Geographic Data Science – Lecture VIII

Grouping Data over Space

Dani Arribas-Bel

Today

- The need to group data
- Geodemographic analysis
- Non-spatial clustering
- Regionalization
- Examples "in the wild"

The need to group data

Everything should be made as simple as possible, but not simpler

Albert Einstein

The need to group data

- The world is **complex** and **multidimensional**
- **Univariate** analysis focuses on **only one** dimension
- Sometimes, world issues are best understood as **multivariate**. E.g.
  - Percentage of foreign-born Vs. *What is a neighborhood?*
  - Years of schooling Vs. *Human development*
 - Monthly income Vs. *Deprivation*

Grouping as *simplifying*

- Define a given number of categories based on **many characteristics** (multi-dimensional)
- Find the **category** where each observation *fits best*
- **Reduce complexity**, keep all the **relevant information**
- Produce easier-to-understand outputs

Geodemographic analysis

Geodemographic analysis

- 1970's, Richard Webber
- **Identify similar neighborhoods**
  → Target urban deprivation
  funding
- **Public** Sector (policy) →
  Private sector (marketing and
  business intelligence)
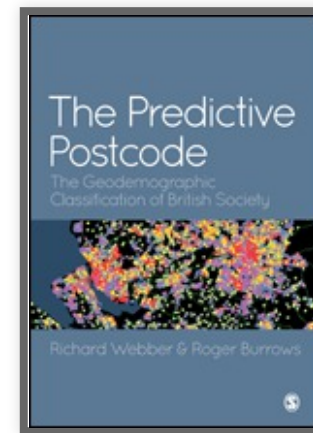
CDRC Maps

Consumer Data Research Centre   An ESRC Data Investment

DATA CHOOSER

Classifications   Retail

Select a map:

