Geographic Data Science - Lecture VII

Grouping Data over Space

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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*

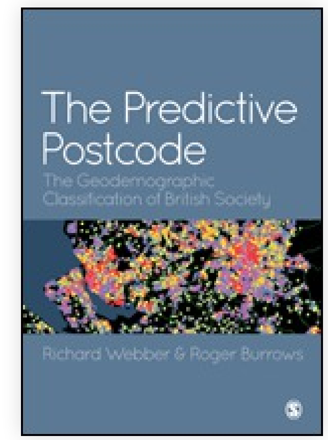
Grouping as *simplifying*

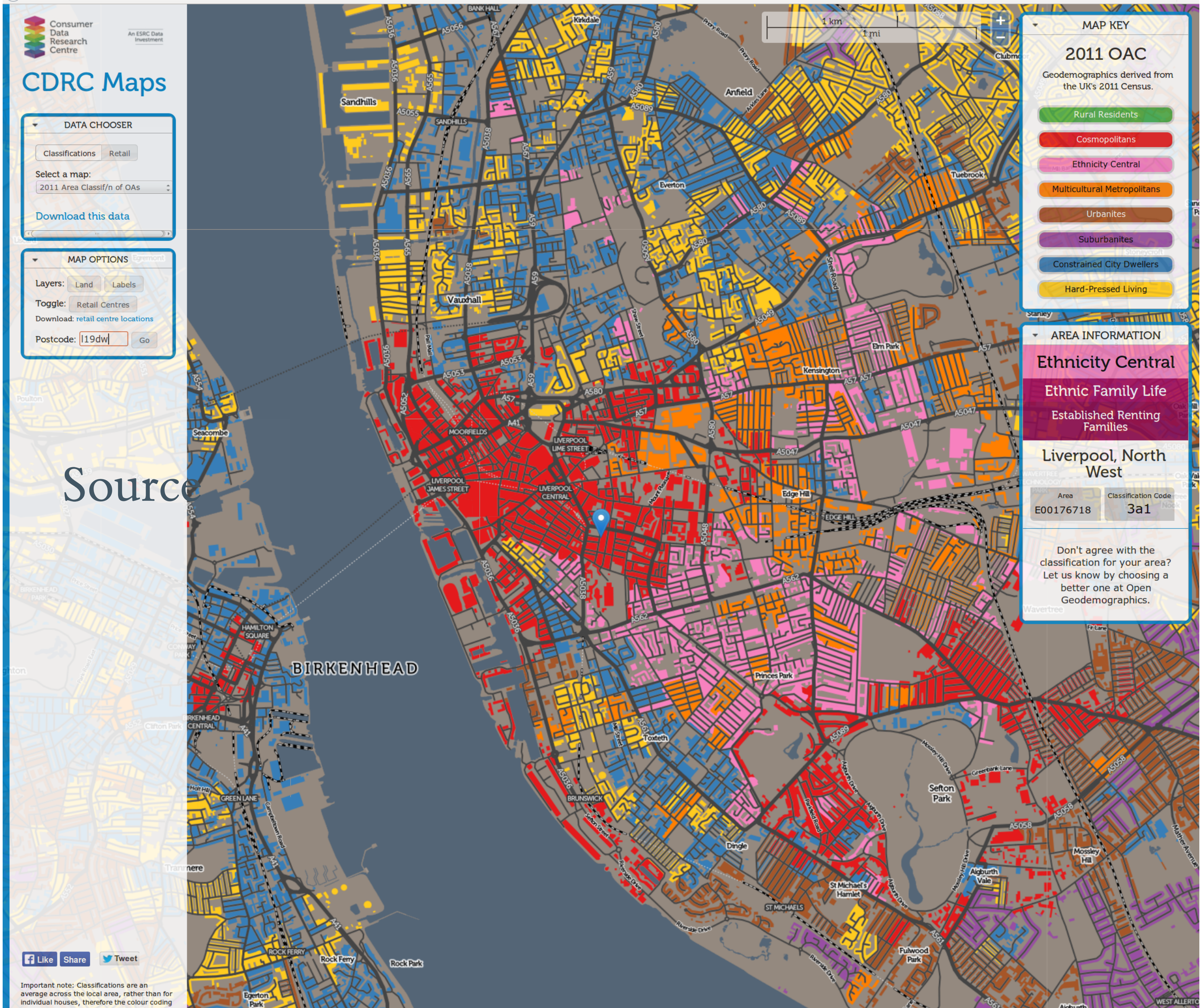
- Define a given number of categories based on **many characteristics** (multi-dimensional)
- Find the **category** where each observation *fits best*
- **Reduce complexity**, keep all the **relevant information**
- Produce easier-to-understand outputs

