

Urban places and regions in GIScience

Concepts, methods and challenges

AGILE 2023

Half-day workshop – June 13th

Workshop outline

9:00-9:10 – General introduction by Marco Painho

9:10-9:50 – Regions by Vicente Tang

9:50-10:30 – Places by Emmanuel Papadakis

10:30-10:45 – Intro to exercise by Vicente Tang

10:45-11:00 – Break?

11:00-12:20 – Hands-on exercise

12:20-12:30 – Wrap-up



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Objectives

- To discuss about the concepts of “place” and “region” in GIScience and within the urban context
- To explain the importance of these concepts in urban sciences/practice
- To bring forward methods and approaches to spatially define these concepts
- To showcase the CityMe project (<https://cityme.novaaims.unl.pt/>)
- To carry out a hands-on exercise



Marco Painho painho@novaaims.unl.pt

Vicente Tang vtang@novaaims.unl.pt

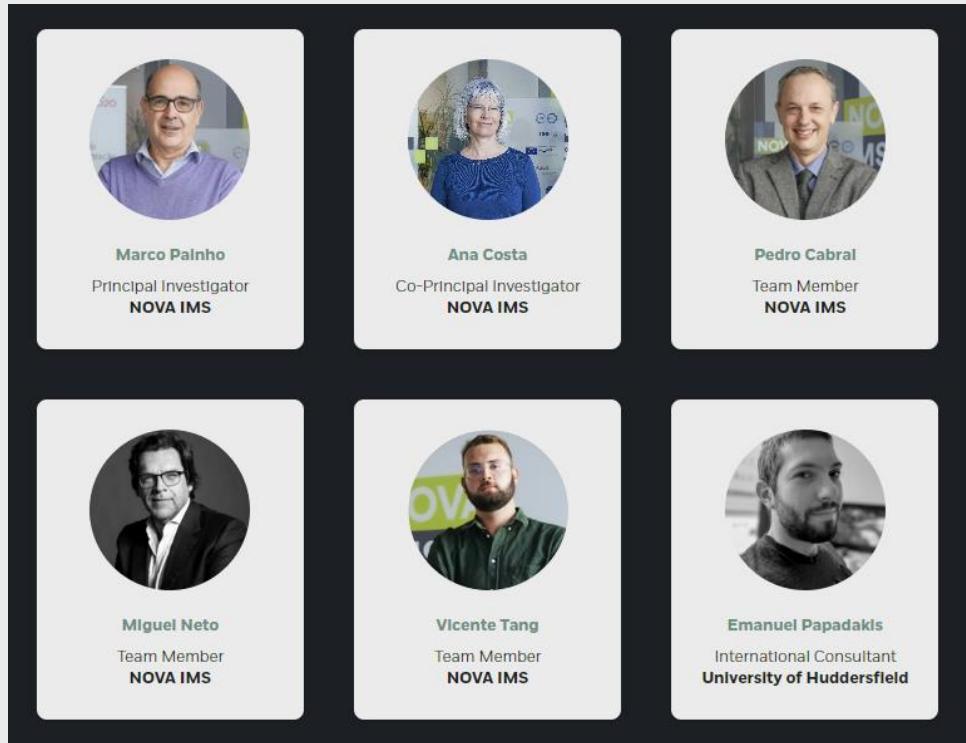
Emmanuel Papadakis E.Papadakis@hud.ac.uk

Cristina Costa cristina@novaaims.unl.pt

CityMe project



- Exploratory project – Portuguese Foundation for Science and Technology (FCT)
- NOVA Information Management School – Geoinformatics Lab (NOVA University Lisbon)
- 18 months
- Mapping regions in the city from citizens' perceptions



Introduction

Marco Painho is currently Full Professor of NOVA IMS and coordinates the MSc. In Geospatial Technologies (Erasmus Mundus) and the masters in Geographic Information Systems and Science.

Vicente Tang is currently a PhD. candidate at the NOVA IMS. His research is about using online data and participant-based methods to map cognitive regions and neighborhoods in the city.

Emmanuel Papadakis is a researcher at the Artificial Intelligence for Mental Health, University of Huddersfield, UK. With a PhD in Geoinformatics from the University of Salzburg, he has experience within Artificial Intelligence and Knowledge Representation and Reasoning with a focus on spatiotemporal information.

Cristina Costa is Associate Professor at NOVA IMS and holds a PhD in Engineering Sciences. The main scientific research area is spatial statistics, particularly the modelling of spatial-temporal phenomena using geostatistics and local spatial regression.



Marco Painho painho@novaaims.unl.pt

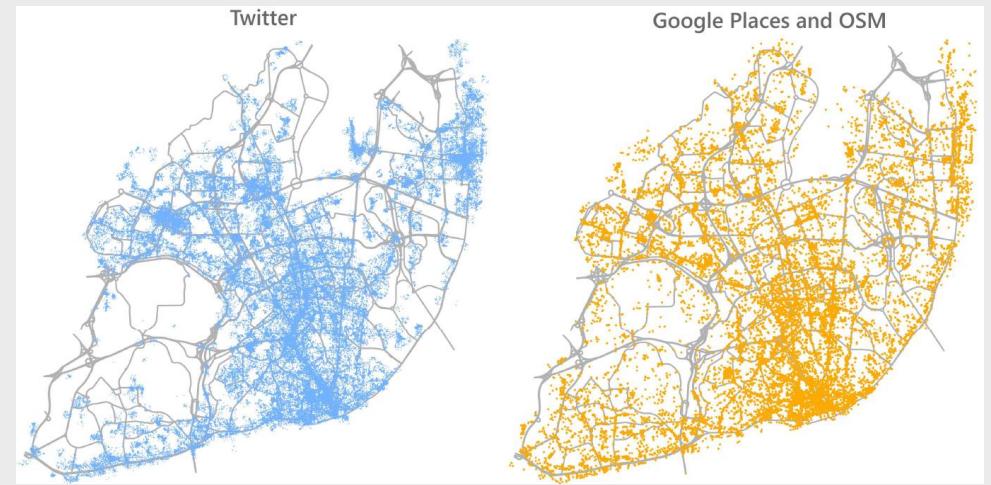
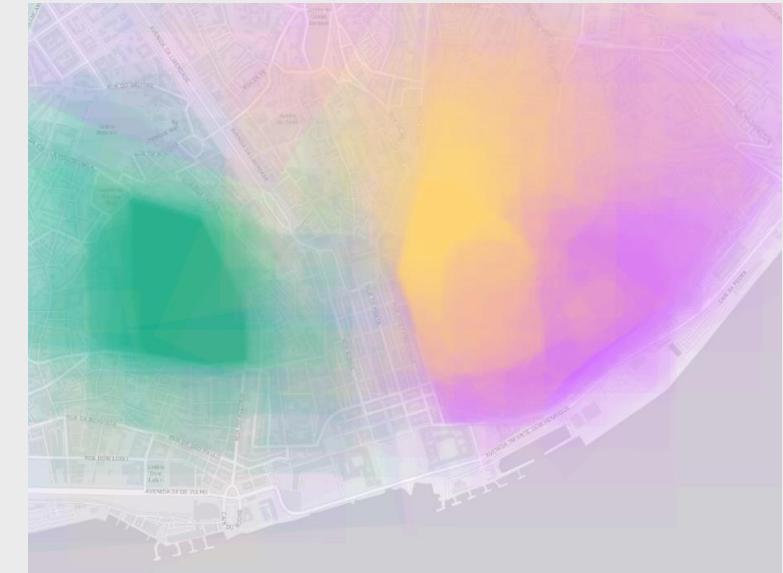
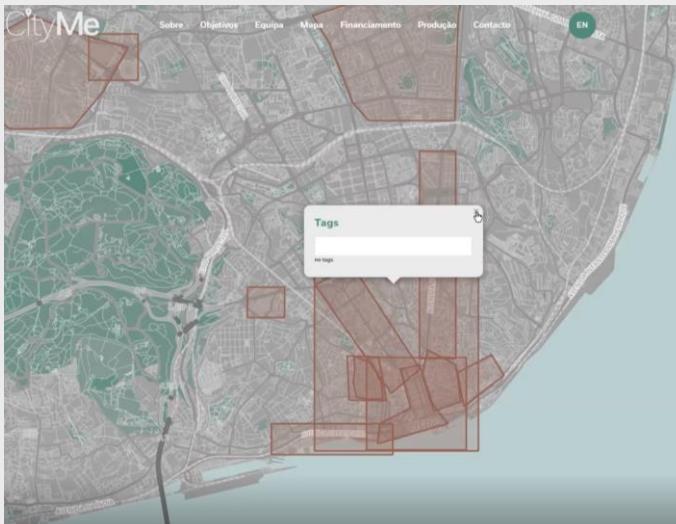
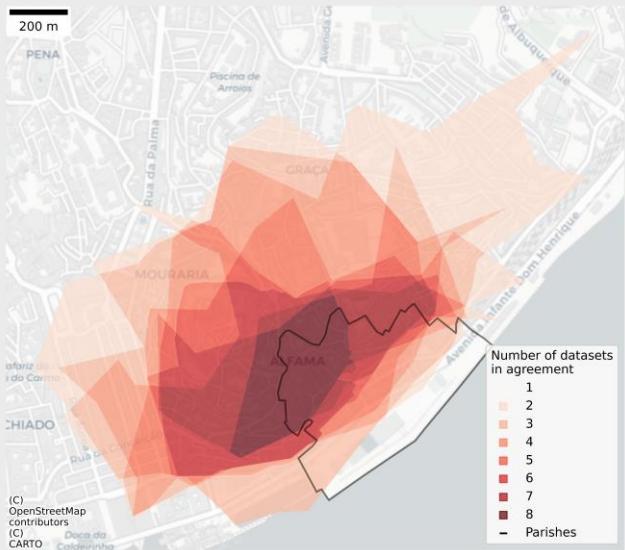
Vicente Tang vtang@novaaims.unl.pt

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CityMe project

- Lisbon as the case study – collect survey data and user-generated content to map different types of regions in the city; compare different sources



Schedule outline



cityme.novaaims.unl.pt

9:00-9:10 – General introduction by Marco Painho

9:10-9:50 – Regions by Vicente Tang

- 30 min. + 10 min. discussions

9:50-10:30 – Places by Emmanuel Papadakis

- 30 min. + 10 min. discussions

10:30-10:45 – Intro to exercise by Vicente Tang

- Exercise introduction and setting-up

10:45-11:00 – Break?