2011 Area Classif/n of OAs

Download this data

MAP OPTIONS

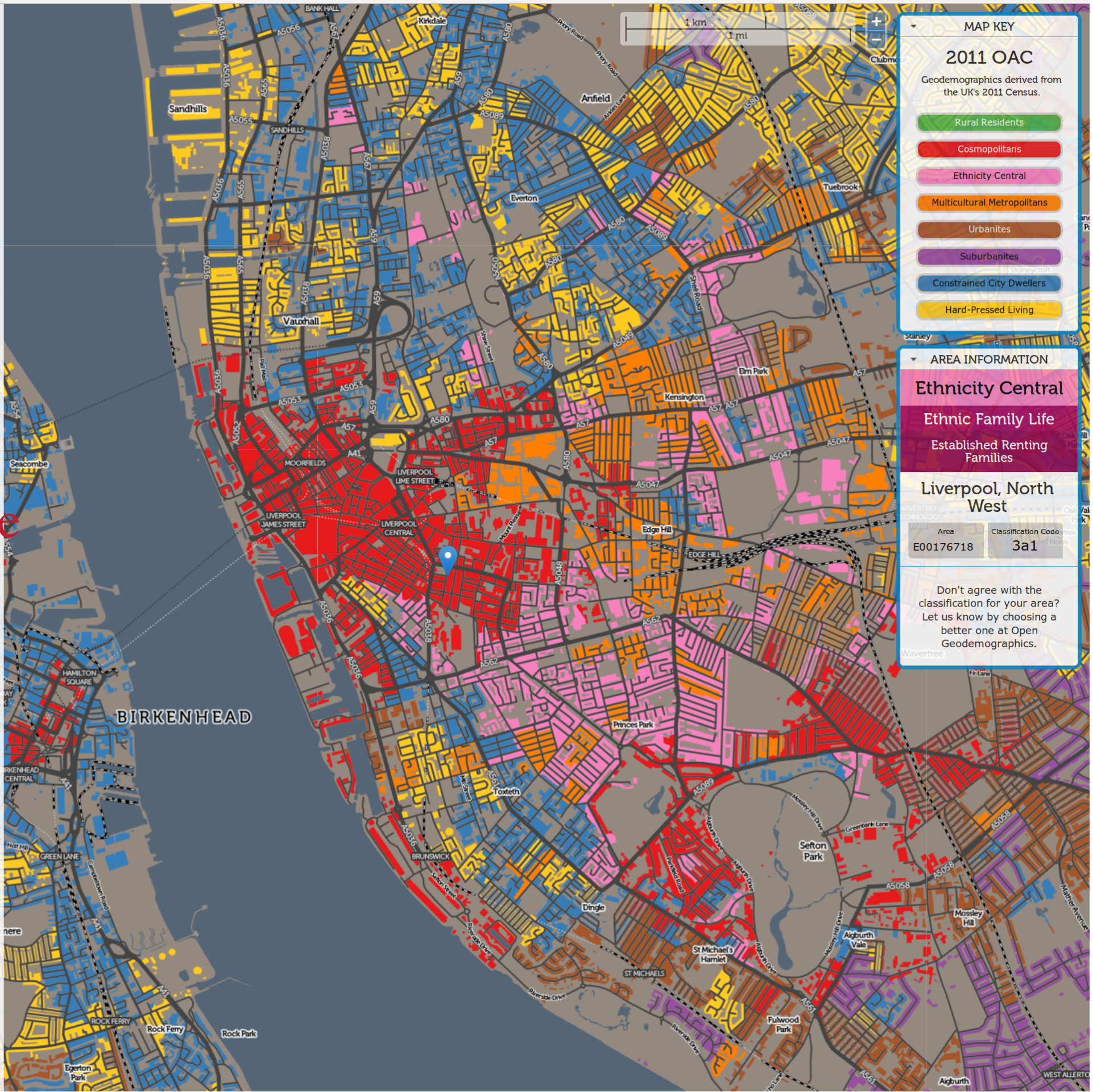Layers: Land   Labels

Toggle: Retail Centres

Download: retail centre locations

Postcode: l19dw   Go

f Like   Share   Tweet

Important note: Classifications are an average across the local area, rather than for individual houses, therefore the colour coding on a building is not necessarily indicative of

MAP KEY

2011 OAC

Geodemographics derived from the UK's 2011 Census.

Rural Residents

Cosmopolitans

Ethnicity Central

Multicultural Metropolitans

Urbanites

Suburbanites

Constrained City Dwellers

Hard-Pressed Living

AREA INFORMATION

Ethnicity Central

Ethnic Family Life

Established Renting Families

Liverpool, North West

Area	Classification Code
E00176718	3a1

Don't agree with the classification for your area? Let us know by choosing a better one at Open Geodemographics.

How do you segment/cluster observations over space?

