

# Operationalizing places in GIScience: a review

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**Transactions in GIS**

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Vicente Tang and Marco Painho

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*Operationalizing places in GIScience: a review*

DOI: [10.1111/tgis.12767](https://doi.org/10.1111/tgis.12767)

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## Context

- **NOVA Information Management School:** research, teaching, labs and partnerships
- **Geoinformatics**
- **Vicente Tang:** Ph.D. student at the NOVA IMS
- **Marco Painho:** full professor at NOVA IMS, co-author



# Introduction

The background is a vibrant, abstract composition. It features a dark purple base color. In the top-left corner, there are layered, wavy shapes in shades of blue, cyan, and magenta. On the right side, there are large, curved, overlapping shapes in bright orange, pink, and red. A thin, glowing yellow arc curves across the right side of the image. The overall aesthetic is modern and digital.

# Places

- **humans in geographic space:** perceptions, cognition, behavior and communication



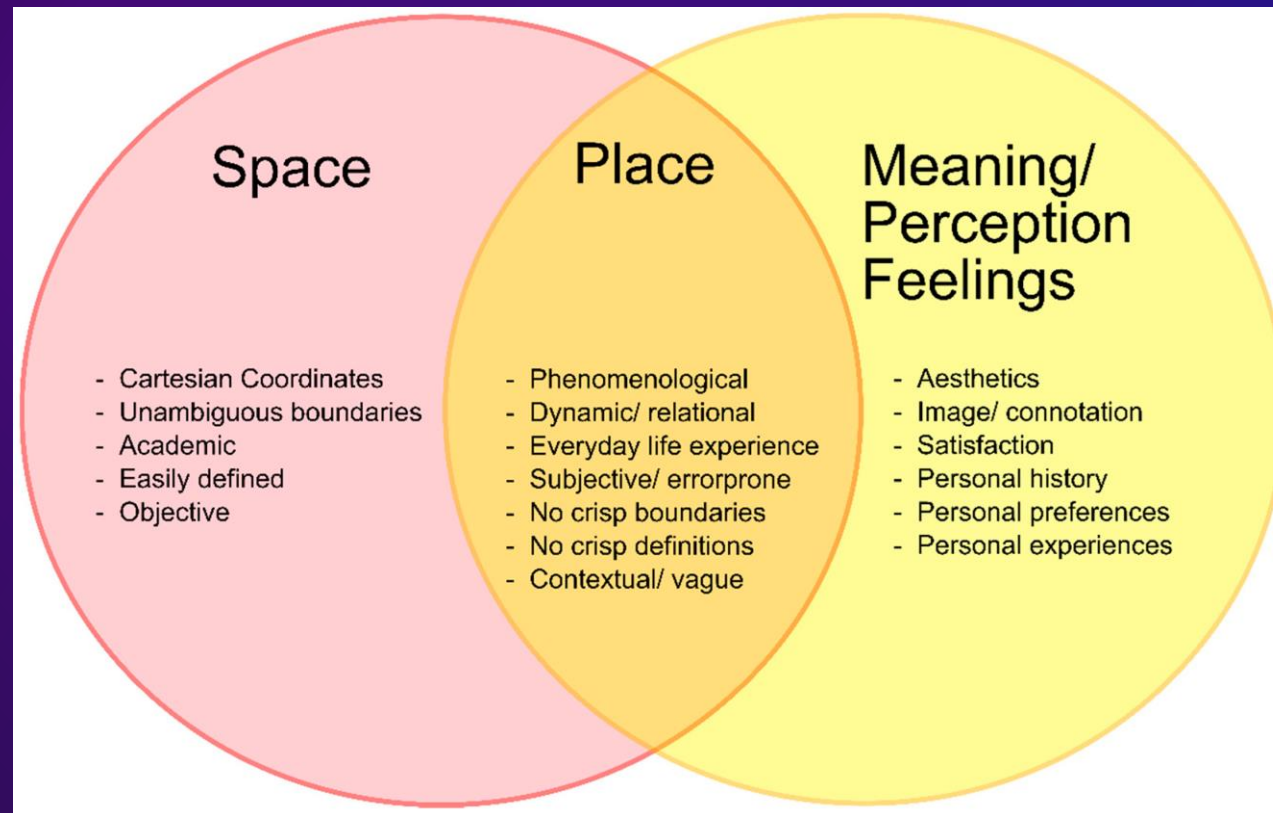
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# Places

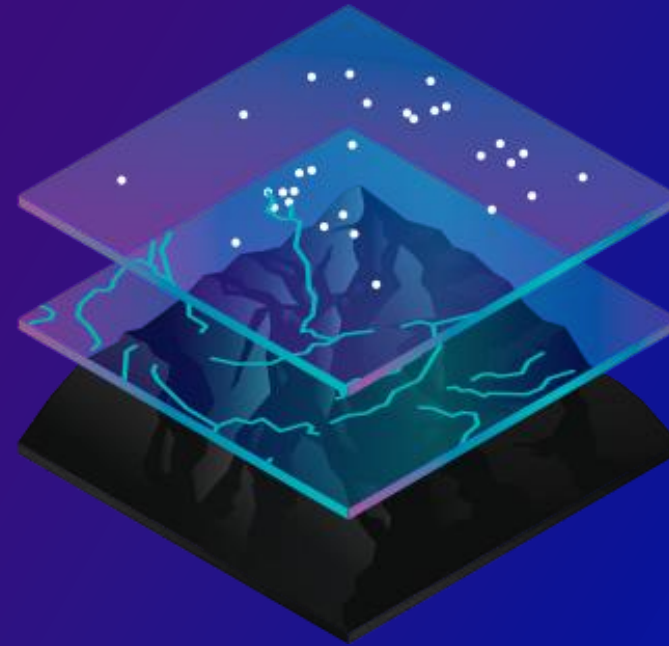
- **space and place:** key concepts in geography