11:00-12:20 – Hands-on exercise

12:20-12:30 – Wrap-up



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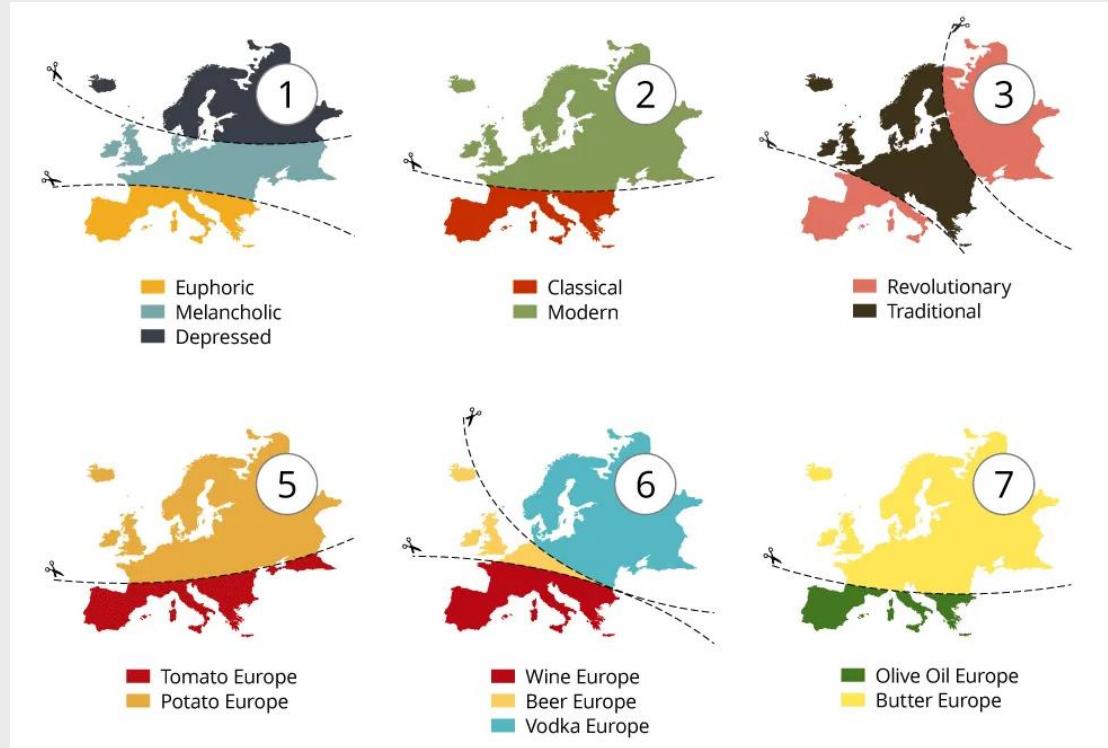
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Regions and the city



Regions

- Categories of land surface area (2D)
- Central importance to geography
- Homogenous regarding one or a set of variables



Yanko Tsvetkov
www.atlasofprejudice.com

Regions

- Categories of land surface area (2D)
 - Central importance to geography
 - Homogenous regarding one or a set of variables
-
- Daniel Montello's (2003) ontological considerations

CHAPTER 9

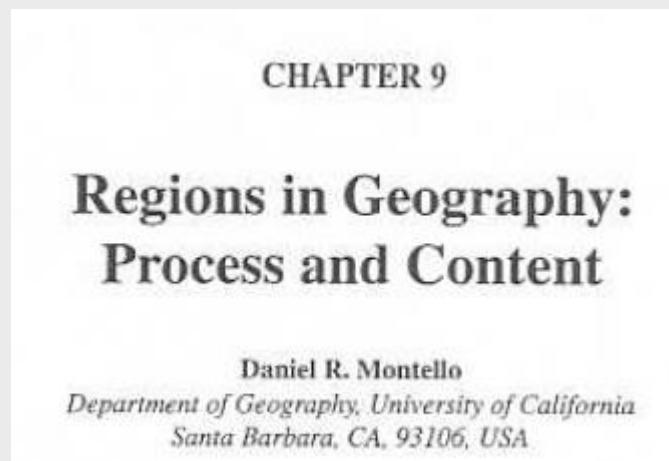
Regions in Geography: Process and Content

Daniel R. Montello

*Department of Geography, University of California
Santa Barbara, CA, 93106, USA*

Regions

- Categories of land surface area (2D)
- Central importance to geography
- Homogenous regarding one or a set of variables
- Daniel Montello's (2003) ontological considerations

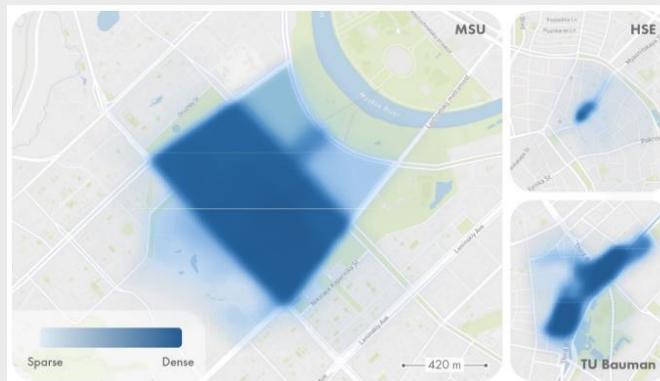


Regions

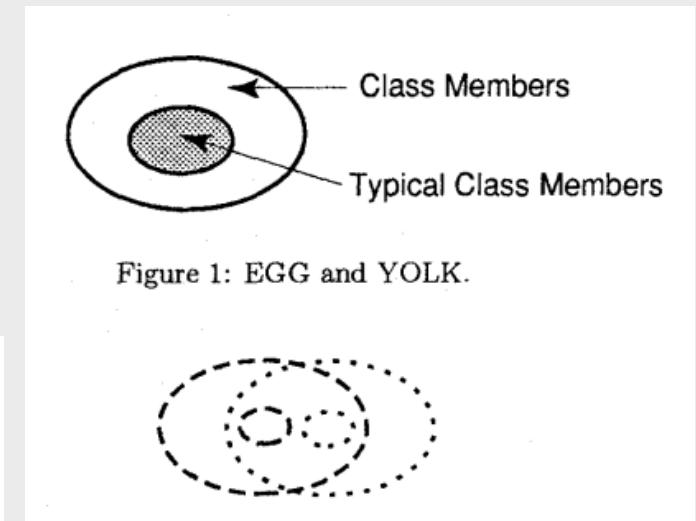
- Daniel Montello's (2003) ontological considerations
- Regions are geographic **objects** – vs fields?
- The act of regionalization is a **cognitive act** – discrete pieces of truth/reality simplifies complexity

Regions

- Daniel Montello's (2003) ontological considerations
 - Regions are geographic **objects** – vs fields?
 - The act of regionalization is a **cognitive act** – discrete pieces of truth/reality simplifies complexity
-
- **Boundaries, inside and outside**
 - Different causes of **vagueness**
 - **Different ways to represent/model boundary vagueness**



Glebova (2021)



Lehmann and Cohn (1994)

Regions

- Daniel Montello's (2003) "taxonomy"
- Administrative regions – human creations

Regions

- Daniel Montello's (2003) "taxonomy"
- Administrative regions – human creations
- Thematic regions – themes, one or set of variables

Regions

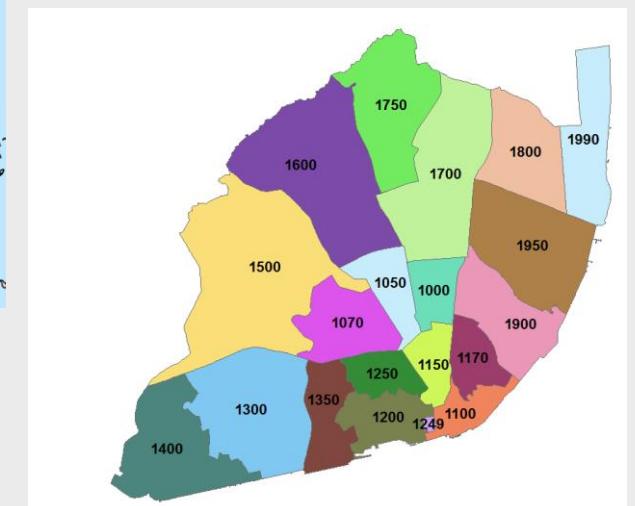
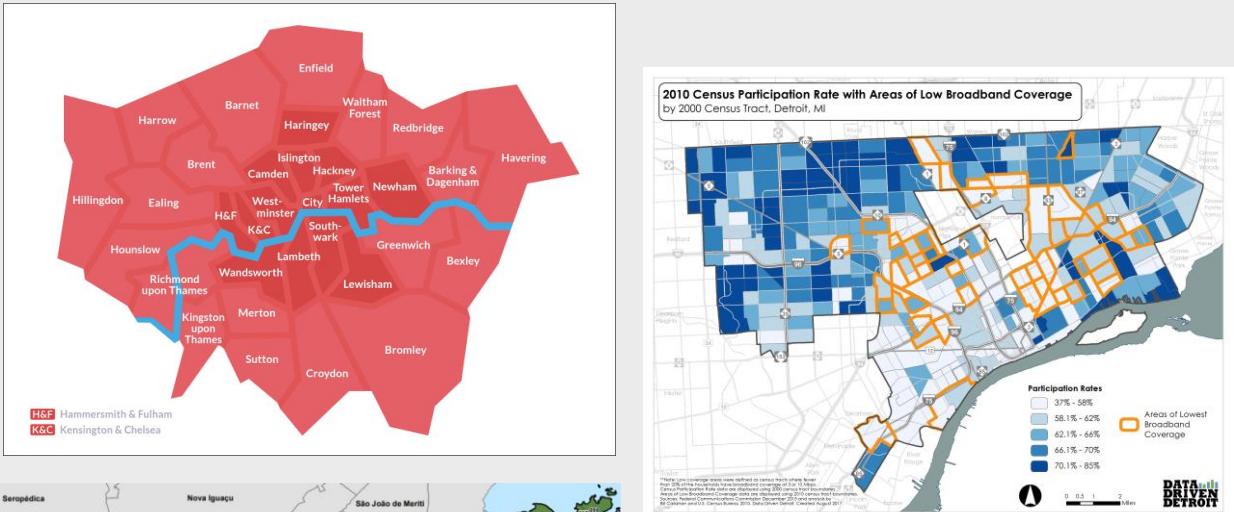
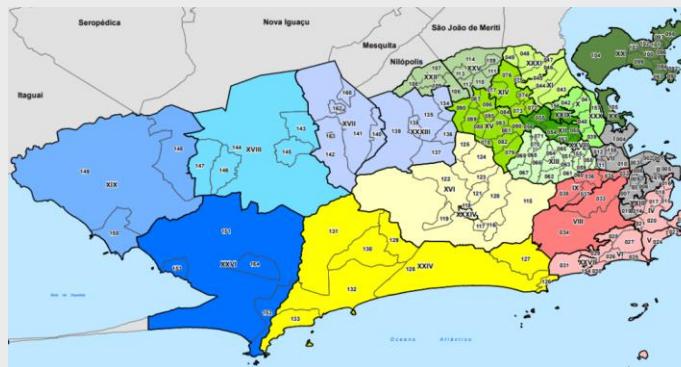
- Daniel Montello's (2003) "taxonomy"
- Administrative regions – human creations
- Thematic regions – themes, one or set of variables
- Functional regions – region defined by activities and spatial interactions

