I think the next century will be the century of complexity”.
S.Hawking, 2000

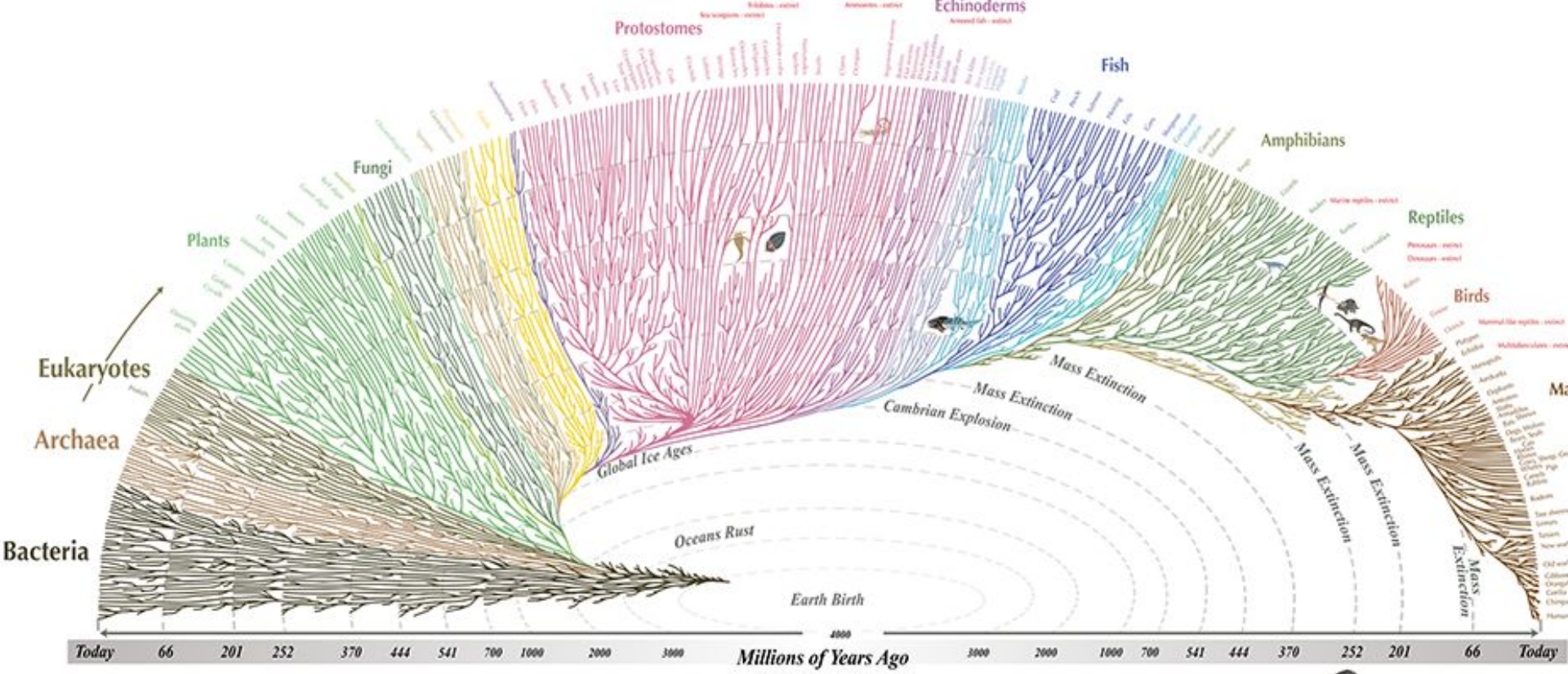
What is a system?





The whole is greater than the sum of the parts





All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct

Paradox:
a system can be deterministic and yet unpredictable

Predictability of various systems

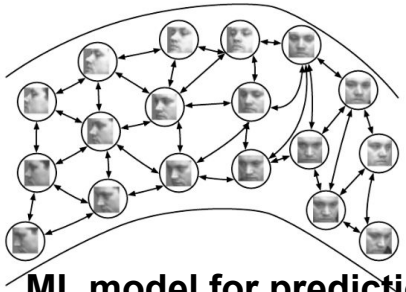
“The "butterfly effect" : a small change in one state of a **deterministic nonlinear system** can result in large differences in a later state.

Double pendulum

Predictability of various systems

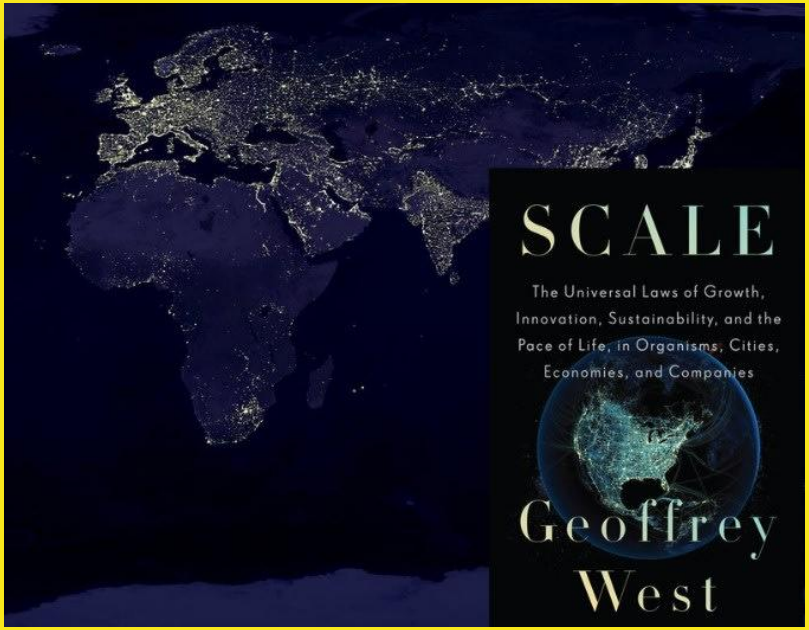
Prediction of the multidimensional system state given some data:
E.g.number of cars, roads in a system etc.