Merschdorf and Blaschke, 2018

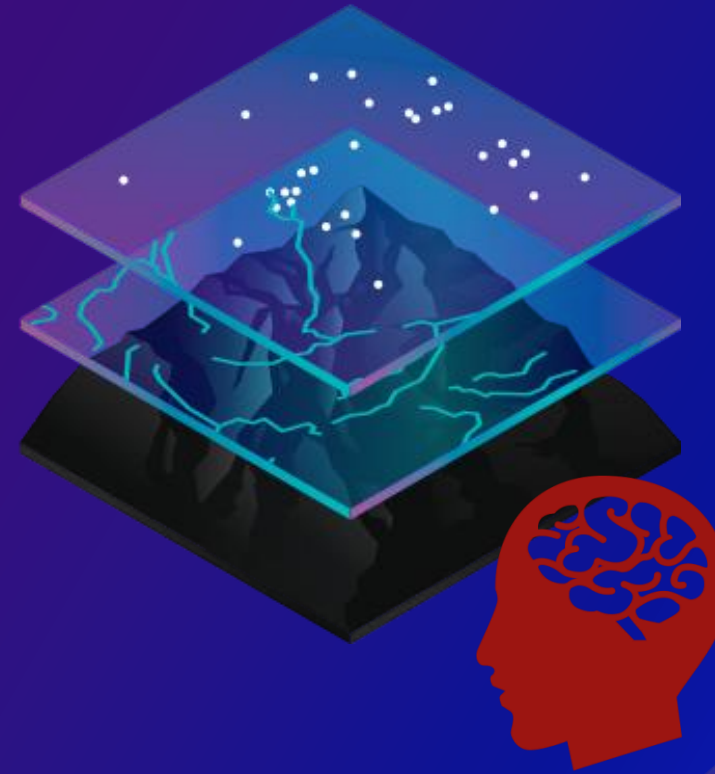
# Places

- **geographic information systems and science: spatial**



# Places

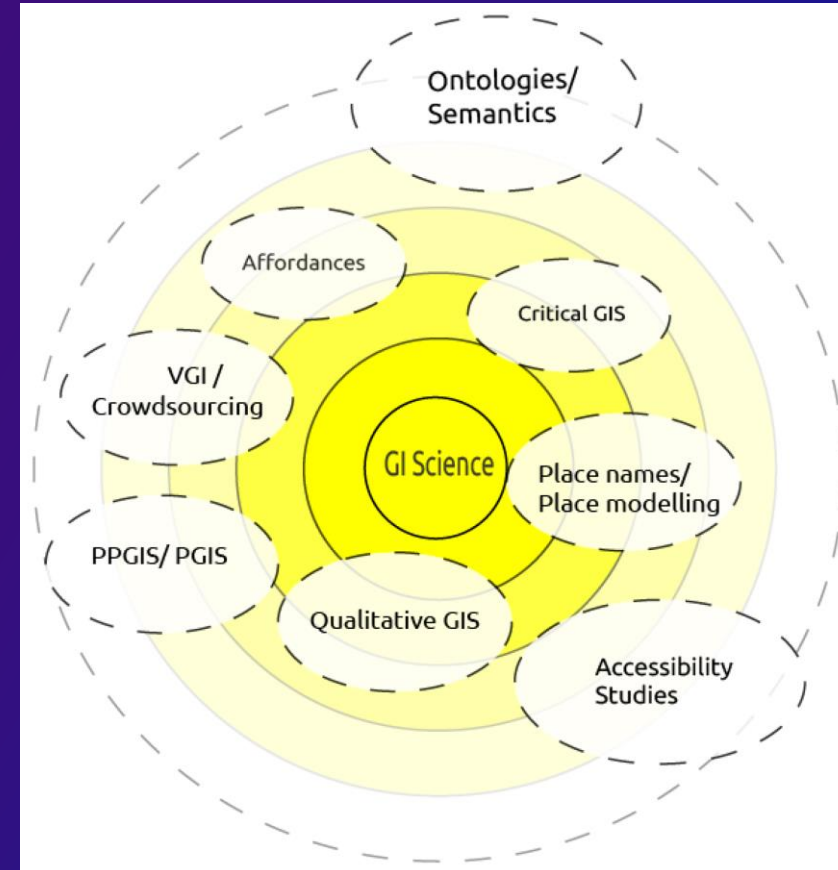
- **geographic information systems and science:** spatial
- **place-based stream:** representation, analysis, data, models, new paradigms
- **patial? placial?**



*Semantics*  
*Activities*  
*Language*  
*Culture*  
*Subjectivities*  
*Experiences*  
*... and more*

# Motivation

- **place and GIS:** several frameworks, conceptualizations and methods
- **What has been done to bridge the gap between places and GIS?**



Merschdorf and Blaschke, 2018

## Motivation

- **previous reviews:** place in GIScience, places in information systems and dimensions of places



## Motivation

- **previous reviews:** place in GIScience, places in information systems and dimensions of places
- **going a step further in mapping the research landscape:**

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***How research has effectively operationalized and formalized the concept of place in geographic information science?***