Regions

- Daniel Montello's (2003) "taxonomy"
- Administrative regions – human creations
- Thematic regions – themes, one or set of variables
- Functional regions – region defined by activities and spatial interactions
- Cognitive regions – all regions are cognitive – "every recognition of a region can be considered fundamentally to be a cognitive act, an act of intent or belief"
- Apart from administrative regions, Montello (2003) argued that all regions can be viewed as thematic, functional or cognitive

Regions in the city

- How can a given city be partitioned?
- Administrative/legal
- Sub-urban jurisdictions: districts, parishes, boroughs, etc.
- "Official" neighborhoods
- Census tracts
- Electoral districts
- Planning guidelines – masterplans
- Cadastral parcels
- Zip-codes

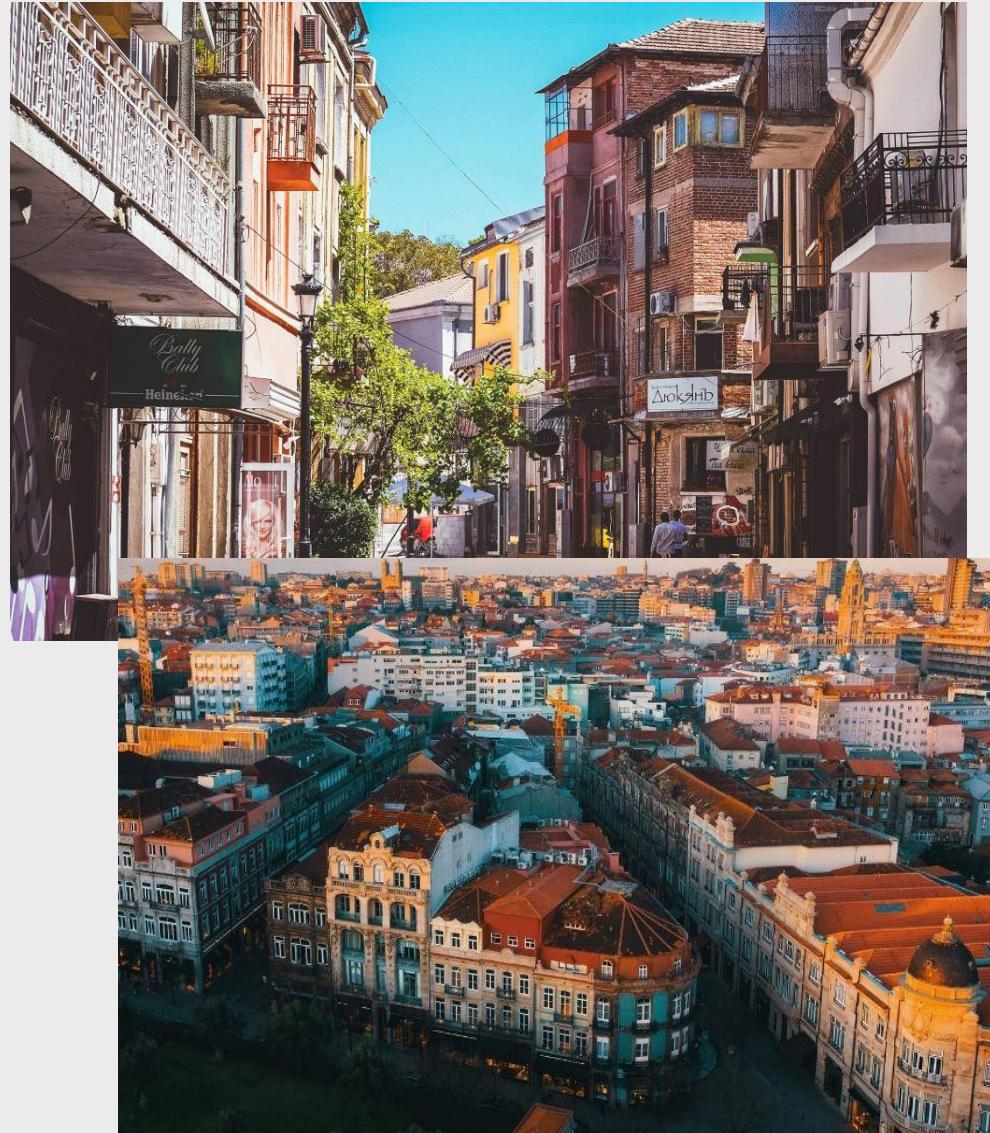


Regions in the city

- How can a given city be partitioned?
- Concepts from the literature
- Neighborhoods – interplay of different dimensions related to identity, community, sense of place, history, culture and spatially-based attributes, “my neighborhood” (surroundings), urban form, cohesion, social interactions, etc.

“The bundle of spatially base attributes associated with cluster of residences, sometimes in conjunction with other land-uses”

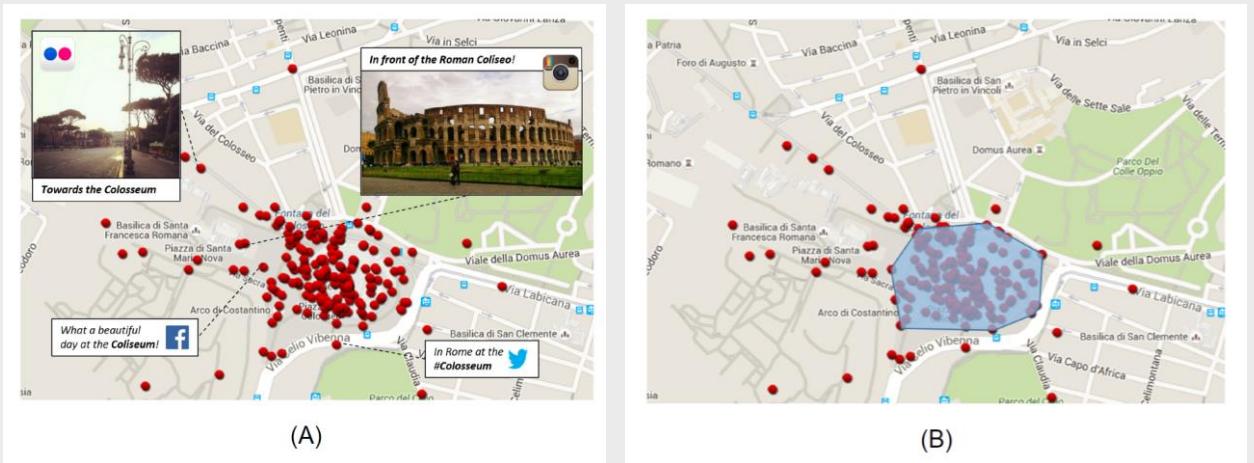
Galster, 2001



Regions in the city

Belcastro et al. (2019)

- How can a given city be partitioned?
- Concepts from the literature
- Areas of interest (AOI) or Regions of Interest (ROI): data-driven character
- Cluster/collection of Points of Interest (POI), cluster of online user trajectories, a proxy of different types of regions/places as POIs are proxies for places



(A)

(B)

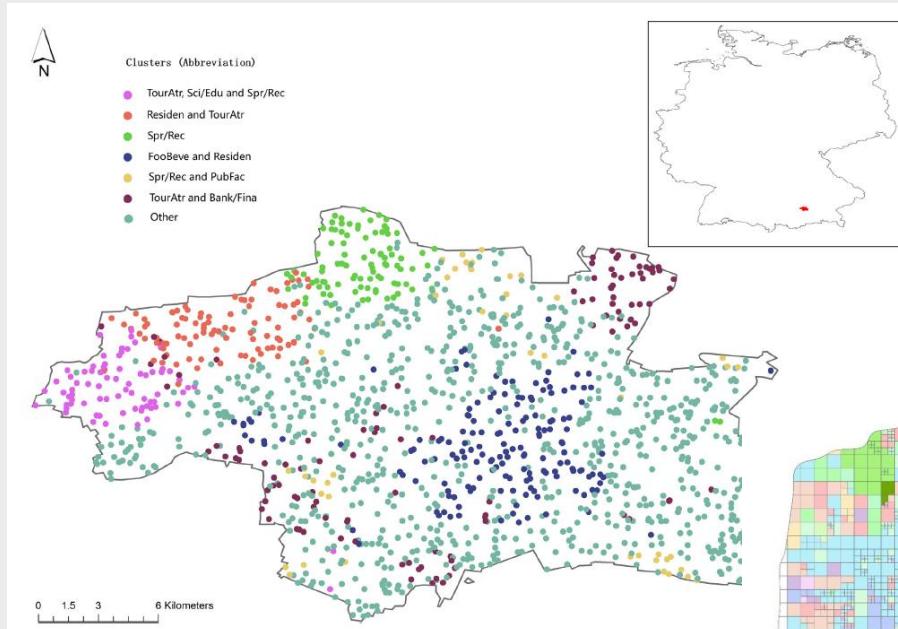


Hu et al. (2015)