Geodemographic analysis

Geodemographic analysis

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




Consumer Data Research Centre
An ESRC Data Investment
CDRC Maps
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
Source
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
1 km
1 mi
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
E00176718
Classification Code
3a1
Don't agree with the classification for your area? Let us know by choosing a better one at Open Geodemographics.
BIRKENHEAD
Sandhills
Anfield
Everton
Vauxhall
Kensington
Edge Hill
Princes Park
Toxteth
Sefton Park
Dingle
Seacombe
Tuebrook
Elm Park
Rock Ferry
Rock Park
Kirkdale
Fulwood Park
Aigburth Vale
Mossley Hill

How do you segment/cluster observations over space?

- Statistical clustering
- Explicitly spatial clustering (regionalization)

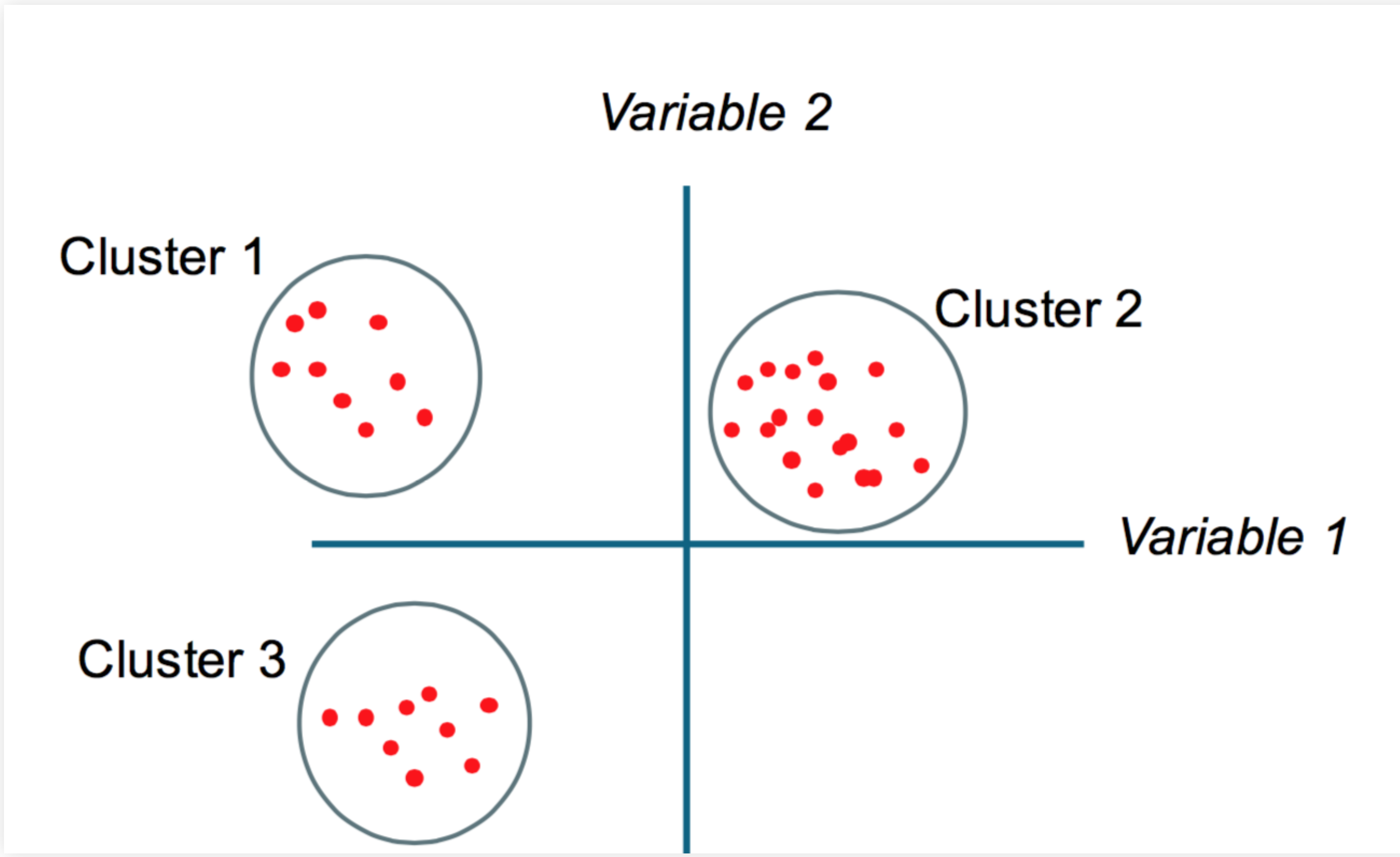
Non-spatial clustering

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**

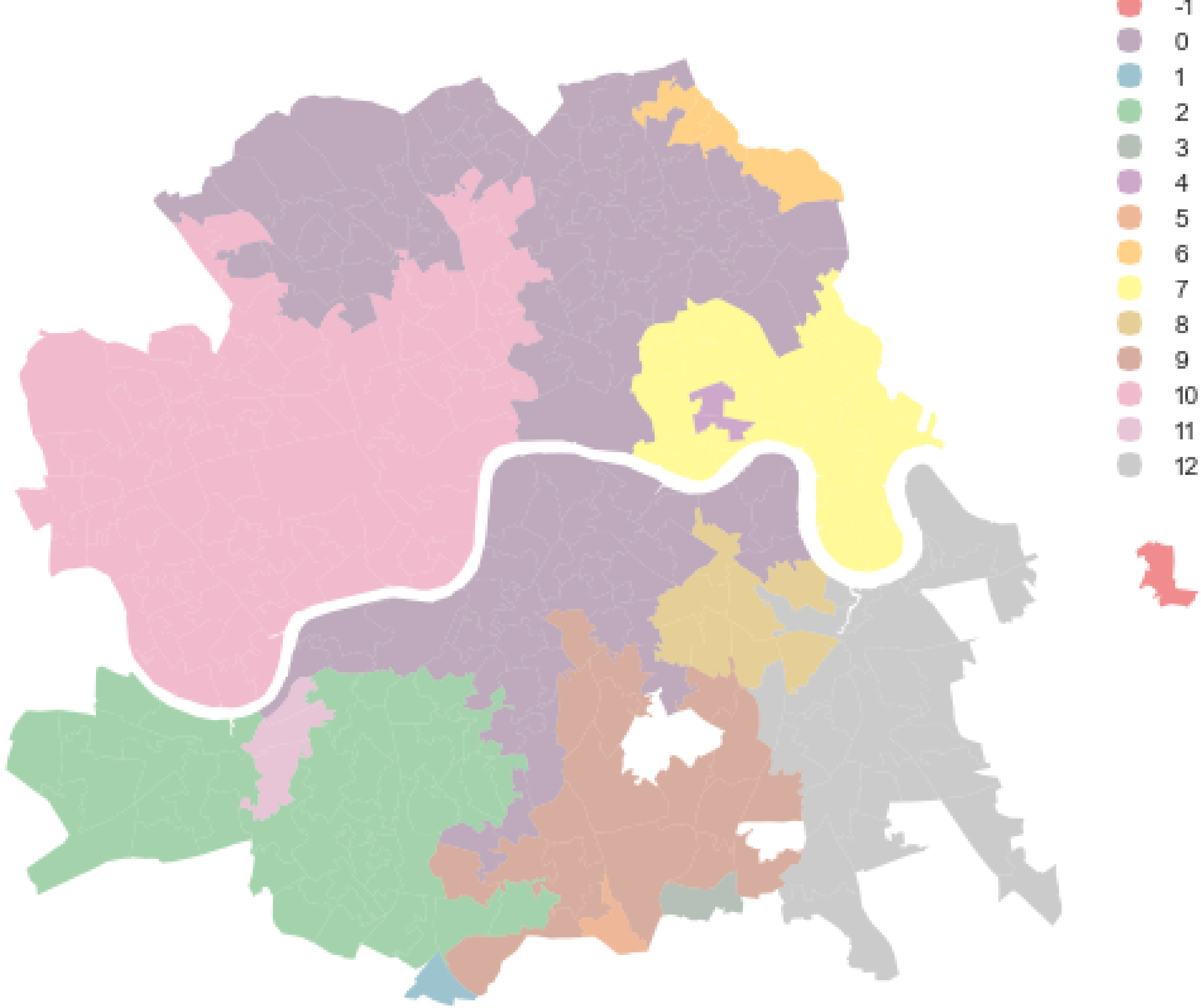
Regionalization

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)