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# Methods

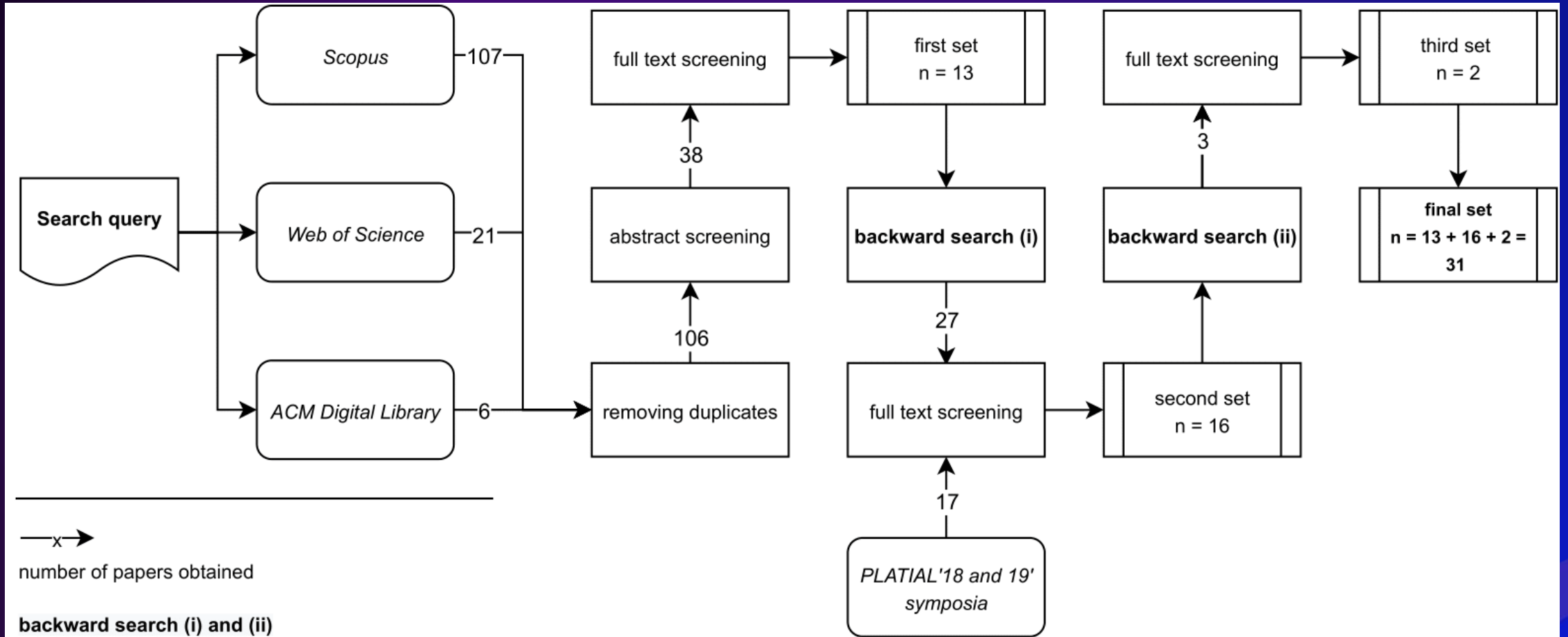
The background features a vibrant, abstract design. On the left, there are layered, wavy shapes in shades of blue, purple, and pink. The right side is dominated by large, curved, overlapping shapes in bright orange, pink, and yellow, creating a sense of depth and movement. A thin, curved yellow line arches across the middle-right section. The overall color palette is rich and saturated, with a gradient from deep purple to bright yellow.

# Review

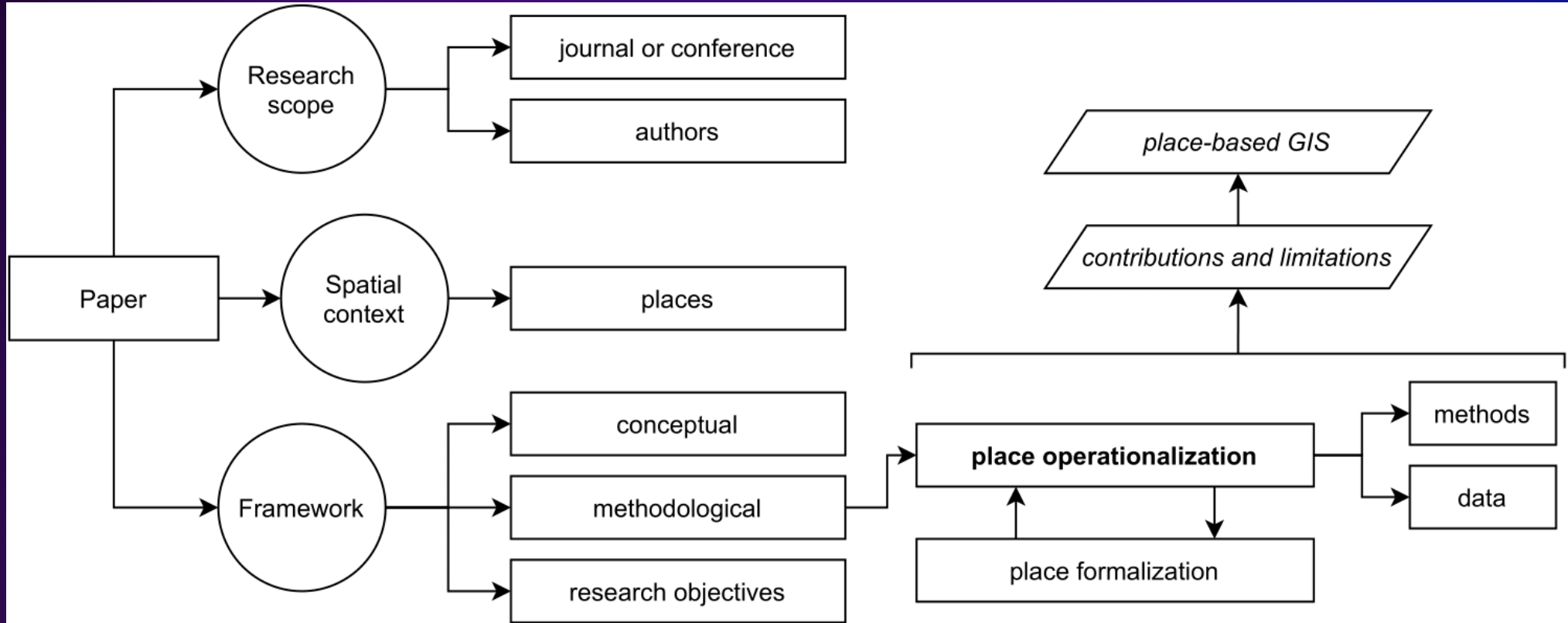
- **mixed-method literature review:** systematic selection process
- **content analysis and narrative synthesis**
- ***search query:***