But even best AI model may not be able to predict its state due to systems properties



ML model for predictions

Double pendulum

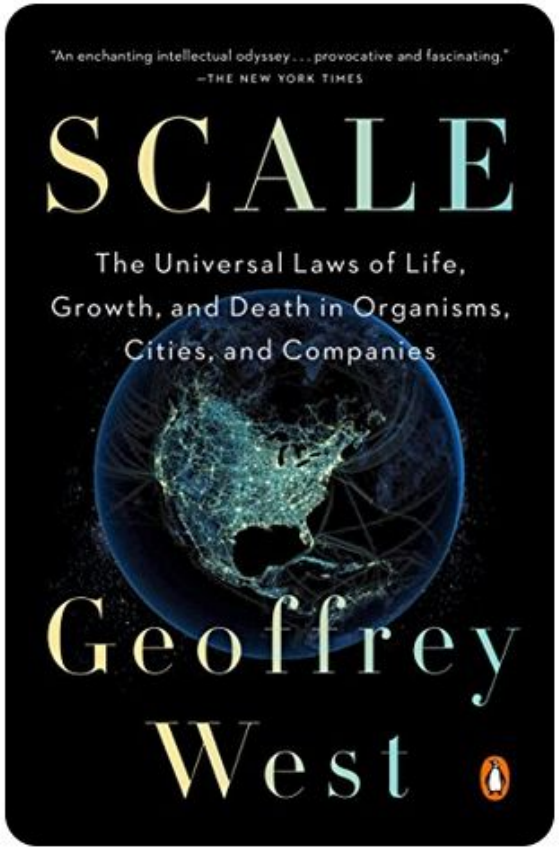


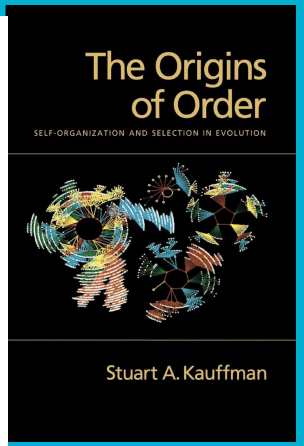
Problems of cities

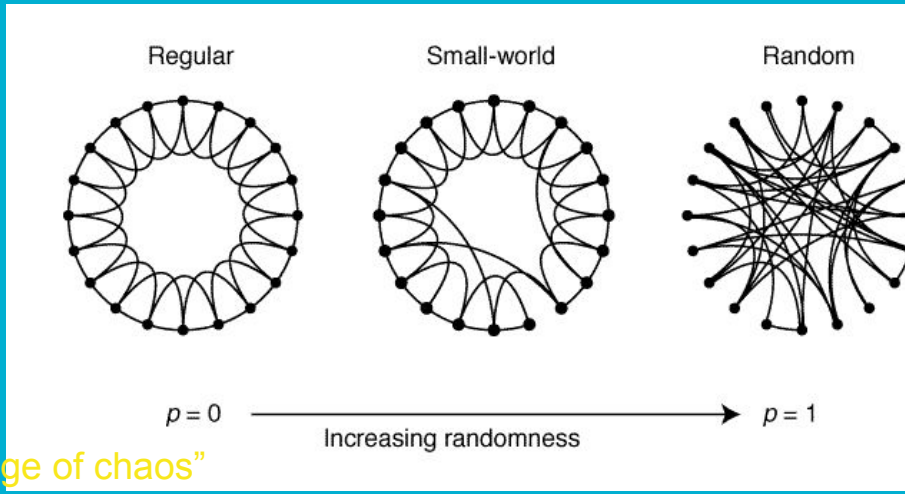
Non-equilibrium, open system

L.Bettencourt, G. West (Santa Fe)
“A unified theory of urban living”, Nature (2010)

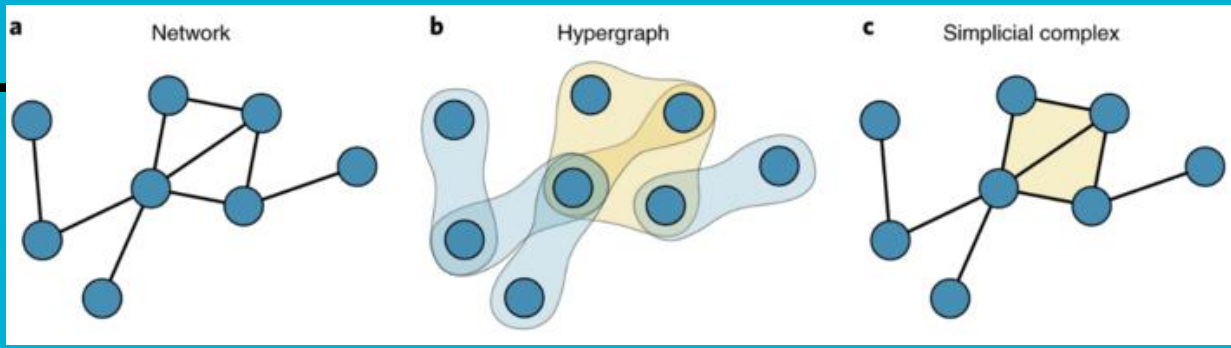
Complex systems and networks as a tool to study cities