- Statistical clustering
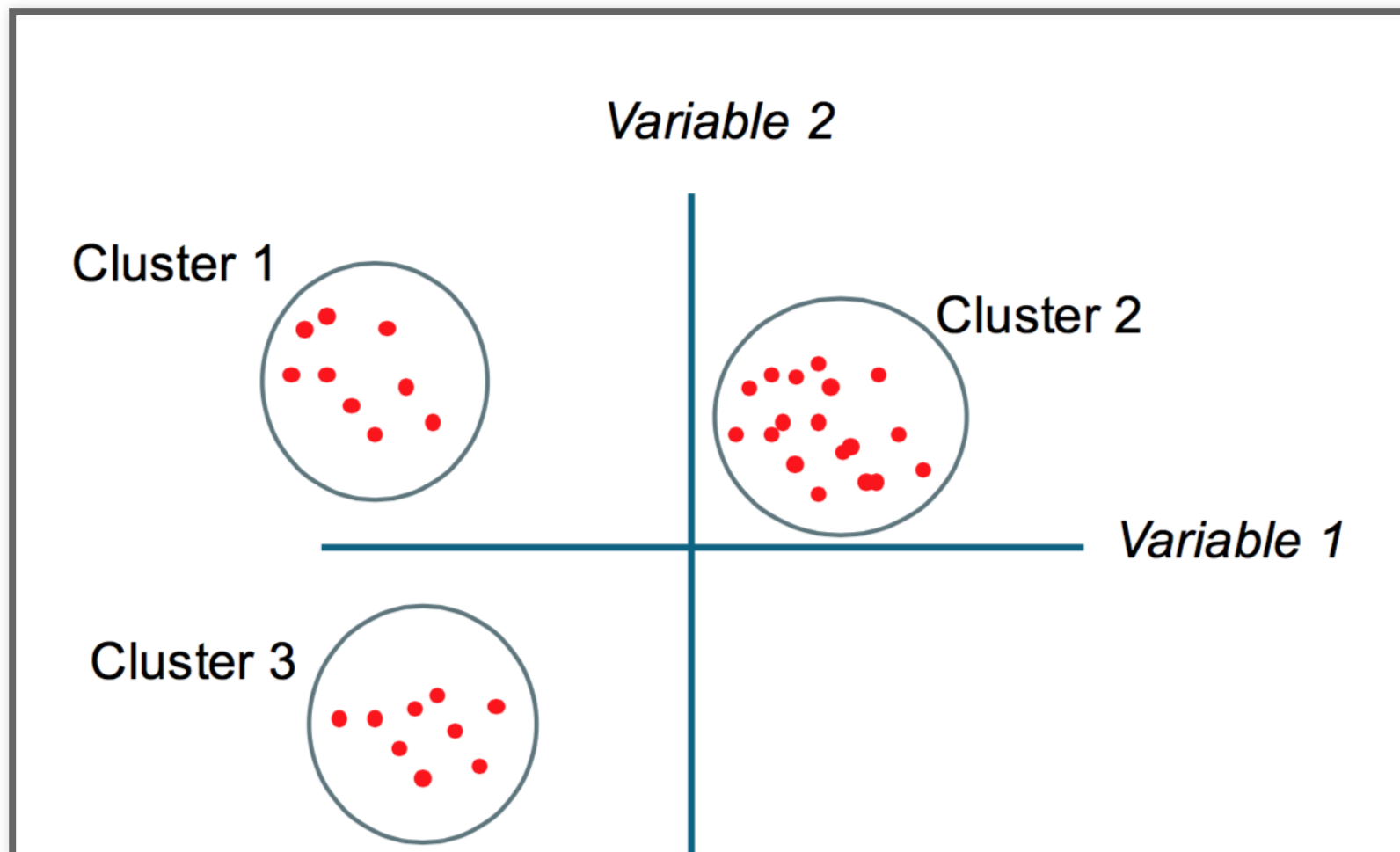- Explicitly spatial clustering (regionalization)

Non-spatial clustering

Split a dataset into **groups** of observations that are **similar within** the group and **dissimilar between** groups, based on a series of **attributes**

Machine learning

Unsupervised

Intuition

K-means [Source]

More clustering…

- Hierarchical clustering
- Agglomerative clustering
- Spectral clustering
- Neural networks (e.g. Self-Organizing Maps)
- DBSCAN

- …

Different properties, different best usecases

See interesting comparison table

Regionalization

Unsupervised **Spatial** Machine Learning

*Aggregating basic spatial units (**areas**) **into** larger units (**regions**)*

Regionalization

Split a dataset into **groups** of observations that are **similar within** the group and **dissimilar between** groups, based on a series of **attributes**…

…with the additional constraint observations need to be **spatial neighbors**

Regionalization

Duque et al. (2007)

Regionalization

- All the methods aggregate geographical areas into a predefined number of regions, while optimizing a particular aggregation criterion;
- The areas within a region must be geographically connected (the spatial contiguity constraint);
- The number of regions must be smaller than or equal to the number of areas;
- Each area must be assigned to one and only one region;
- Each region must contain at least one area.