SQ = (("placial" OR "platial" OR "place-based GIS") AND ("GISc" OR "GIScience" OR "GIS" OR "geographical information" OR "geographic information"))

# Review



# Topics

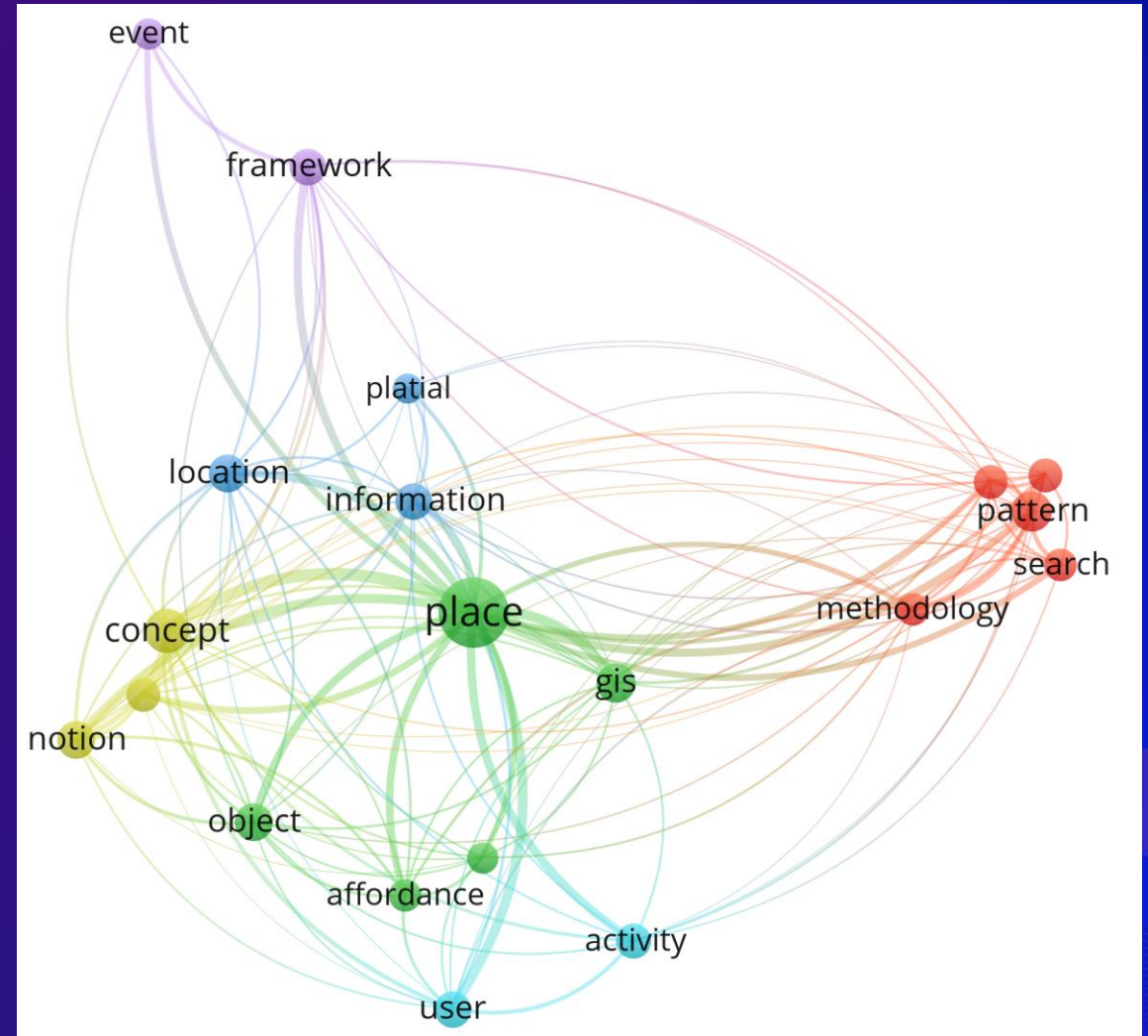
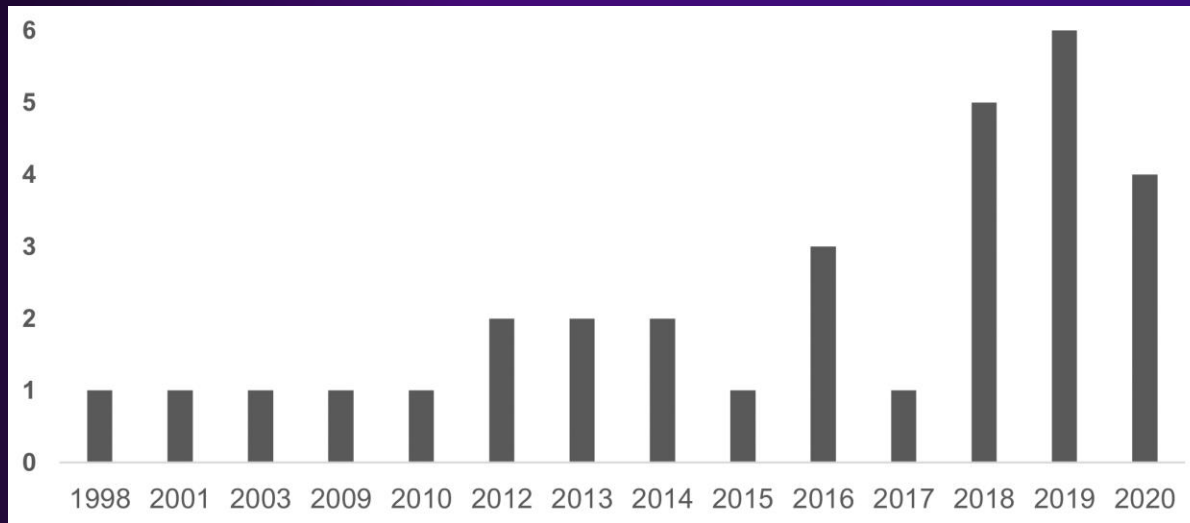