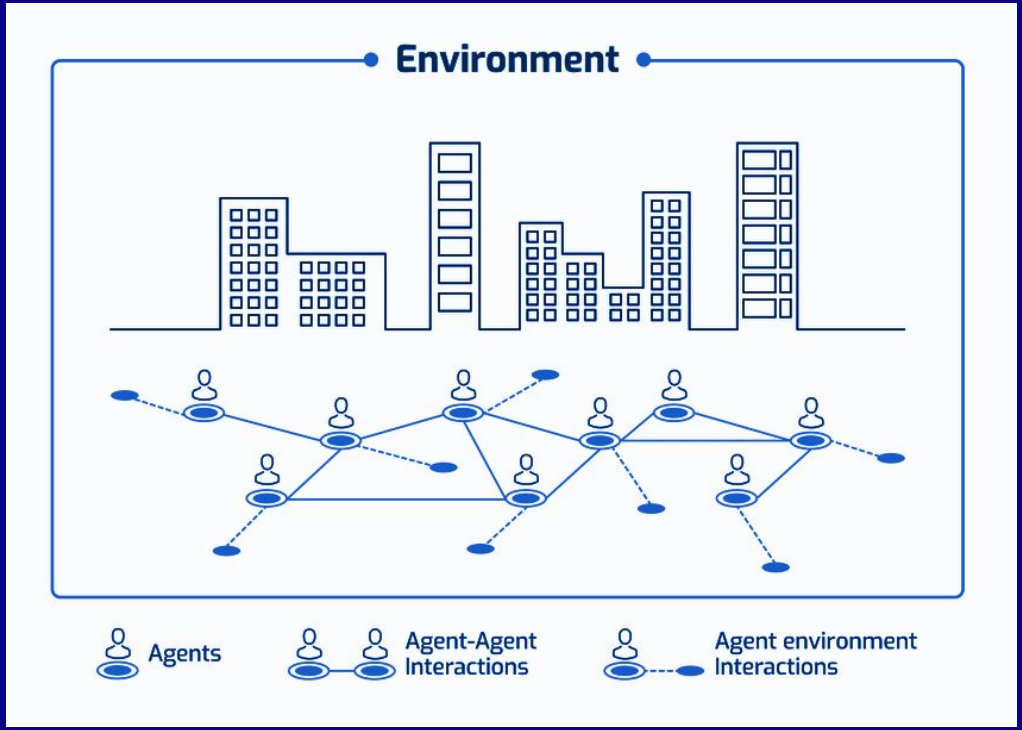


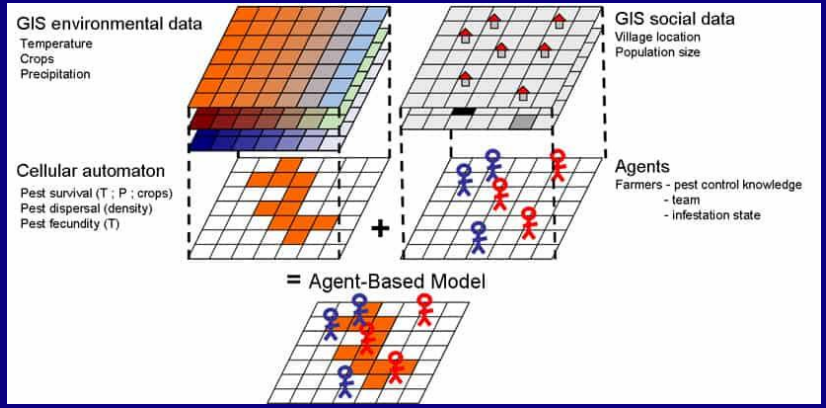


Complexity at the "edge of chaos"



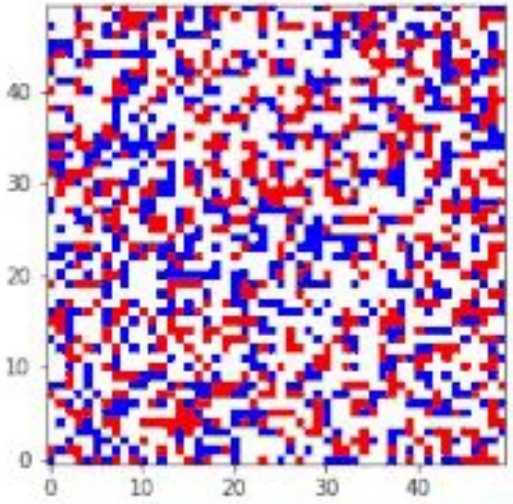
Another approach to complexity: Agent based modeling



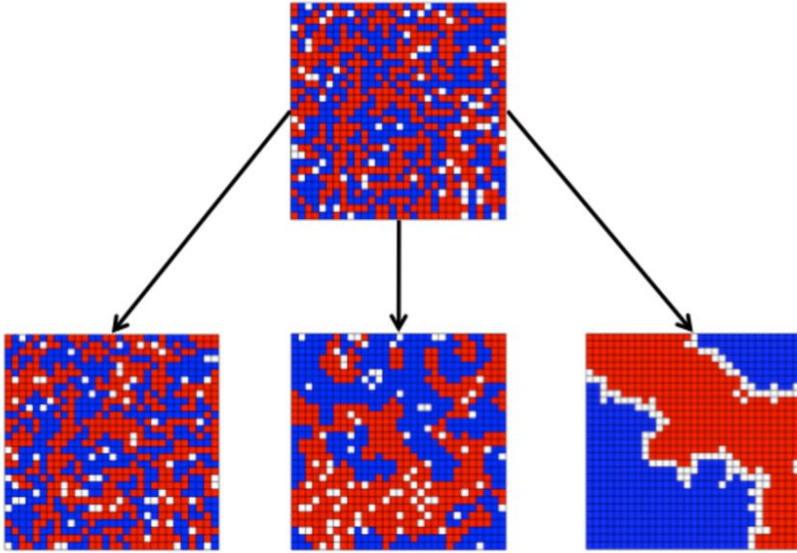


Another approach to complexity: Game of life

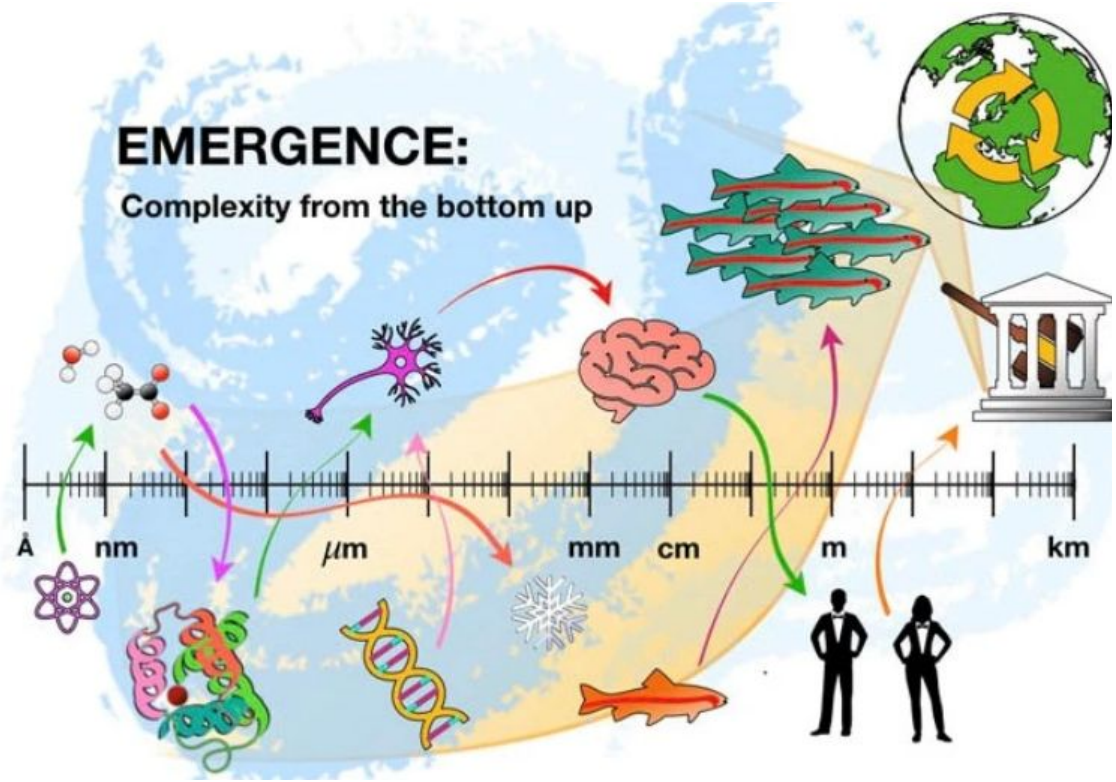
Emergence and self-organisation
Swarm dynamics and Shelling model for segregation