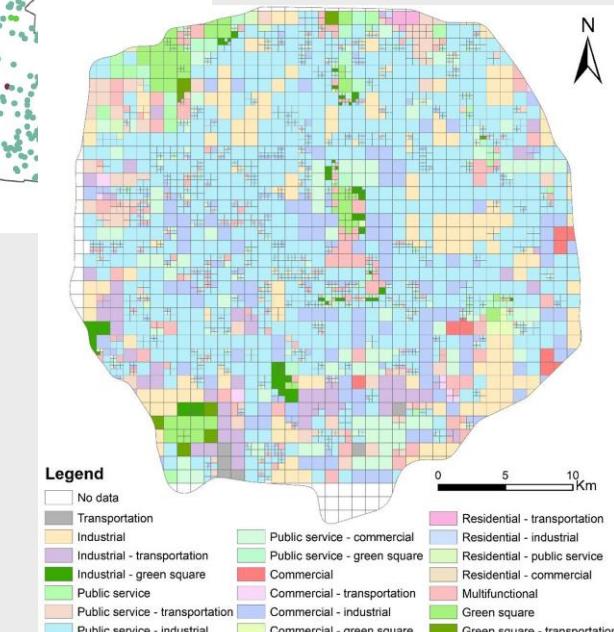
Regions in the city

- How can a given city be partitioned?
- Concepts from the literature
- Functional regions
- Land-use, human activity, profiles of categories of POIs, socioeconomic activities, human-environment interaction: living, working, shopping

Hu et al. (2020)

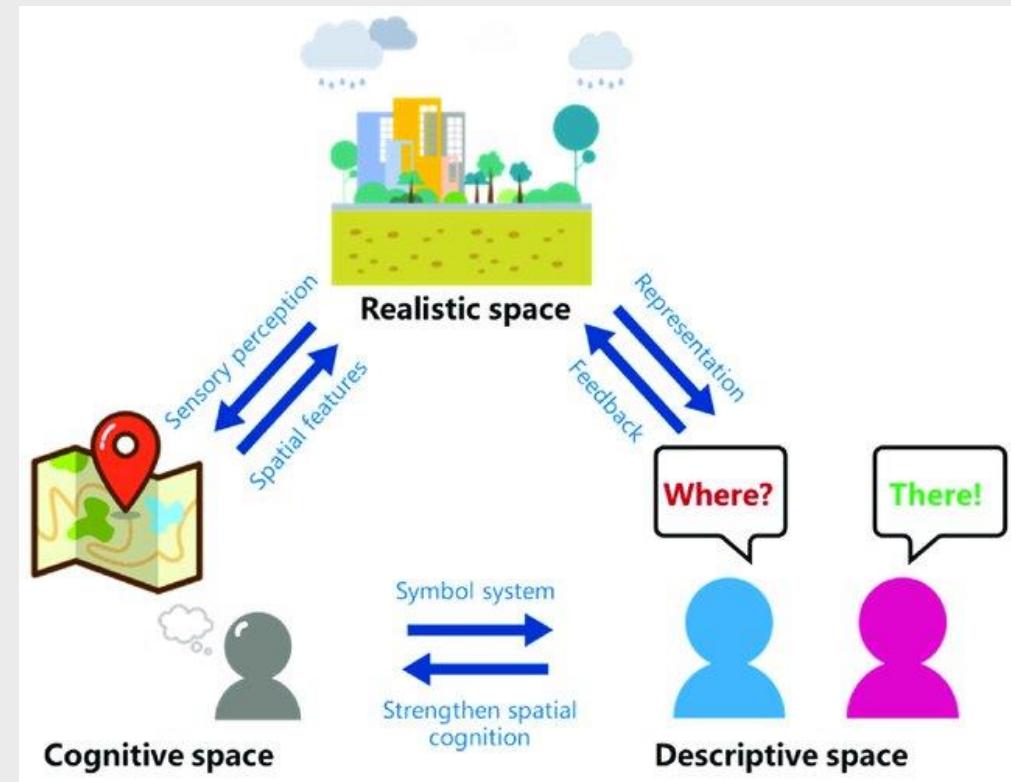


Jing et al. (2022)



Regions in the city

- How can a given city be partitioned?
- Concepts from the literature
- Cognitive regions – vernacular regions, vague cognitive regions, imprecise regions, fuzzy cognitive regions, vague regions, perceptual region
- "Every recognition of a region can be considered fundamentally to be a cognitive act, an act of intent or belief" – Daniel Montello (2003)

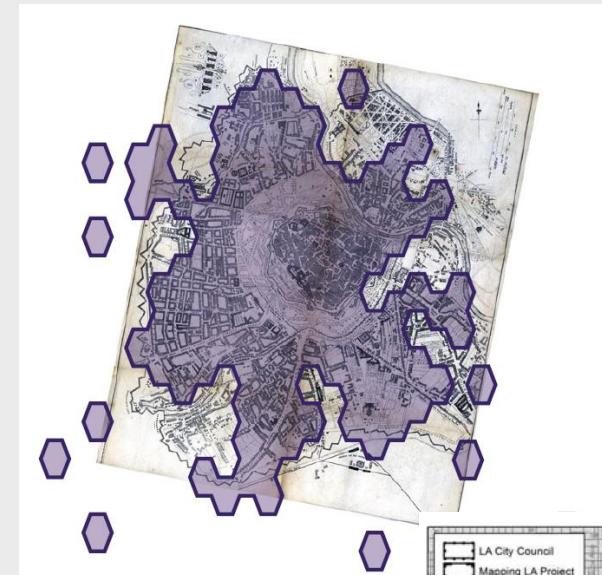


Ye et al. (2022)

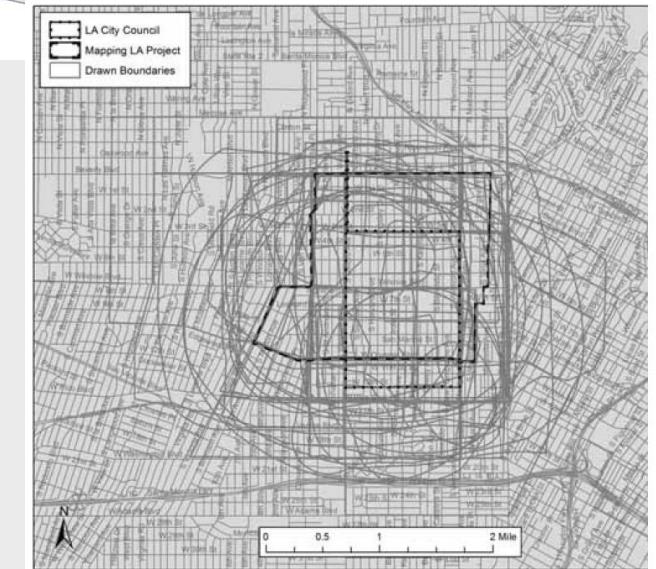
Regions in the city

- How can a given city be partitioned?
- Concepts from the literature
- Cognitive regions – vernacular regions, vague cognitive regions, imprecise regions, fuzzy cognitive regions, vague regions, perceptual region
- Neighborhoods, vernacular neighborhoods, “downtown”
- Communicated by people, oftentimes inherently vague and fluid in their boundaries, based on people’s conceptualizations

Hobel et al. (2016)



Bae and Montello (2018)



Regions in the city

- **Importance** of describing and mapping these regions
- **Describe** people's perspectives of the urban structure and space: based on their activities, perceptions and cognitive representations
- One dimension of people's urban mental maps (projected space)
- **To understand** how people conceptualize the extent, the content and the boundaries
- **To outline** bottom-up perspectives that can foster more human-centered urban planning, management, policy-making and research

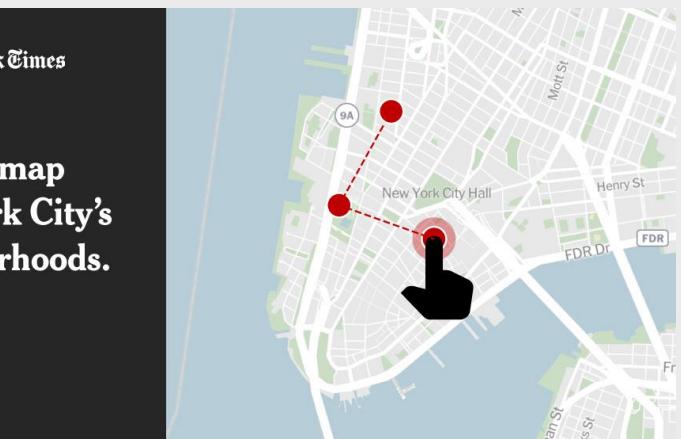


Tang and Painho (2023)

Regions in the city

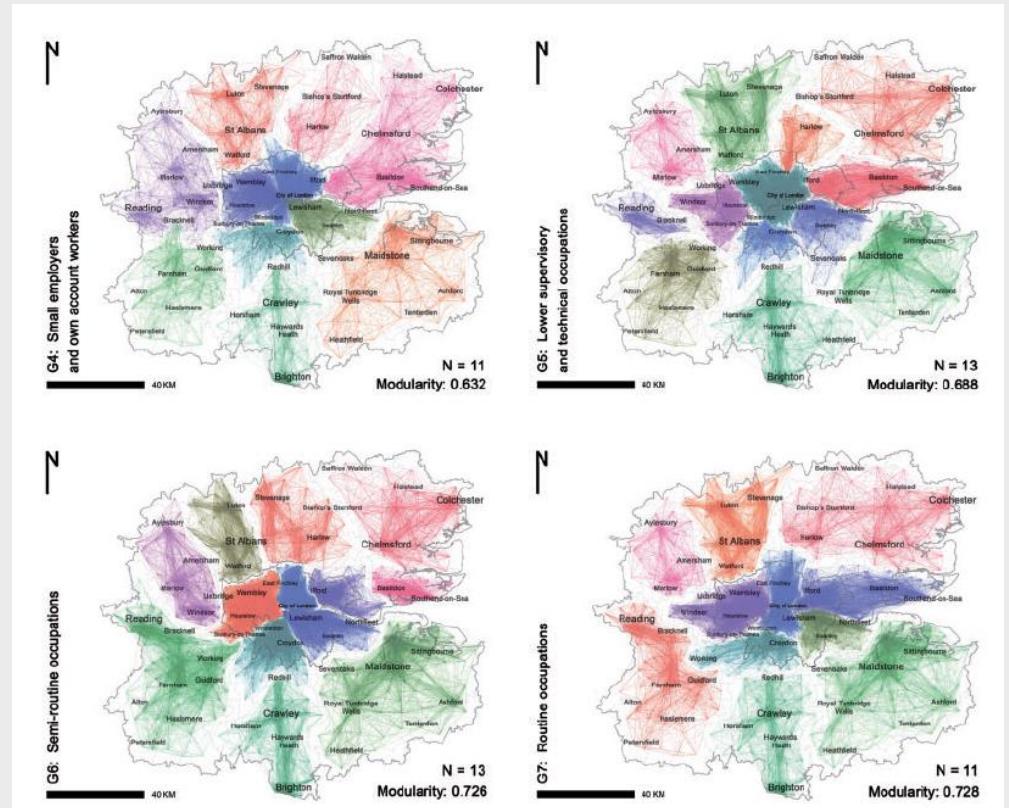
<https://mappingfutures.org/>

- Importance of describing and mapping these regions
- Defining proper and meaningful spatial unit of analysis
- Neighborhoods: “meaningful definitions and delineations of neighborhoods are often needed to address numerous concerns in human society such as poverty and social inequity, racial segregation, child development, public health, lifestyle choice, political behavior, public services, real estate, and crime and disorder, among others” – Deng (2016)