# Initial results

The background features a vibrant, abstract design. On the left, there are layered, wavy shapes in shades of blue, purple, and pink. The right side is dominated by large, curved, overlapping shapes in bright orange, pink, and yellow, creating a sense of depth and movement. A thin, curved yellow line arches across the middle-right section. The overall color palette is rich and saturated, with a gradient from deep purple to bright yellow.

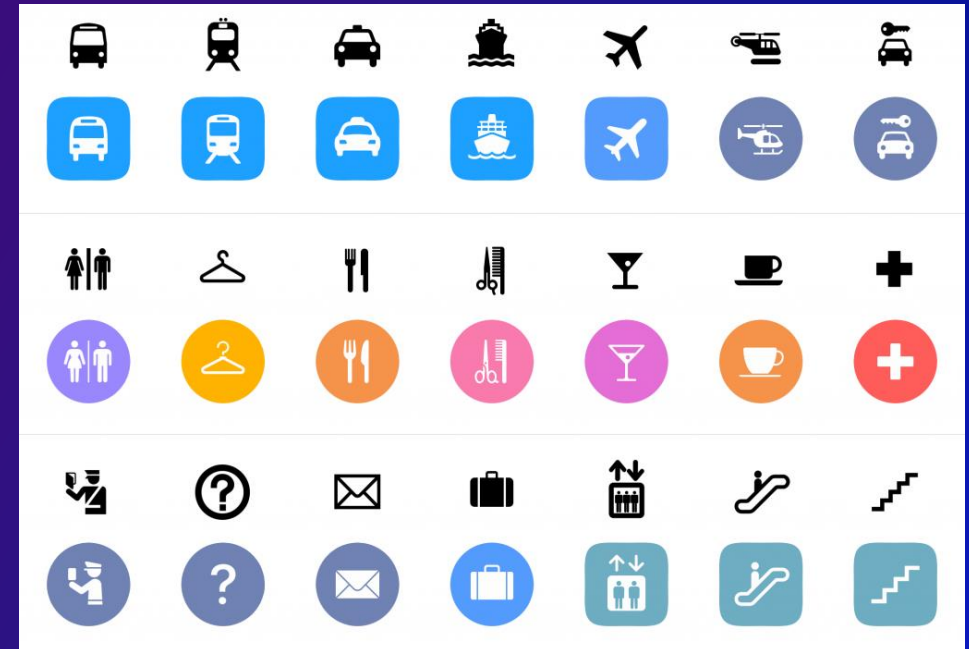
# Text analysis

- final set: 31 papers
- exploratory text analysis



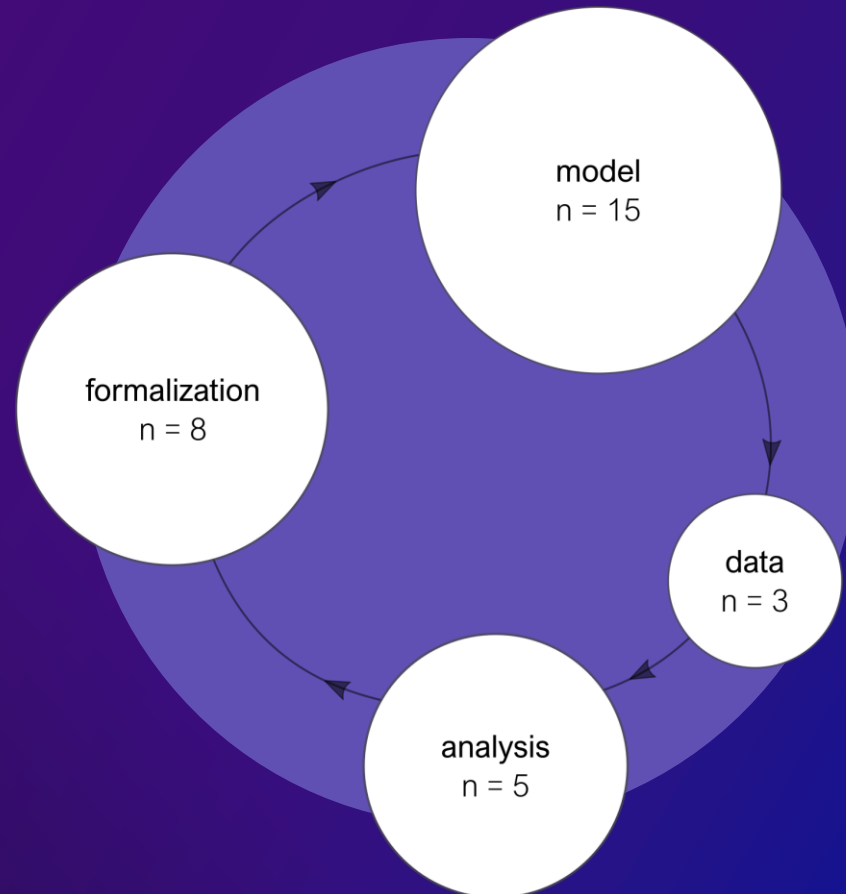
# Where?