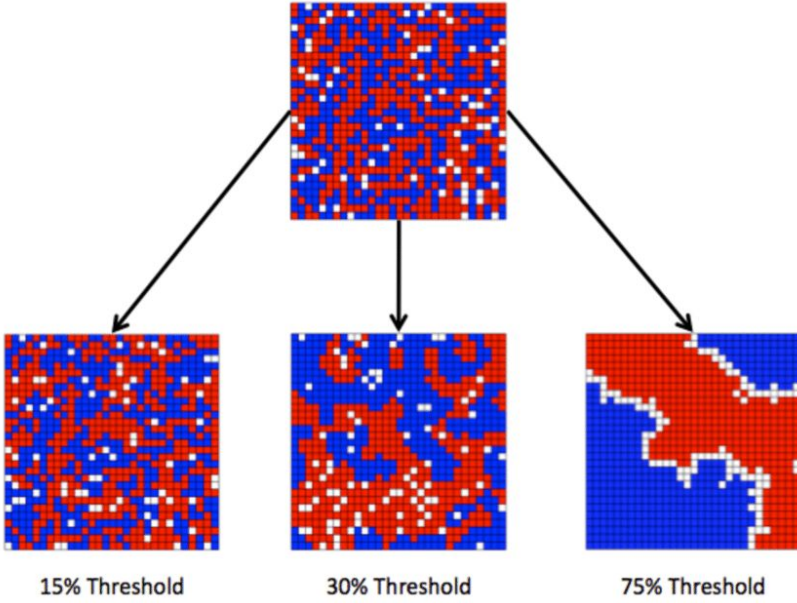


Agents will move at each step until the fraction of neighbors that are from their own group is greater than B, B a ≥ B seg ≈ 1 / 3 leads to the groups segregating themselves



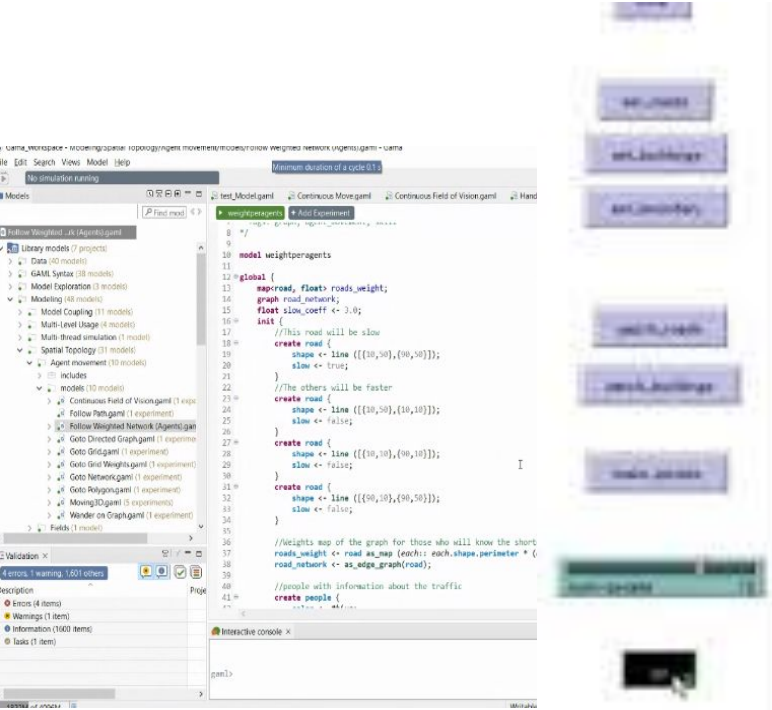
Emergence and self-organisation
Swarm dynamics and Shelling model for segregation





Try it yourself as GAMA platform

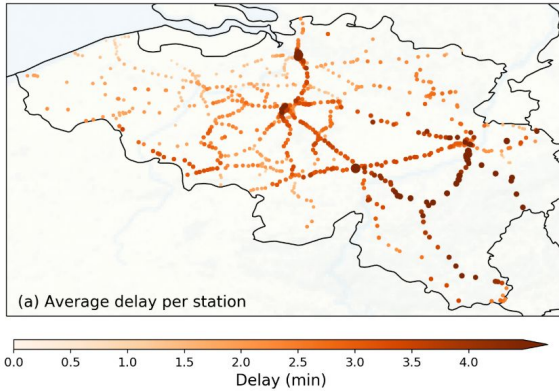
Emergence and self-organisation: Agent based models for transportation and social systems

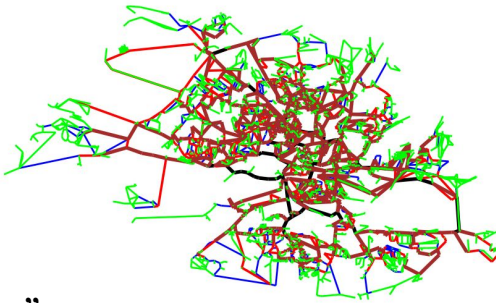


Programming behavior

Agents

Project on mapping trees pathways and human trajectories





Dekker “Modelling railway delay propagation as diffusion-like spreading”, EPJ 2022, Yasgari “The effect of infrastructure on social connectivity” (CSS 2022), Tupikina et al. “Hidden pathways through city” JC (2023), Jacquet, Tupikina, 2021 “COVID trajectories” GSI 2021