Regions in the city

- Importance of describing and mapping these regions
- Defining proper and meaningful spatial unit of analysis
- Functional regions: “Some functional regions are designed by urban planners, whereas others are naturally formulated due to citizens’ actual lifestyle. Understanding fine-grained urban function regions is essential for both city managers and residents” – Deng and Hu (2016)



Shen and Batty (2018)

Regions in the city

- Importance of describing and mapping these regions
- Defining proper and meaningful spatial unit of analysis
- Vernacular neighborhoods: “Giving neighbourhoods official names and boundaries to mark their status can bring about more outside recognition better planning and development, and increased investment in the local economy; it can also encourage residents to engage in more civic participation” – Bae and Montello (2018)

Bae and Montello (2018)

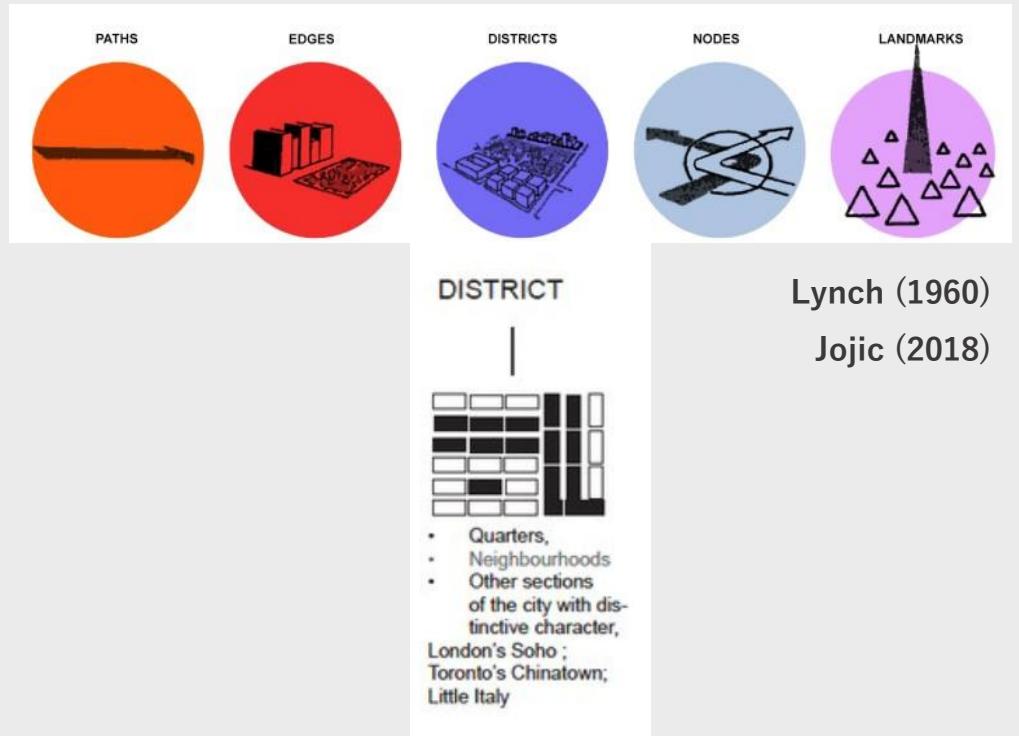


Regions in the city

- Importance of describing and mapping these regions
- Geographic Information Retrieval (GIR) – adding new layers of information to enrich databases for specific queries
- Geo-ontologies – new starting points to establish an ontology of regions in the city or enrich urban or place-based ontologies
- "Last but not least, we also aim at developing a functional region ontology by combining the data-driven approach as outlined in this work with the top-down knowledge engineering approach based on our understanding of urban functional regions from human geography and urban planning" – Gao et al. 2017

Regions in the city

- Cognition, perception and mental maps
- Defining regions as “composites of mental maps of the population” as only a combination of several perceptual regions creates an “objective” formal region (**based on a consensus in perception**) – Jordan (1978)
- We can link to the concept of mental mapping – e.g., Lynch’s (1960) space syntax constituents, the **district** represents areas in the city that have thematic continuities and carry elements that hold a common character, enabling the perception of insideness/outsideness



Regions in the city

- How do we map those regions? What to map?

	Consensus	Footprints	Boundary	Relatively static	Spatial Interaction	Named Place
Administrative Region	Semantics and footprints	Polygons	Crispy	Y	N	Y
Point Of Interest	Semantics and footprints	Points	-	Y	N	Y
Vague Cognitive Region	Semantics	Polygons	Vague	Y	N	Y
Functional Region	Applications dependent	Polygons	Crispy/Vague	Y/N	Y	N
Neighborhood	Applications dependent	Polygons	Crispy/Vague	Y/N	N	Y/N
Region Of Interest	Applications dependent	Polygons	Crispy	-	N	N
Area Of Interest	Applications dependent	Polygons	Vague	N	N	N

- Mai et al. (2018)
- **Consensus** – are the semantics and spatial footprints of these concepts commonly agreed among people? To what extent footprints are agreed upon?
- **Footprints** – Which type of geometry or spatial representation is typically used to represent the concept? What are their spatial projections?
- **Boundary** – Does this concept have a vague or crisp boundary? Are there other features that define the boundary?

Regions in the city

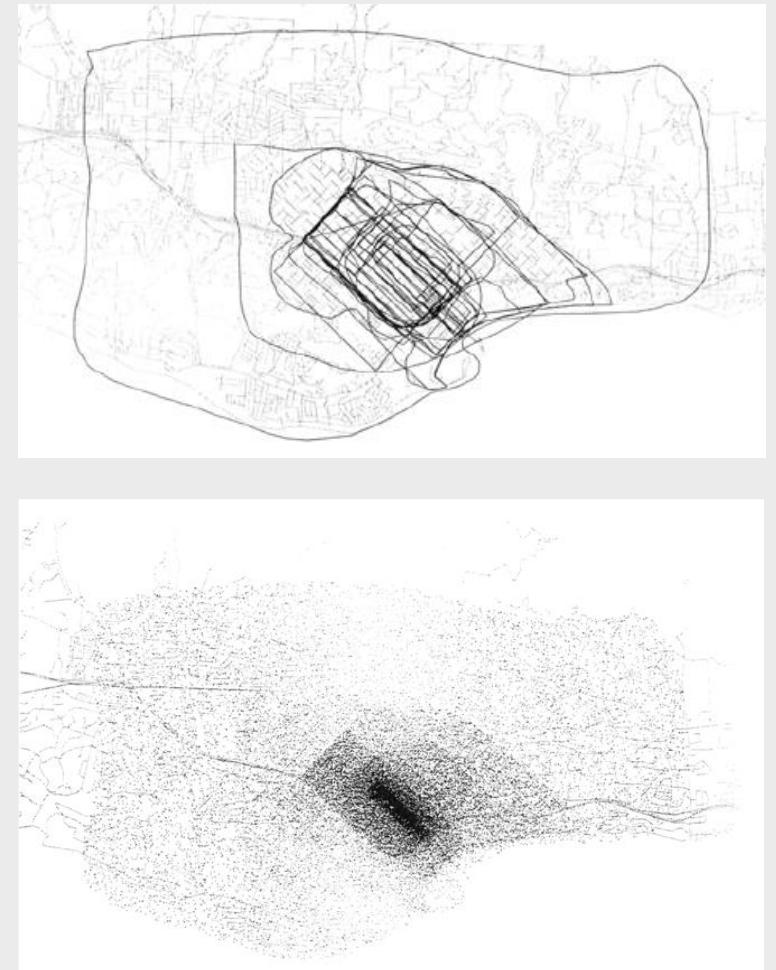
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Region Of Interest	Applications dependent	Polygons	Crispy	-	N	N
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- Mai et al. (2018)
- Relatively static – is the extent of the region relatively static or does it change over time?
- Spatial interaction – is the concept defined based on the interactions among the places within this area?
- Named Place – is naming a key aspect of this type of region?