- **location in space:** what did the studies operationalized?
- **55%** - places within the urban landscape (POI's, landmarks, green urban areas)
- **places:** *buildings, markets, administrative regions, restaurants, landscape features, beaches, gardens, “safe places”, shopping areas and places in dreams!*



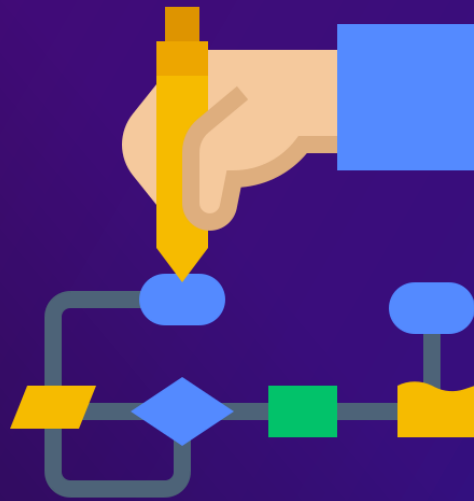
# Research objectives

- motivation, research questions, aims and objectives



## Formalizing the concept of place

- **translating the concept into formal components:** enabling integration in GIS and other systems
- **varying degrees of formalization:** from diagrams to mathematical axioms



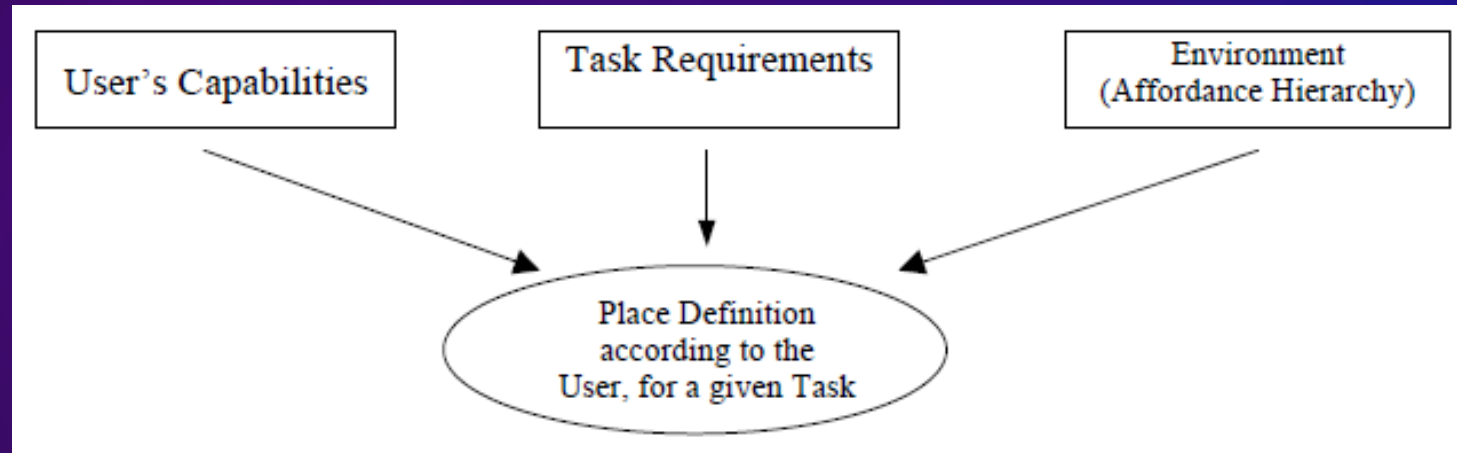
## Formalizing the concept of place

- **common feature:** the *where* element
- ***where, what*** and the relationship with other places



# Formalizing the concept of place

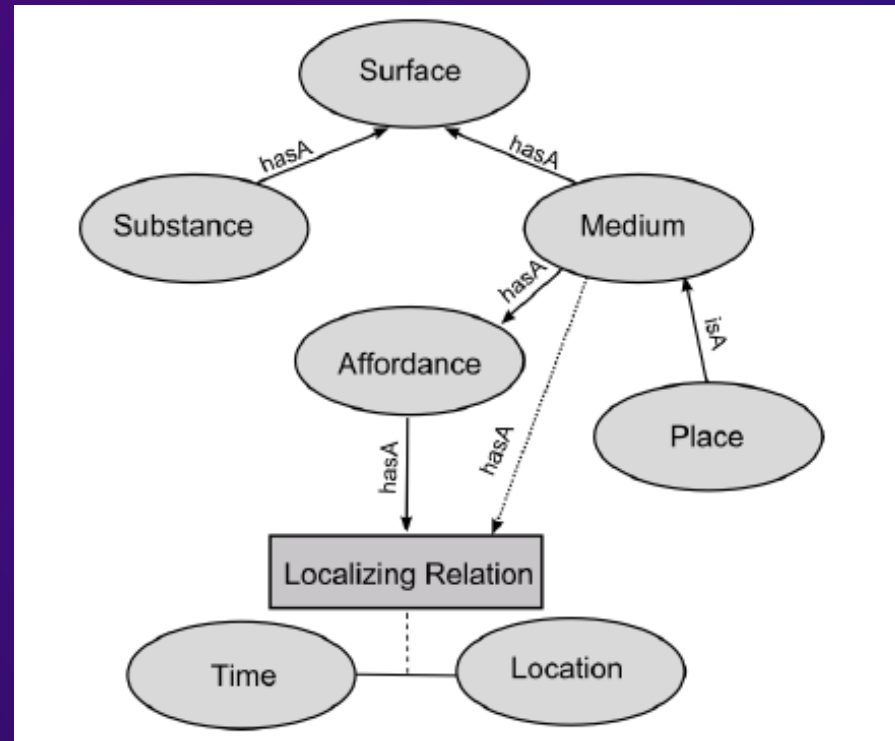
- **examples:** Jordan et al. 1998



Jordan et al. 1998

# Formalizing the concept of place

- **examples:** Scheider and Janowicz, 2010



Scheider and Janowicz, 2010

# Formalizing the concept of place

- **examples:** Purves et al. 2019

1. Places must be identifiable through some set of definable properties and/or relationships, and are thus unique geographic objects.
2. Because places are geographic objects they must have locations.
3. The identity of a place must be shared—emphasizing that places are social constructions and emerge from some form of human consensus.