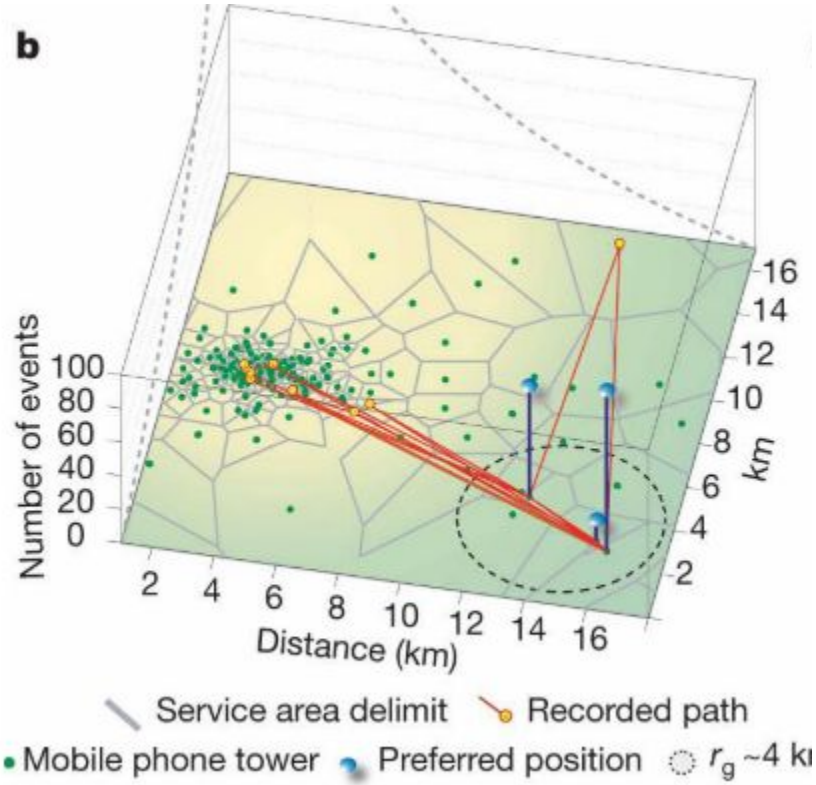
Part 2
Data science and network theory for urbanism

Methods to work with big data

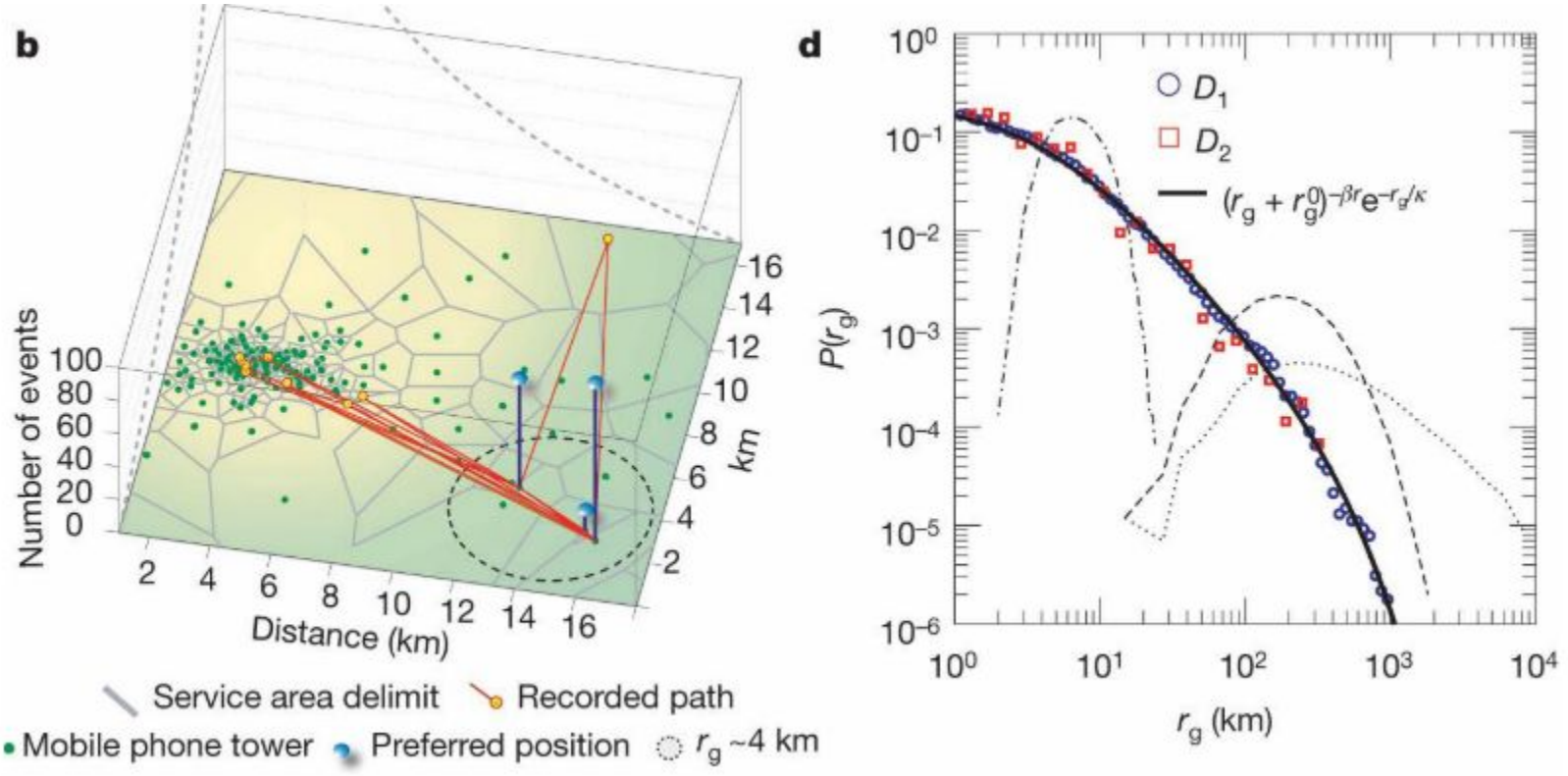
Do people move in the city similarly to each other?