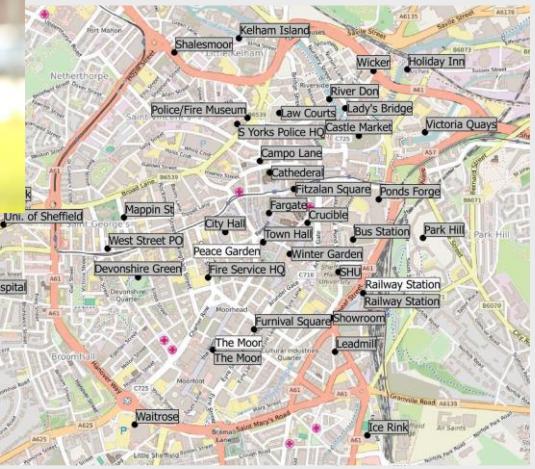
Regions in the city

- How do we map those regions? Data, methods and considerations
- Participant-based methods
- Montello et al. 2003 – Where's downtown? Santa Barbara, US
- Participants – pedestrians stopped in several locations asked to draw onto a base map: “outline the area of the city that you consider to be downtown”
- “Of course, a person's concept of downtown is not a single context-free representation” – Montello et al. 2003

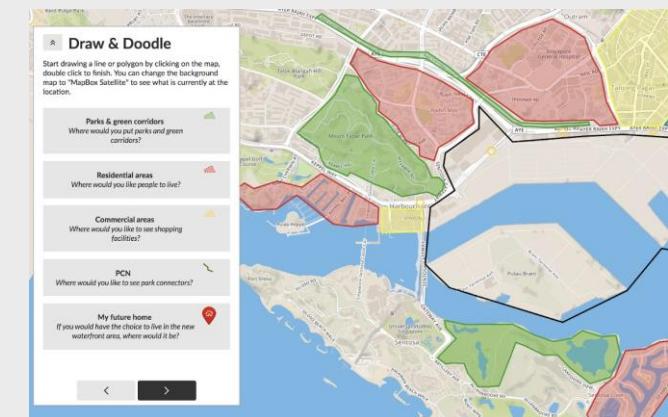


Regions in the city

- How do we map those regions? Data, methods and considerations
- Participant-based methods
- Methods of data collection: drawing sketches in the field, drawing sketches in web-based applications, asking participants – about current location and membership to regions, about places and their membership to regions, mental maps.



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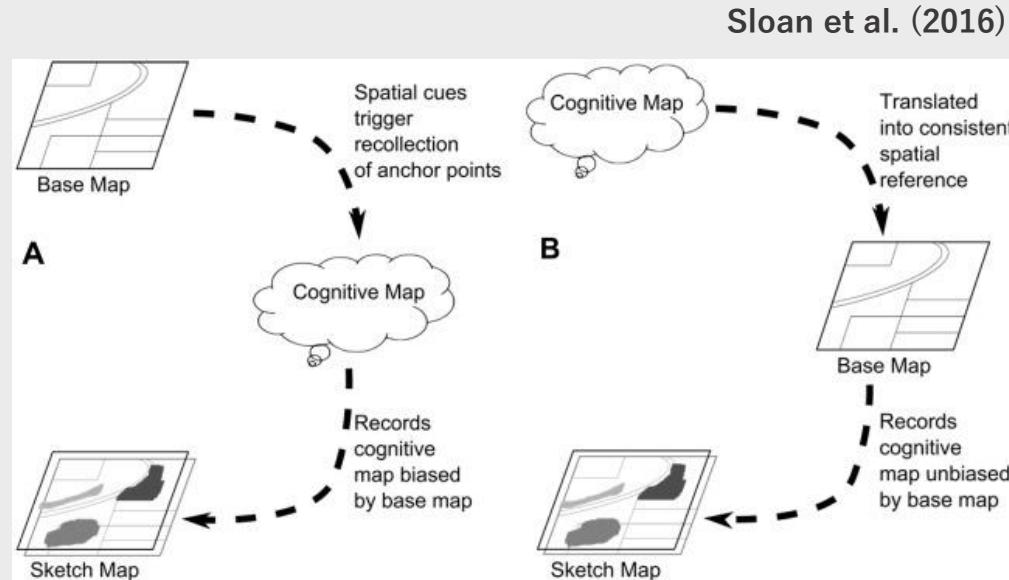
Maptionnaire



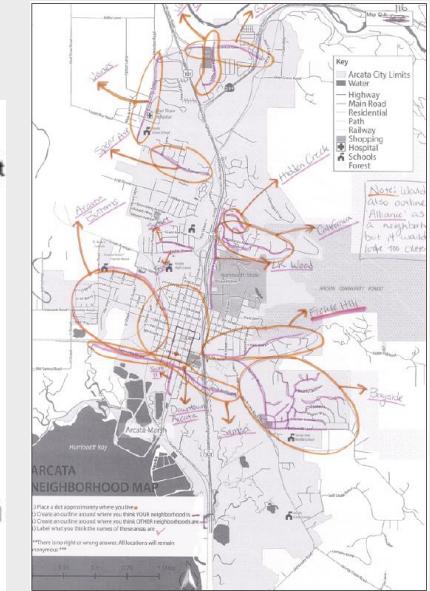
Montello et al. (2014)

Regions in the city

- How do we map those regions? Data, methods and considerations
- Participant-based methods
- Considerations:
- Time and cost
- Directly asking residents or target groups
- Bias? Population, context, basemaps
- Enrich with other information (semantic, cognitive)
- What is a representative sample?



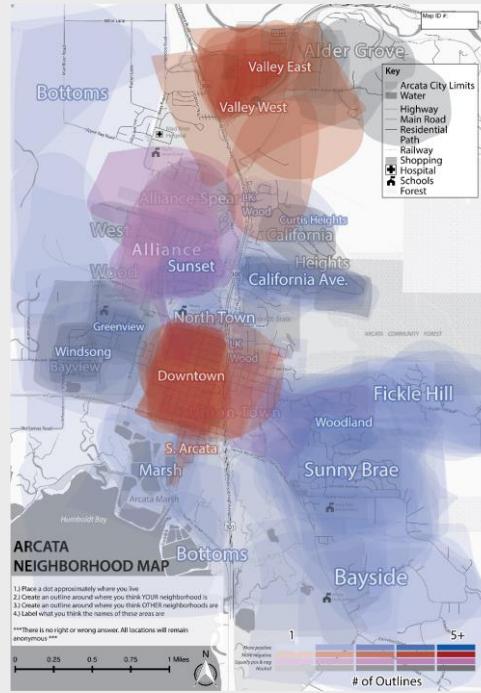
Sloan et al. (2016)



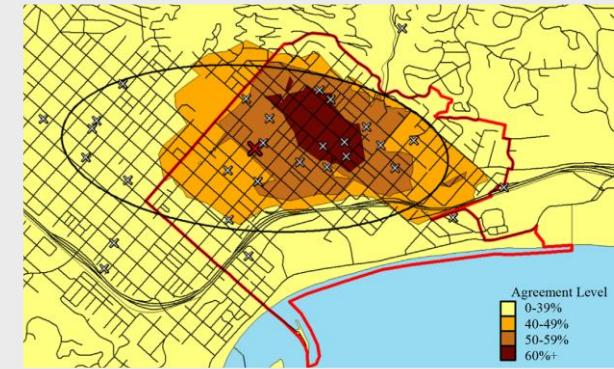
Douglas and Perdue (2018)

Regions in the city

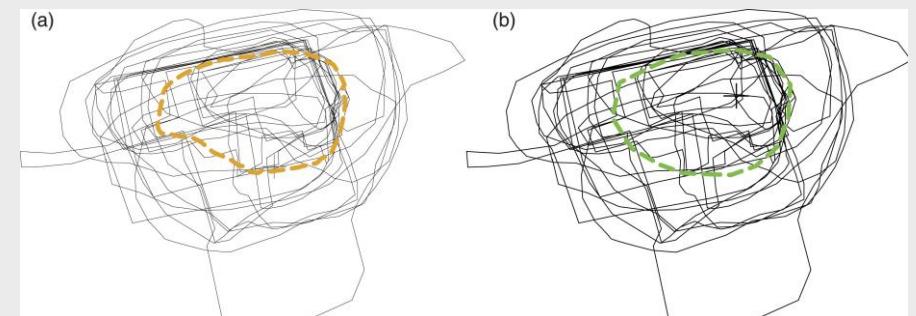
- How do we map those regions? Data, methods and considerations
- Participant-based methods
- Analysis: agreement areas/boundaries, averaged polygons, depends on the objective
- Visualization
- Reducing complex concepts to polygons – scale and granularity (spatial, cognitive and thematic)
- Is sketching enough? Qualitative methodologies, retrieving other information that describes, explains and contextualize, how to deal with that in GIS?



Douglas and Perdue (2018)



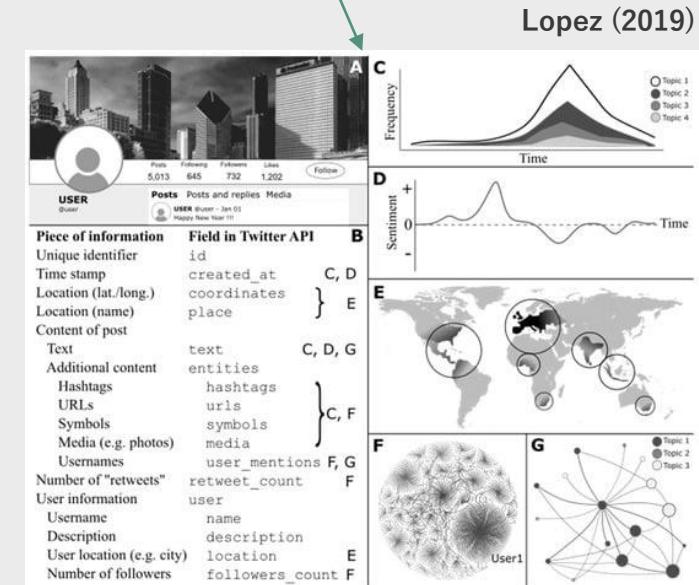
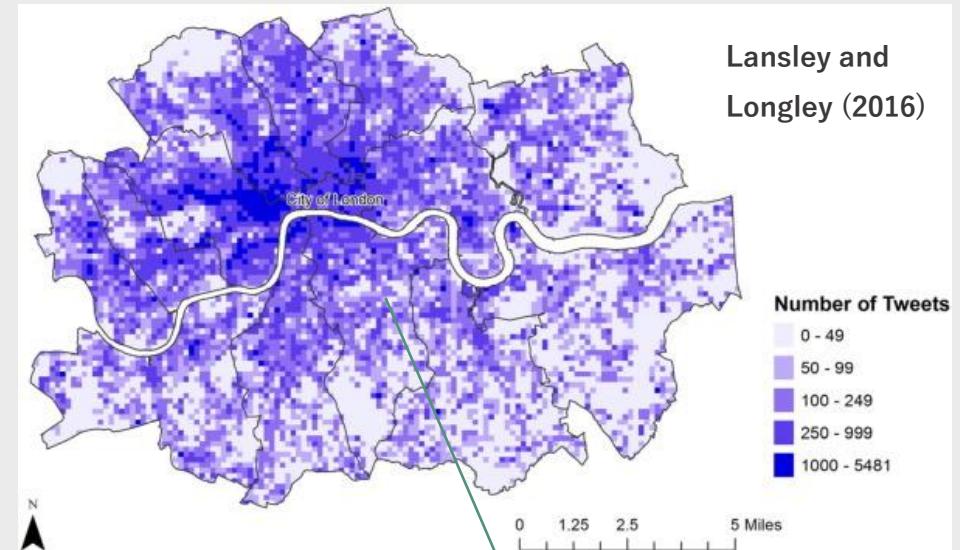
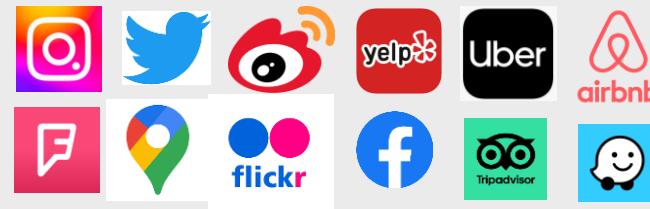
Phillips and Montello (2017)