Purves et al. 2019

# Formalizing the concept of place

- **examples:** Papadakis et al. 2019

Element Name	Element Set	Description
Functions	$\mathcal{F}$	Functions the place offers
Components	$\mathcal{CMP}$	Components that form the place
Composition Rules	$\mathcal{CR}$	Composition rules
Functional Implications	$\mathcal{FI}$	$f \leftarrow \phi(cr), f \in \mathcal{F}, cr \in \mathcal{CR}, \phi$ logical formula

**Table 2.** Composition rules [7].


Composition rule	Semantics
$Occurrence(A, T)$	Component $A$ appears $T$ times, $T \subseteq \mathbb{N} \cup \{0\}$
$Correlation(A, B, N)$	Ratio of occurrence of components $A$ and $B$ is $N$ , $N \subseteq \mathbb{R}^+$
$Spatial\ Relation(A, B, R)$	Spatial relation between any combination of components from sets $A$ and $B$ is $R$ , $R \in DE-9IM$ [20]
$Proximity(A, B, D)$	Distance between any combination of components from sets $A$ and $B$ is $D$ , $D \subseteq \mathbb{N} \cup \{0\}$

## Operationalizing the concept of place

- **implementation and methods**
- **how researchers implemented their models or frameworks?**



## Operationalizing the concept of place

- **implementation and methods**
  - **how researchers implemented their models or frameworks?**
  - **varying degrees of implementation:** real data, real-world examples, suggestions, future applications.
  - **common feature:** outlined tangible examples in which the boundaries between GIS and the notion of place were merged
- 

## Operationalizing the concept of place

- **implementation in different tasks:** place-based queries; place-based GIS operations; information retrieval based on similar places; footprint approximations; exploratory data analysis; data classification and data representation, among others.
- **knowledge-based models; knowledge-based and empirical models; and theoretical solutions.**



# Operationalizing the concept of place

- **examples:** Scheider and Janowicz, 2014

$X \in \{Talking, Giving\}$ :

$[WithinDistance^{GIS} s_1 s_2, footprint^{GIS} ag = s_2]$

$\implies \exists a_1, a_2, f_1, f_2, ag_1. X a_1 \wedge purpose a_1 = a_2 \wedge performedAt a_2 f_2 \wedge performedAt a_1 f_1$   
 $\wedge agentOf ag a_2 \wedge agentOf ag_1 a_1 \text{ where } f_1 = s_1 \wedge \text{where } f_2 = s_2$