Universal and distinct properties

Data science for mobility



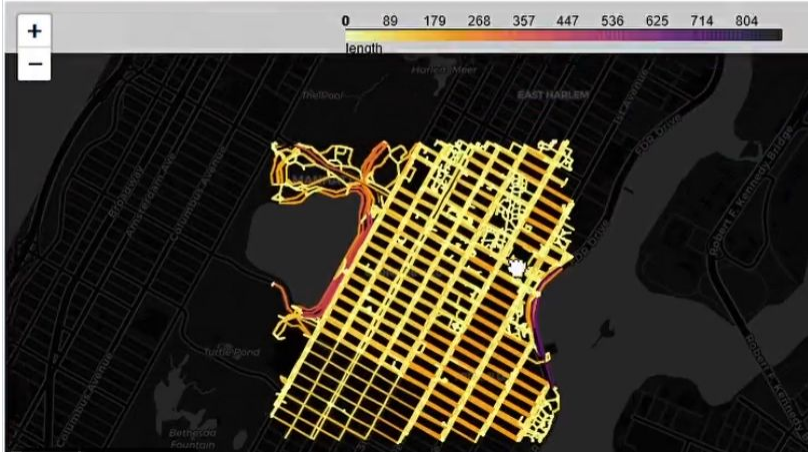
Data science for mobility



Different approach to cities: open data

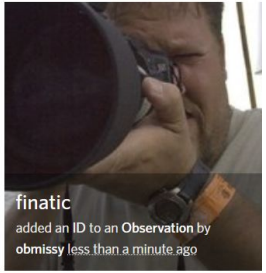
Where data can come from?
City data accessible through its inhabitants

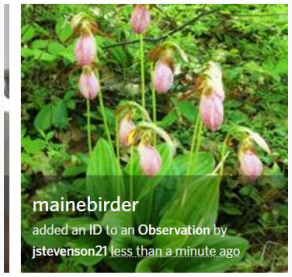
Github, open data hub, aino.world

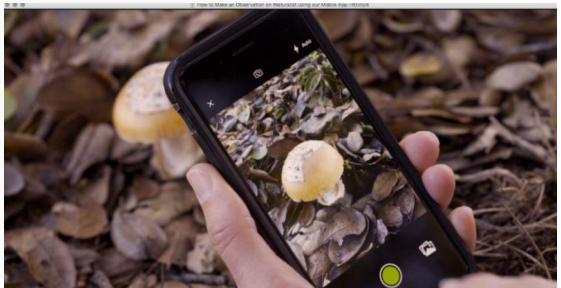


Different approach to cities:

City as its inhabitants







iNaturalist citizen science community study

Method development to study city community characterise users activity and attrition: who are core-members of participants, how and why users stay or come back?

https://arxiv.org/abs/2112.02693
https://github.com/correlaid-paris/citizen_science_inaturalist

arXiv.org > cs > arXiv:2112.02693

Search...
Help | Ac

Computer Science > Social and Information Networks

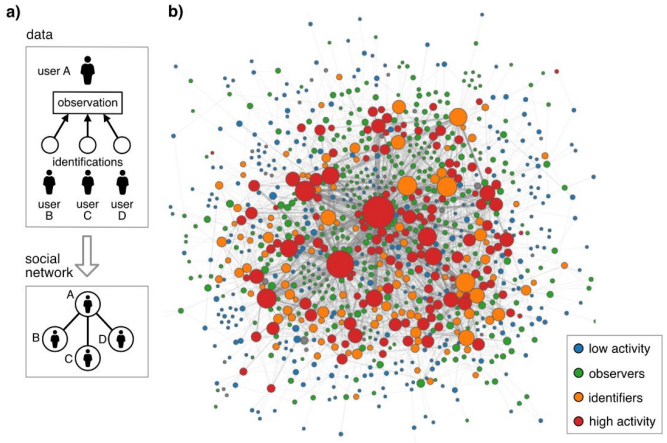
[Submitted on 5 Dec 2021]

iNaturalist citizen science community during City Nature Challenge: new computational approach for analysis of user activity

Liubov Tupikina, Frank Schlosser, Vadim Voskresenskii, Katharina Kloppenborg, Florence Lopez, Albrecht Mariz, Anna Mogilevskaja, Mułł Haklay, Bastian Greshake Tzovaras

Analysing patterns of engagement among citizen science participants can provide important insights into the organisation and practice of individual citizen science projects. In particular, methods from statistics and network science can be used to understand different types of user behaviour and user interactions to help the further implementation and organization of community efforts. Using publicly available data from the iNaturalist community and their yearly City Nature Challenges (CNC) from 2017-2020 as an example; we showcase computational methods to explore the spatio-temporal evolution of this citizen science community that typically interacts in a hybrid offline-online way. In particular, we investigate the user types present in the community along with their interactions, finding significant differences in usage-behavior on both the level of engagement and the types of community tasks/roles and how they interact with the network of contributors. We expect that these computational analysis strategies will be useful to gain further understanding of other citizen science communities and projects.

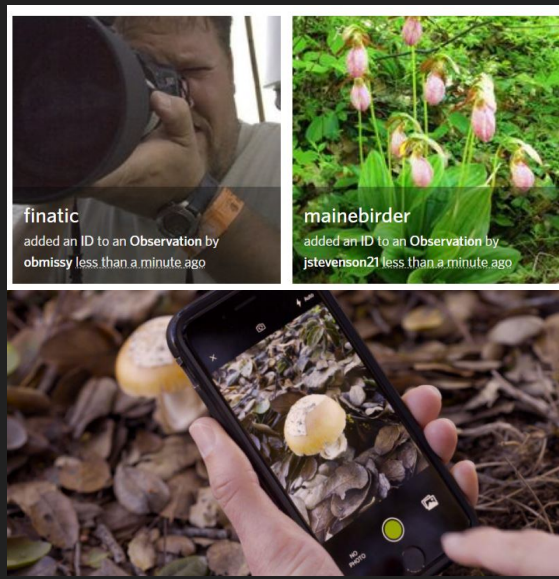
Comments: 9 figures, 29 pages, submitted to this https URL
Subjects: **Social and Information Networks (cs.SI)**; Physics and Society (physics.soc-ph)
Cite as: arXiv:2112.02693 **[cs.SI]**