Dalton and Hurrell (2022)

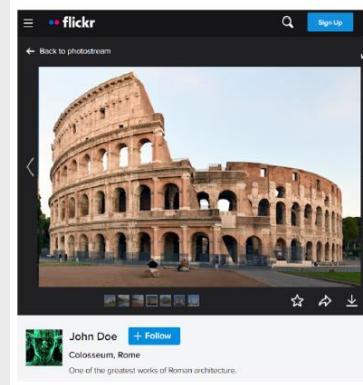
Regions in the city

- How do we map those regions? Data, methods and considerations
- User-generated content
- Spatial proxies of human-environment interaction
- Geo-tagged activity with discursive information and/or images
- Different platforms: social media networks, websites, location-based services, real-estate, reviews, places
- Extra dimension of the city: activities, functions, places, flows, sentiment, perception

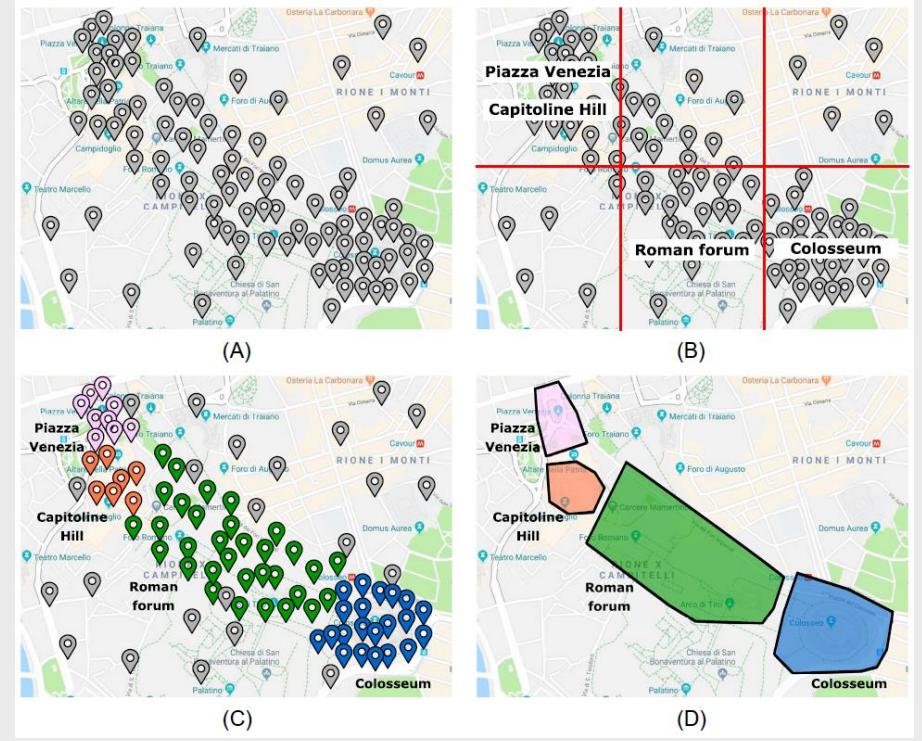


Regions in the city

- How do we map those regions? Data, methods and considerations
- User-generated content
- Most cases: coordinates with textual data and/or other metadata
- Analysis will depend on the region: areas of interest (thematic; topic-based areas), specific neighborhoods, functional regions, etc.
- Natural language processing: keyword search, topic modeling, sentiment analysis, etc.



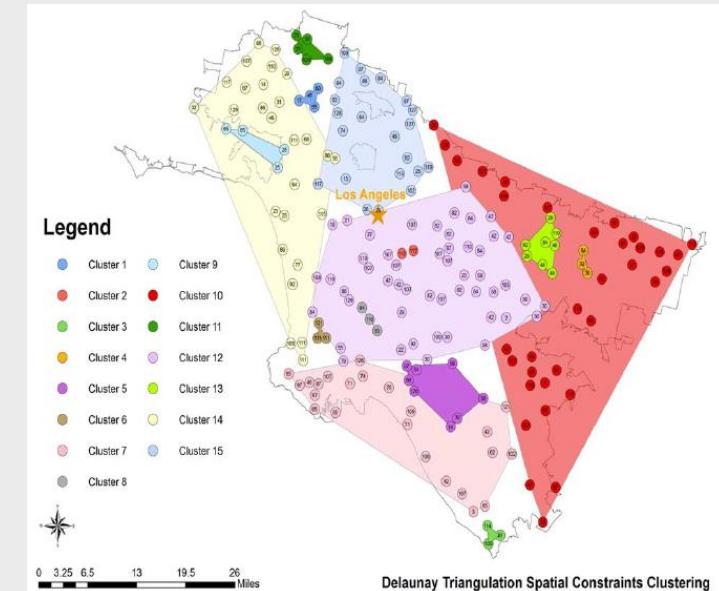
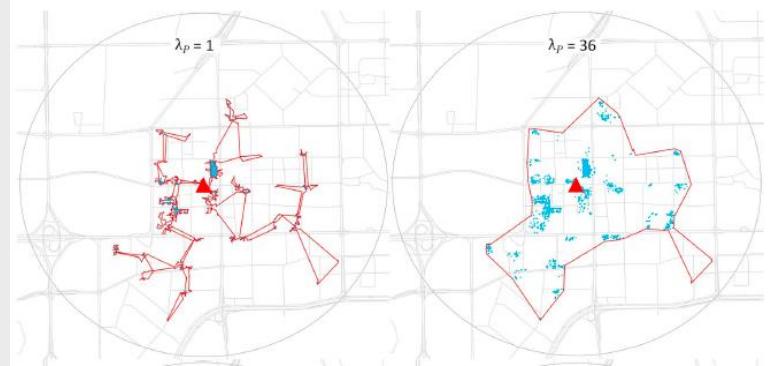
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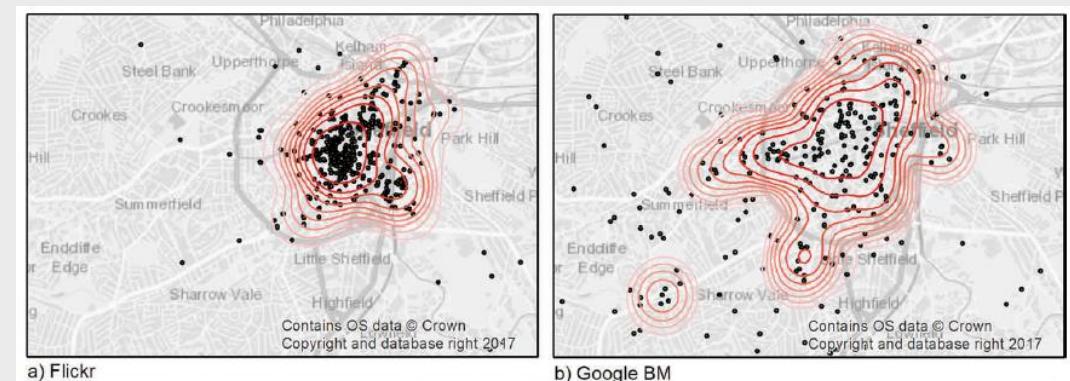
Belcastro (2019)

Regions in the city

- How do we map those regions? Data, methods and considerations
- User-generated content
- Point-based information to regions: clustering, shapes (concave shapes, convex hull), density analysis (KDE), point-pattern analysis, triangulation



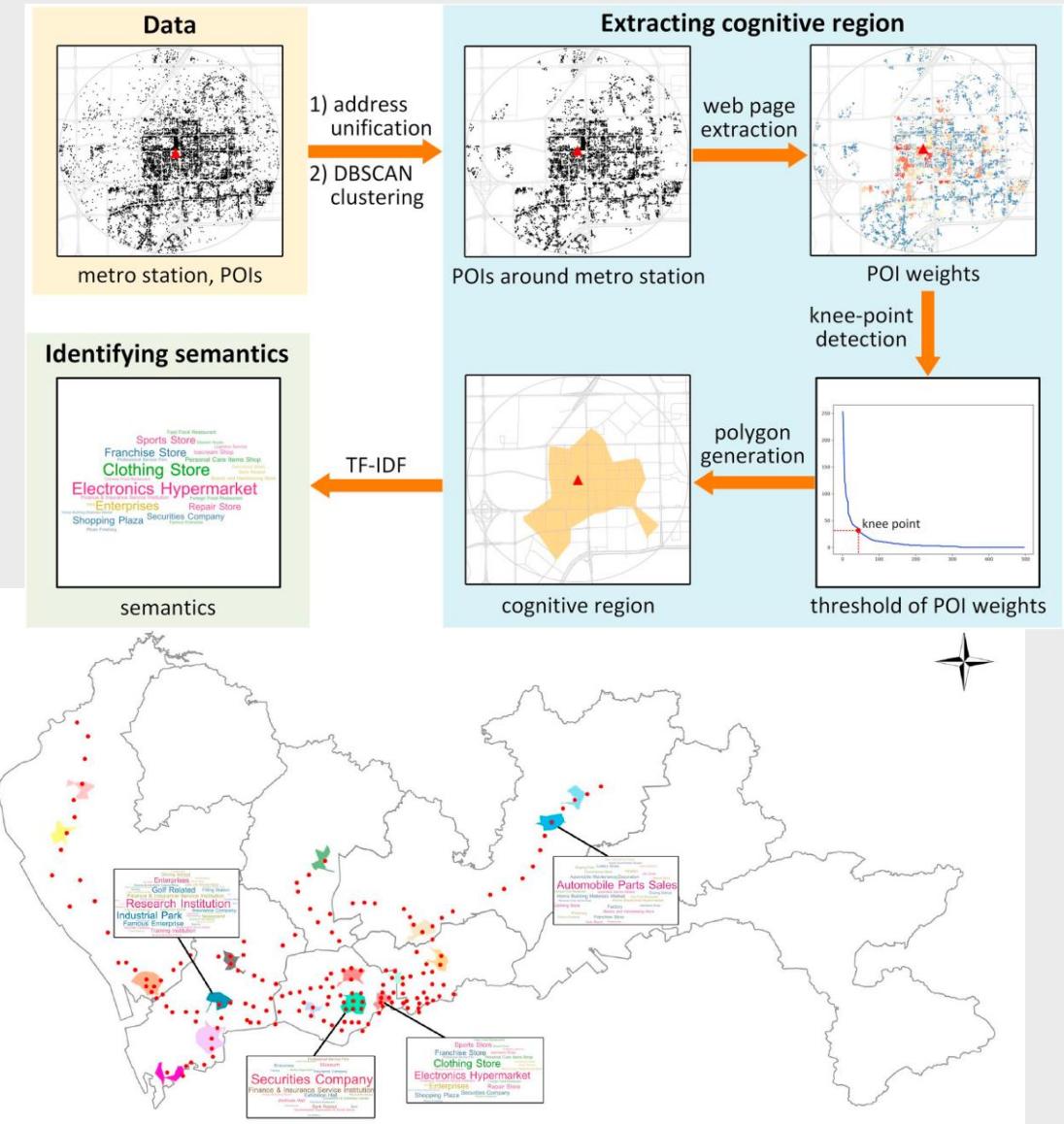
Gao et al. (2017)