Duque et al. (2007)

🔴	-1
🟣	0
🔵	1
🟢	2
⚫	3
🟣	4
🟠	5
🟠	6
🟡	7
🟡	8
🟤	9
🩷	10
🩷	11
⚪	12
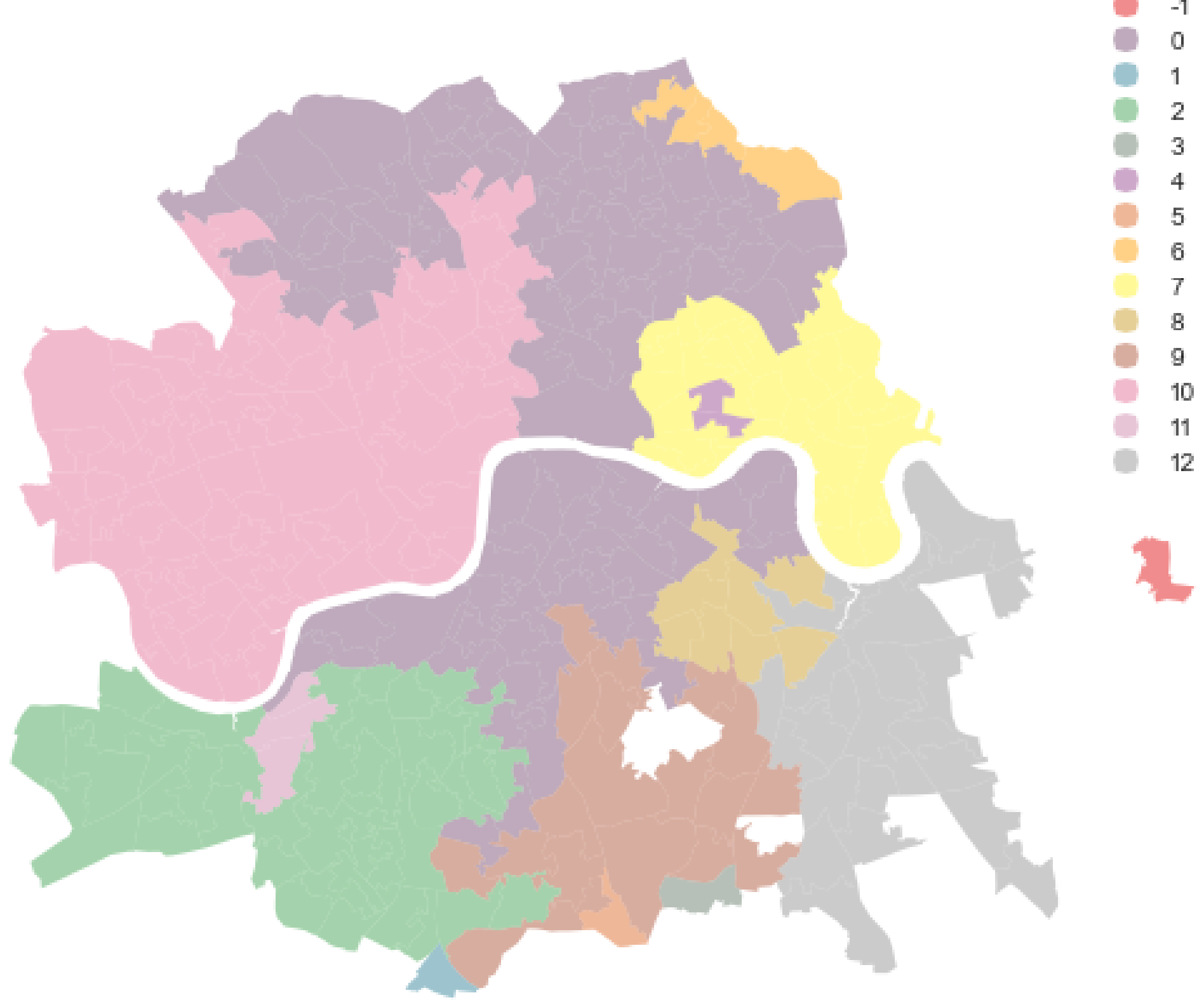
Algorithms