iNaturalist citizen science data

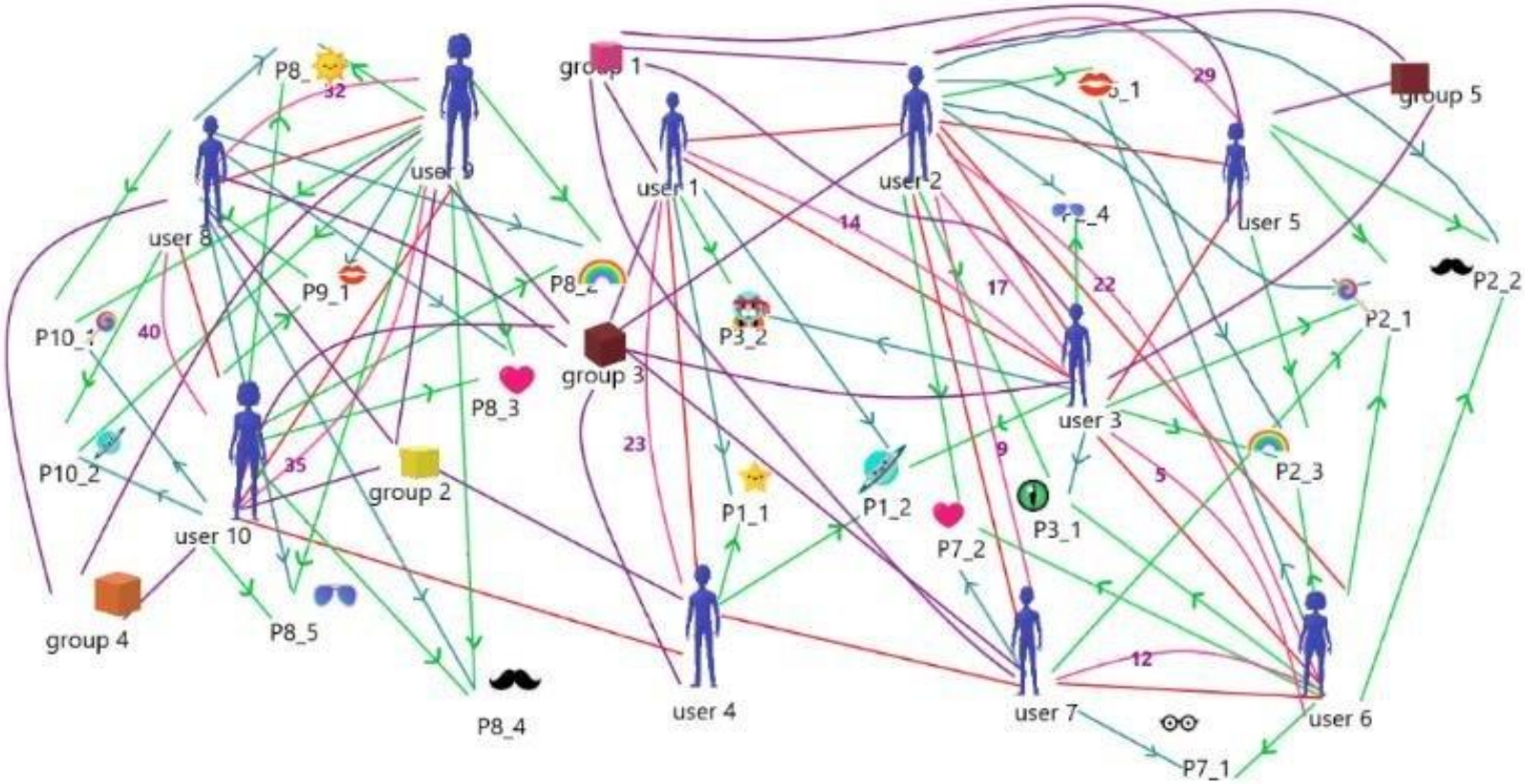
Users contribute voluntarily on a platform.

	id	observed_on_string	observed_on	time_observed_at	time_zone	user_id	user_login	created_at
0	11479007	2018-04-27 7:52:34 am BST	2018-04-27	2018-04-27 07:52:34 UTC	UTC	159021	muki	2018-04-27 07:06:17 UTC
1	11480212	2018-04-27 8:39:41 am BST	2018-04-27	2018-04-27 07:39:41 UTC	London	664459	lucyrobinsonnhm	2018-04-27 08:02:52 UTC
2	11480902	Fri Apr 27 2018 08:34:31 GMT+0100 (GMT+1)	2018-04-27	2018-04-27 06:34:31 UTC	Amsterdam	908315	tess26	2018-04-27 08:42:01 UTC
3	11481097	Fri Apr 27 2018 09:54:35 GMT+0100 (GMT+1)	2018-04-27	2018-04-27 07:54:35 UTC	Amsterdam	796473	bryonycross	2018-04-27 08:54:45 UTC
4	11482247	2018-04-27 8:42:21 am BST	2018-04-27	2018-04-27 07:42:21 UTC	London	664459	lucyrobinsonnhm	2018-04-27 10:09:55 UTC



CitSciVirtual
LOCAL, GLOBAL, CONNECTED

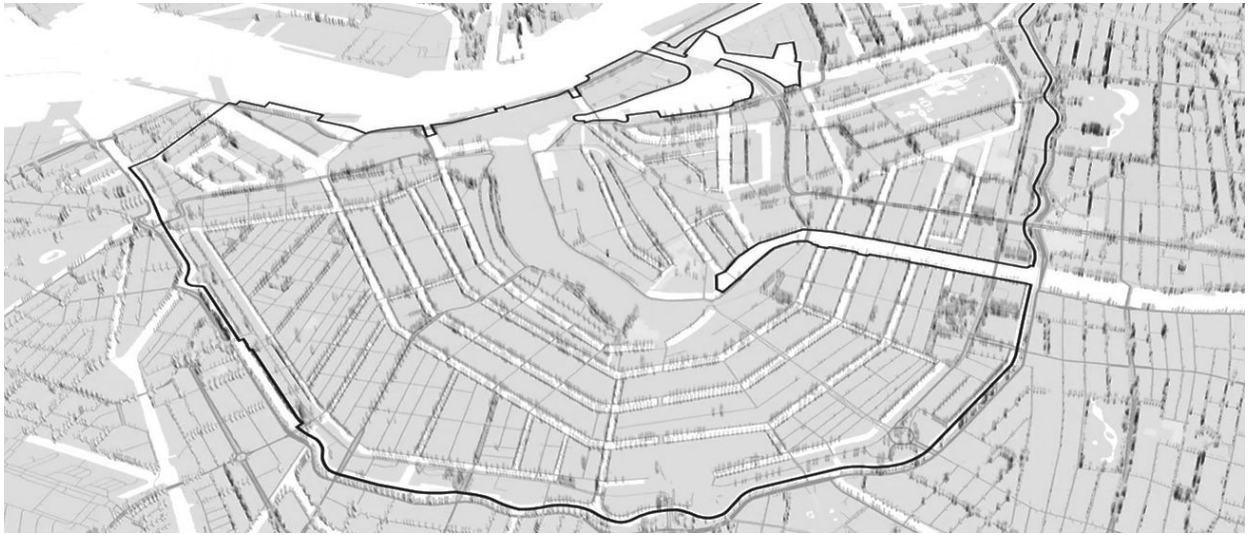
CORRELAID
GOOD CAUSES. BETTER EFFECTS.
Für Nonprofits
Für Volunteers



http://d1o.beauty/facebook-social-network-graph

Part 3
Participatory projects and cities

Examples of projects on city systems: participatory practice with citizens
Citizen assemblee - definitions and concepts
https://en.wikipedia.org/wiki/Citizens%27_assembly
OECD discussions