Scheider and Janowicz, 2014

# Operationalizing the concept of place

- examples: Gao et al. 2013

SPARQL Query Interface for Spatial Join Operation

isPartOf

Goleta "isPartOf" Santa Barbara County

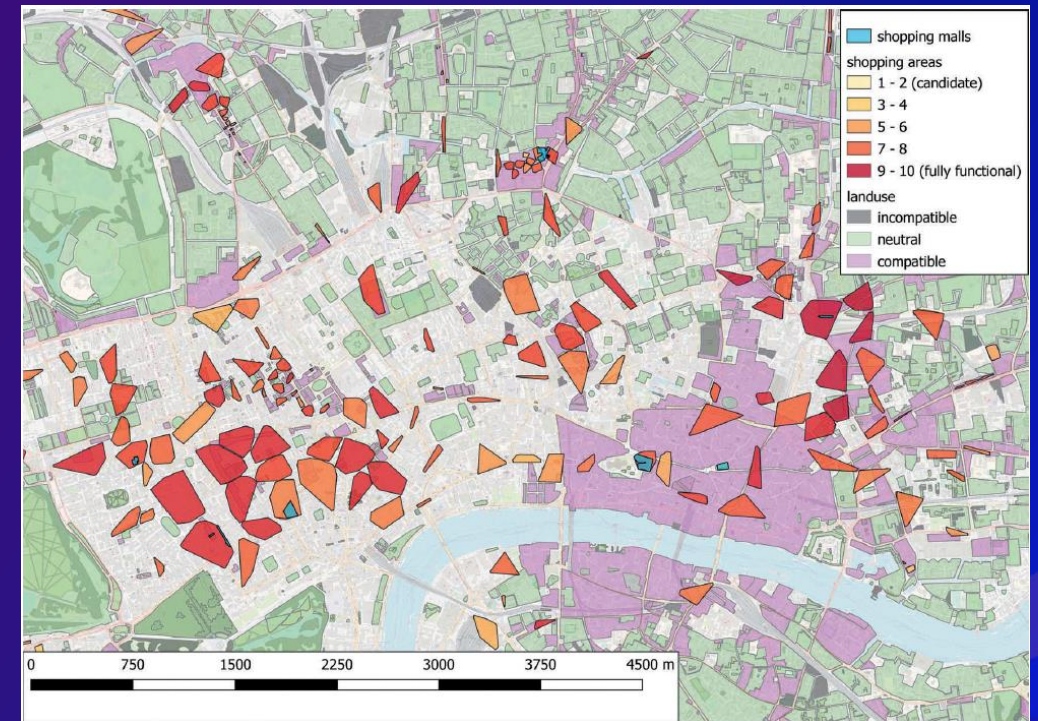
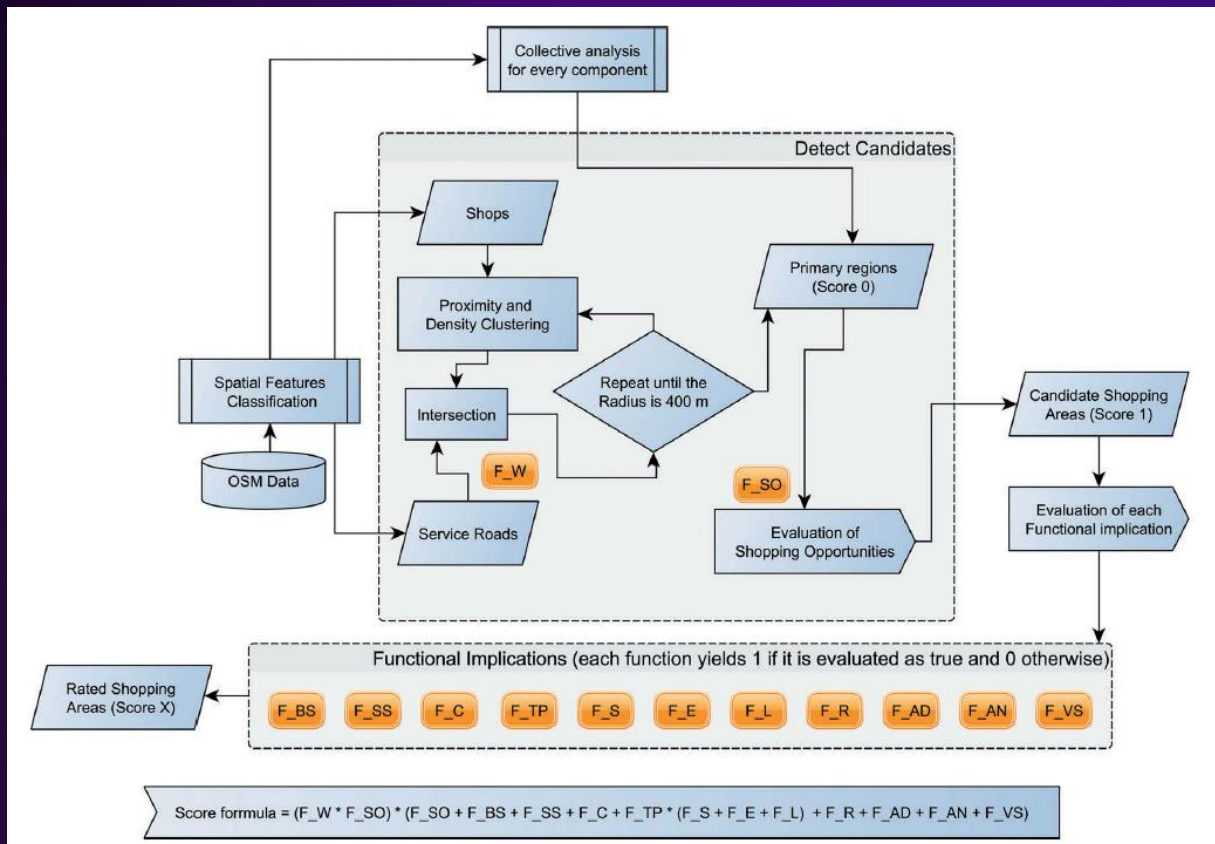
Goleta hasProperty "populationTotal"



Gao et al. 2013

# Operationalizing the concept of place

- examples: Papadakis et al. 2020



# Operationalizing the concept of place


- **data:** different uses in the selected studies
- **sources and types:**
  - Digital gazetteers
  - Wikipedia (Dbpedia linked data)
  - Surveys
  - Ontologies
  - Lexical databases
  - Narratives
  - Testimonies
  - Social media ....




The background features a vibrant, abstract design. On the left, there are layered, wavy shapes in shades of blue, purple, and pink. On the right, a large, curved shape in shades of orange and red dominates the space. In the bottom right corner, there is a stylized, low-poly representation of a mountain range in shades of orange and yellow. The overall color palette is rich and saturated, with a gradient from deep purple to bright orange.

# **Bridging places and GIS: toward place-based GIS?**


## Contributions and limitations

- **integrating place in GIS:** advances and different degrees of context/application dependency
  - **place reference systems and ontological commitments:** examples of generalizing frameworks
  - **the role of geotagged user-generated content:** source of information that is much more than locational
- 

## Contributions and limitations

- **important concepts/fields in the literature:** topology, hierarchy, networks, semantics, ontologies, cognition, linguistics, uncertainty, vagueness, time and scale.
  - **general contribution:** outlining solutions to address place in GIS
  - **common limitation:** often lack of exemplification or further implementation
- 

## A new paradigm?


- **What is a place-based GIS?** lack of definitions
  - **Do we need a platial paradigm?** contrasting opinions
  - **Heterogenous and fragmented research stream:** no consensus
- 

## A new paradigm?

- **What would a platial GIS look like? Platial Information Science?**
- **We have the theoretical, methodological and technological tools**




## A new paradigm?

- **What would a platial GIS look like? Platial Information Science?**
  - **We have the theoretical, methodological and technological tools**
  - **What is place?** The need for more conceptualizations and formalizations
  - **Language, culture and context:** challenges
  - **Towards improving our knowledge on human-environment interaction**
- 


# Final remarks

The background is a vibrant, abstract composition. It features a gradient of colors from deep purple and blue on the left to bright pink and orange on the right. There are several overlapping, semi-transparent shapes, including a large, curved yellow shape on the right side. The overall effect is dynamic and modern.

## Final remarks

- **31 papers:** published between 1998 and 2020, mostly in GIScience journals and conferences
  - **Most part:** formalized and/or operationalized places in the urban context through knowledge-based models using open sources of spatial data, using theory from human and critical geography
  - **Gaps:** reductionist approaches, lack of fully operational examples
- 

## Final remarks

- **Limitations of the review:** disciplinary breadth outside the terms of the search query
  - **Future work:** more in-depth quantitative methods for investigating how place has been dissected and operationalized
  - **Continue to map, clarify and outline the research landscape:** encourage new research to help us understand the complex relationship between people and their spatial settings
- 

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**Thank you**

## References (figures)

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