- Automated Zoning Procedure (AZP)
- Arisel
- Max-P
- …

See Duque et al. (2007) for an excellent, though advanced, overview

Examples

Non-spatial clustering

Spotify

YOUR LIBRARY

Your Daily Mix
Recently Played
Songs
Albums
Artists
Stations
Local Files
Videos
Podcasts

PLAYLISTS

Discover Weekly
Release Radar
Classical
Electronic
HipHop
Jazz
Playlists by others
Tras la cena
After dinner
Cumple
Mi patria
party - summer street
Deftones walk
TX-trip
Liked from Radio
Krugman Friday Night Music
Dinner
Cosmopolitan
Personal-recommendations

New Playlist

Search

dreamessence

Your Daily Mixes

Play the music you love, without the effort. Packed with your favorites and new discoveries.

Your Daily Mix 1

Daily Mix 1
Gata Cattana, DELLAFUENTE, ToteKing and more
MADE FOR DREAMESSENCE

Your Daily Mix 2

Daily Mix 2
Aphex Twin, George FitzGerald, Nosaj Thing and more
MADE FOR DREAMESSENCE

Your Daily Mix 3

Daily Mix 3
Dedekind Cut, Helena Hauff, Taylor Deupree and more
MADE FOR DREAMESSENCE

Your Daily Mix 4

Daily Mix 4
Berliner Philharmoniker, Alexandre Tharaud, Sir Colin Davis and more
MADE FOR DREAMESSENCE

Your Daily Mix 5

Daily Mix 5
GoGo Penguin, Yussef Kamaal, Blue Lab Beats and more
MADE FOR DREAMESSENCE

Your Daily Mix 6

Daily Mix 6
Fleet Foxes, Andrew Bird, Iron & Wine and more
MADE FOR DREAMESSENCE

Friend activity

townhallsymphon...
Step Out
José González
The Secret Life O...

1236163056   6 h
Divine Hammer
The Breeders
Last Splash

_maxi   10 h
Sensationz of the M...
Mentol Nomad
Subterranean Hit...

FIND FRIENDS

https://ca-political.com/?__hstc=163013475.b1001e9ef2d9e98e22fa0fd952f21a5c.1528388939083.1528388939083.1528388939083.1&__hssc=163013

CA
Political

Data-driven campaigns

Cambridge Analytica (UK) Limited, SCL Group Limited, SCL Analytics Limited, SCL Commercial Limited, SCL Social Limited and SCL Elections Limited (together "the Companies")

On 3 May 2018, Vincent John Green and Mark Newman, insolvency practitioners at Crowe Clark Whitehill LLP were appointed independent Joint Administrators of the Companies under order of the High Court.

Please click on this link to contact the Joint Administrators.

Contact address:
Crowe Clark Whitehill LLP, 4 Mount Ephraim Road, Tunbridge Wells, Kent TN1 1EE
E-mail:
recoverysolutions@crowecw.co.uk

Let's talk

We find your voters and move them to action.

CA Political has redefined the relationship between data and campaigns. By knowing your electorate better, you can achieve greater influence while lowering overall costs.
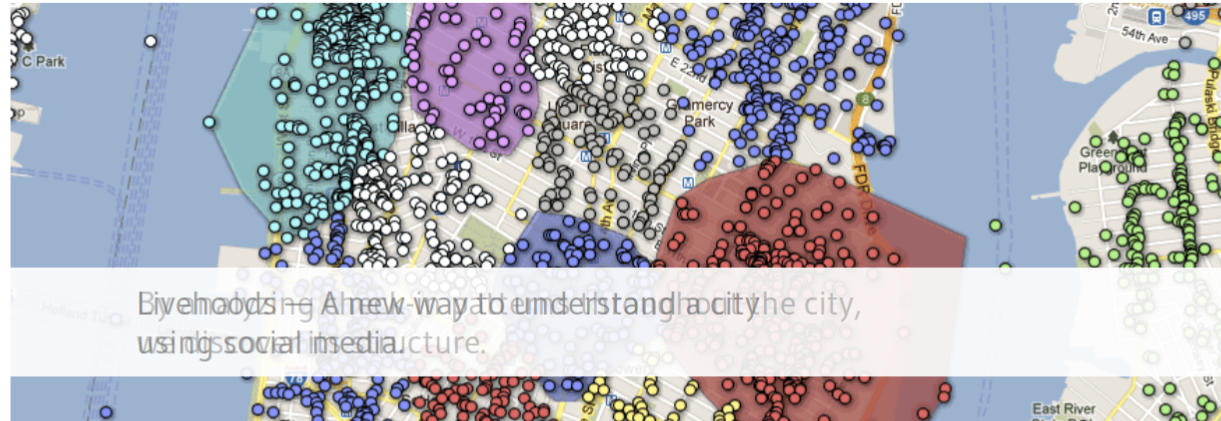
TRUMP
MAKE AMERICA GREAT AGAIN!