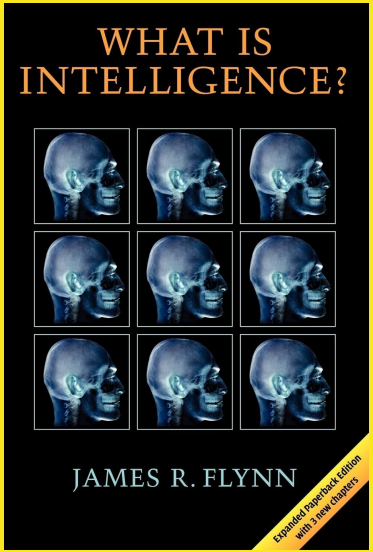


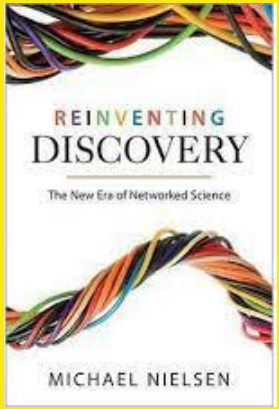
Reading discussions

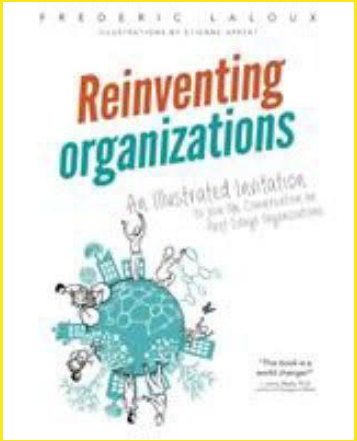
OECD report: participatory governance

Report link

Topics of discussions:
Introduction: Deliberation and new forms of governance







Books and other resources

“Network science”

L. Barabasi
http://barabasi.com/book/network-science

Complexity science “The origins of order” S. Kauffmann

“What is intelligence” J.Flynn

“Reinventing Discovery”, Nielsen

“Der Stadt”, M. Weber

“Reinventing organisations”, F.Lalou

Course topics

Complexity Science

self organised transport, systems thinking, city as a complex system Paper 1

Data Science for cities, and its limitations Paper 2

OECD report: participatory governance

Report link

Learning more on the recent trends and news on this: https://demnext.substack.com/

Part X

Examples. where architecture, urbanism meets data science and network science

Examples where architecture, urbanism meets data science

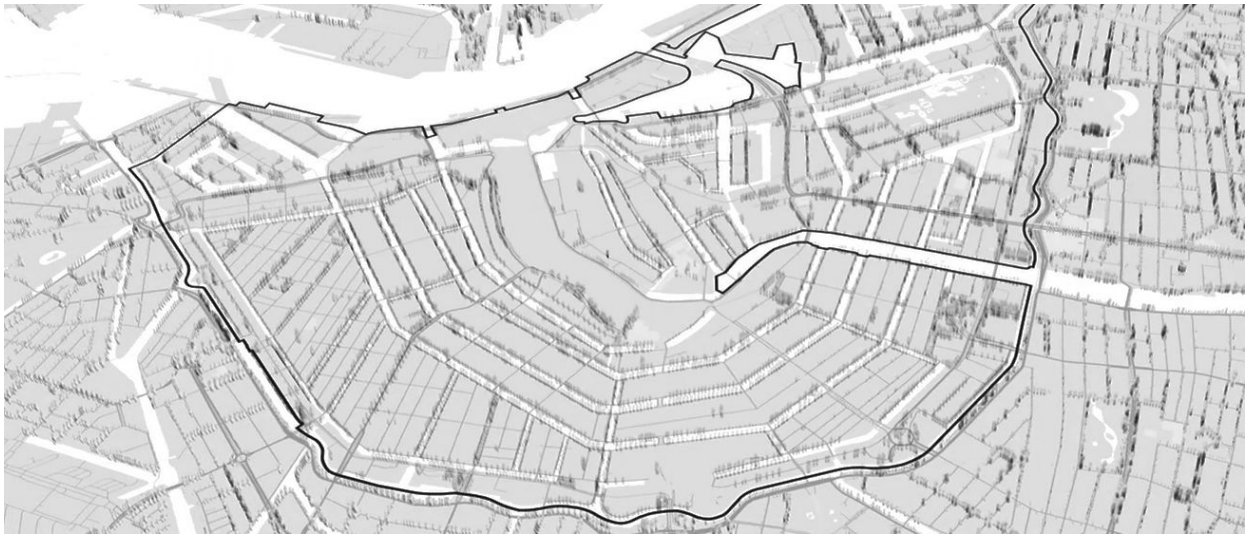
Examples where architecture, urbanism meets data science

Chandigarh city construction, 1949
The Master plan prepared by Le Corbusier was broadly similar to the one prepared by the team of planners led by Albert Mayer and
Mathew Nowicki except that the shape of the city plan was modified. Head (The capitol complex)

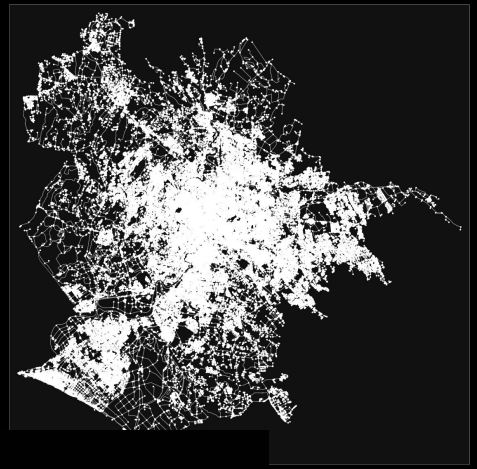
- Heart (The city centre)
- Lungs (The leisure valley, innumerable open spaces and sector greens)
- Intellect (The cultural and educational institutions)
- Circulatory system (The network of roads, the 7Vs)
- Viscera (The industrial area)

Examples where architecture, urbanism meets data science:

City projects integration Carlo Ratti and physicist from Santa Fe university, post-occupancy phase, time: 21st century
https://senseable.mit.edu/



Main idea project on trees and city



- Our project centers on the relationship between trees and cities, their resemblance and potential for cooperation.
- We analyze several layers of city data:
  City map, which is a replica of trees which live in this city (Figure)
  Mobility patterns of people living in the city
  Citizens mapping the information about the city
- Through overlapping these three layers of the data we search new ways of integrating trees into the cityscape and maintaining the city structure alive.

Other examples of projects on cities and trees