Twaroch et al. (2019)

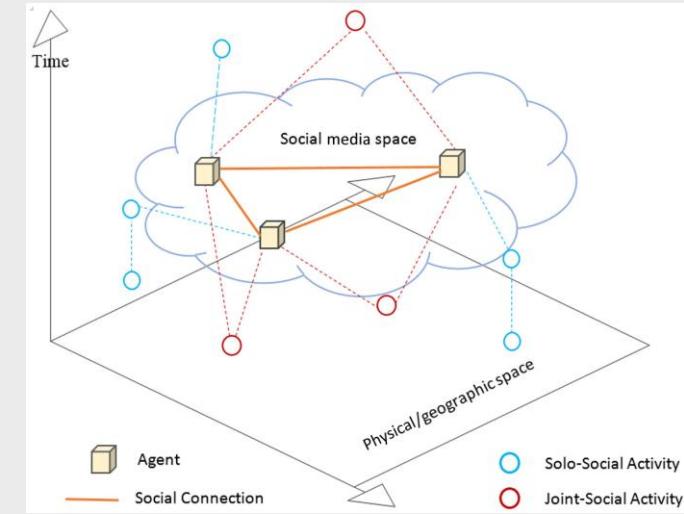
Regions in the city

- How do we map those regions? Data, methods and considerations
- User-generated content
- Combining semantic and spatial properties

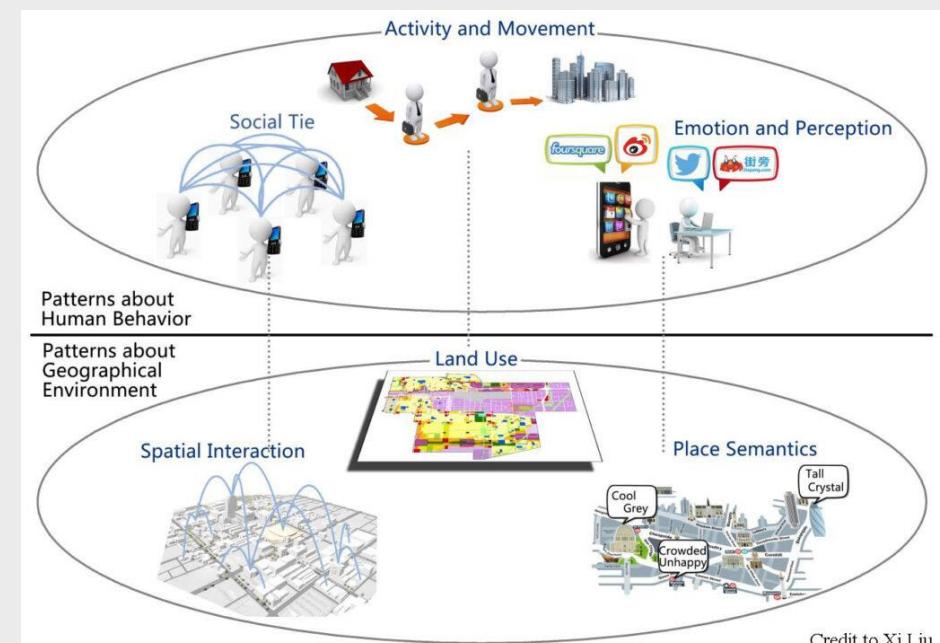


Regions in the city

- How do we map those regions? Data, methods and considerations
- Considerations
- Bias – platforms, demographics, population distribution
- Geo-tag – coordinates, places, motivation to do so, precision
- Ground-truth – said places and true places
- Proxies – we are not asking people
- Scale and granularity – spatial, cognitive and thematic
- Points – reduction to a collection of points



AlBanna et al. (2016)



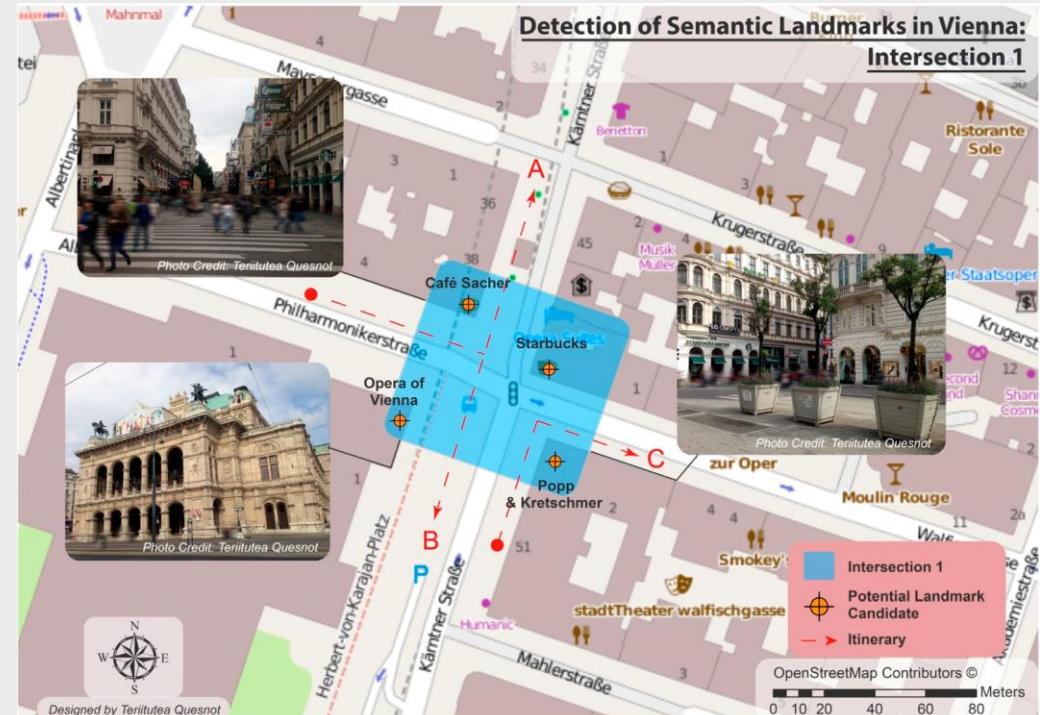
Credit to Xi Liu
[source]

Regions and places



Regions as a super set of places

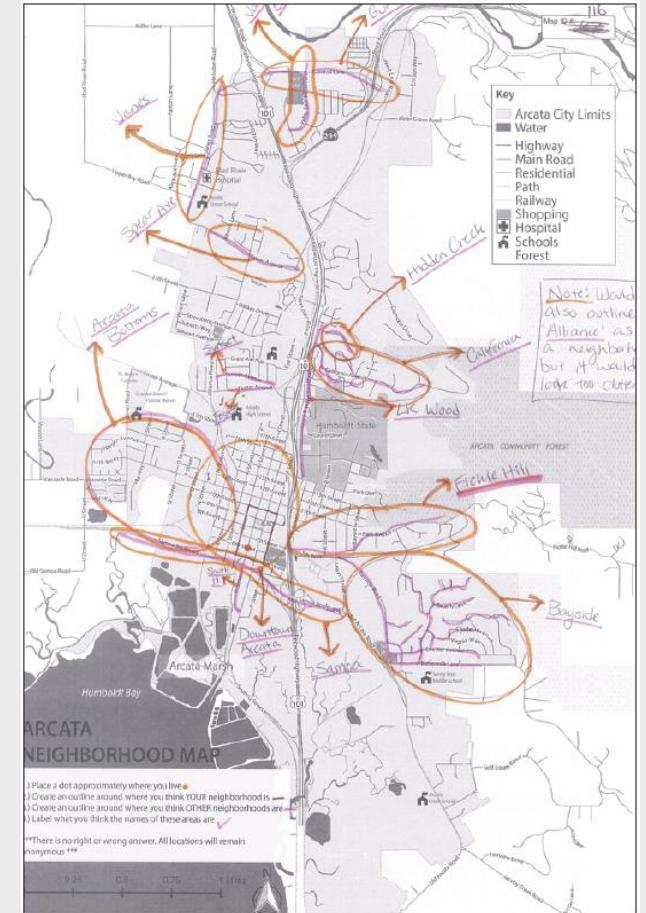
- Places – spatial settings imbued with human meaning or the human understanding of space – human geography, philosophy, anthropology
- Regions and places – they share common features
- Region as a collection or a collage of places?
- Montello (2014) – “we believe that the concept of place is a subset of the concept of region”



Quesnot and Roche (2014)

What information we might be missing from online content? and from surveys?

Can we extract additional information by combining them?



Urban places and regions in GI Science

Concepts, methods and challenges

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