TedCruz 2016

BEN CARSON
FOR PRESIDENT 2016

JOHN
BOLTON
★ P A C ★

MAKE AMERICA
NUMBER 1

THOM
TILLIS
U.S. Senate

Regionalisation

Census geographies

Algorithms for reengineering 1991 Census geography

S Openshaw, L Rao¶
School of Geography, University of Leeds, Leeds LS2 9JT, England

Livehoods: A new way to understand a city, using social media.

Re-Imagining the City in the Age of Social Media

Livehoods offer a new way to conceptualize the dynamics, structure, and character of a city by analyzing the social media its residents generate. By looking at people's checkin patterns at places across the city, we create a mapping of the different dynamic areas that comprise it. Each Livehood tells a different story of the people and places that shape it.

> MORE

Using Machine-Learning to Study Cities

Our research hypothesis is that the character of an urban area is defined not just by the the types of places found there, but also by the people that make it part of their daily life. To explore this idea, we use data from approximately 18 million check-ins collected from the location-based social network foursquare, and apply clustering algorithms to discover the different areas of the city.
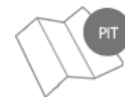
> MORE

Livehoods

Current Maps

 > New York City   > San Francisco   > Pittsburgh   > More Maps

News and Press

Livehood at ICWSM
Our work with Livehoods won the best paper award at ICWSM in Dublin this June! Watch the video from our presentation.

Livehoods on CBC Radio
Justin was on the CBC Radio program Spark talking with host Nora Young about the Livehoods Project. Listen to the full interview.

Livehoods in the Atlantic
Livehoods appeared as the Map of the Day on the Atlantic's Cities blog. See their post about us.

Wired Insider
Wired's Insider blog says Livehoods is "taking a big swing" at minining insights into "cultural habits and how societies flow." Read the full post.

> MORE

Recent Tweets

@tiffehr
Best map/location mashup I've seen in quite some time: http://livehoods.org/maps/nyc# (Via http://roomthily.tumblr.com)

@Werner
Livehoods is a cool CMU research project to visualize cities through the use of social media (@foursquare in this case) http://wv.ly/IJZ3We

@tomcoates
The 'Related' tab on http://livehoods.org is the best. See which neighboring places people travel too. Algorithmic divination of commuting!

@brainpicker
Forget neighborhoods, it's about Livehoods — Carnegie Mellon maps the dynamic character of cities through social media http://j.mp/HzmkoN

@kellan
clearly i live on the wrong side of the bqe - http://livehoods.org/maps/nyc

> MORE

Subscribe to our newsletter

Find out more about Livehoods and get updates on future developments by subscribing to our mailing list.

EMAIL*

NAME

SUBSCRIBE

Recapitulation

- Some problems are truly **highly dimensional** and univariate representations are not appropriate
- **Clustering** can help reduce complexity by creating **categories** that retain statistical information but are easier to understand
- Two main types of clustering in this context:
    - Geo-demographic analysis
    - Regionalization

```html
<a rel="license" href="http://creativecommons.org/licenses
```