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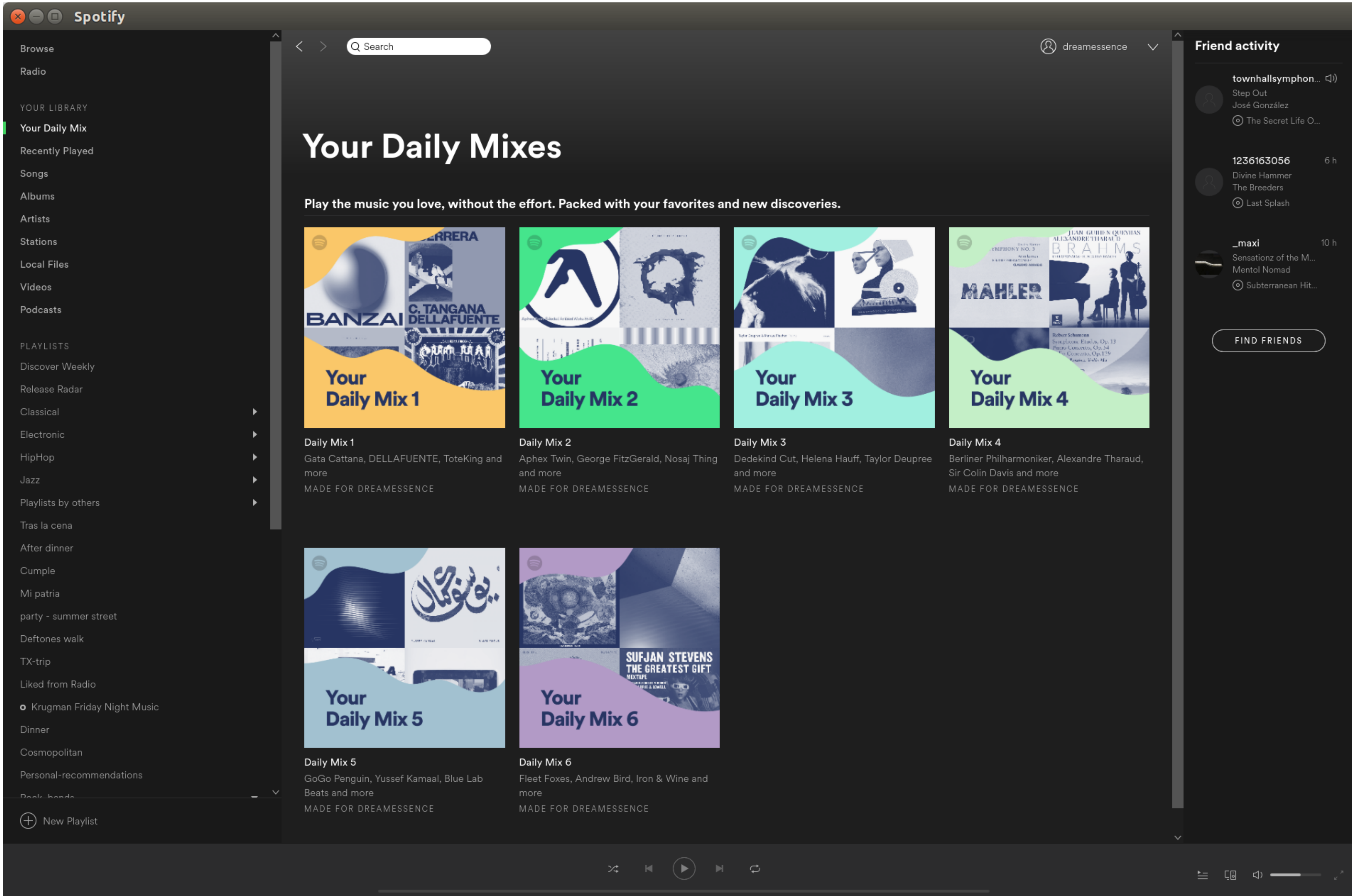
Algorithms

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

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

Examples

Non-spatial clustering


Spotify
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Your Daily Mix
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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
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dreamessence
Your Daily Mixes
Play the music you love, without the effort. Packed with your favorites and new discoveries.
Your Daily Mix 1
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Gata Cattana, DELLAFUENTE, ToteKing and more
MADE FOR DREAMESSENCE
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Aphex Twin, George FitzGerald, Nosaj Thing and more
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Your Daily Mix 3
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Dedekind Cut, Helena Hauff, Taylor Deupree and more
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MAHLER
Your Daily Mix 4
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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
SUFJAN STEVENS THE GREATEST GIFT
Your Daily Mix 6
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Fleet Foxes, Andrew Bird, Iron & Wine and more
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The Secret Life O...
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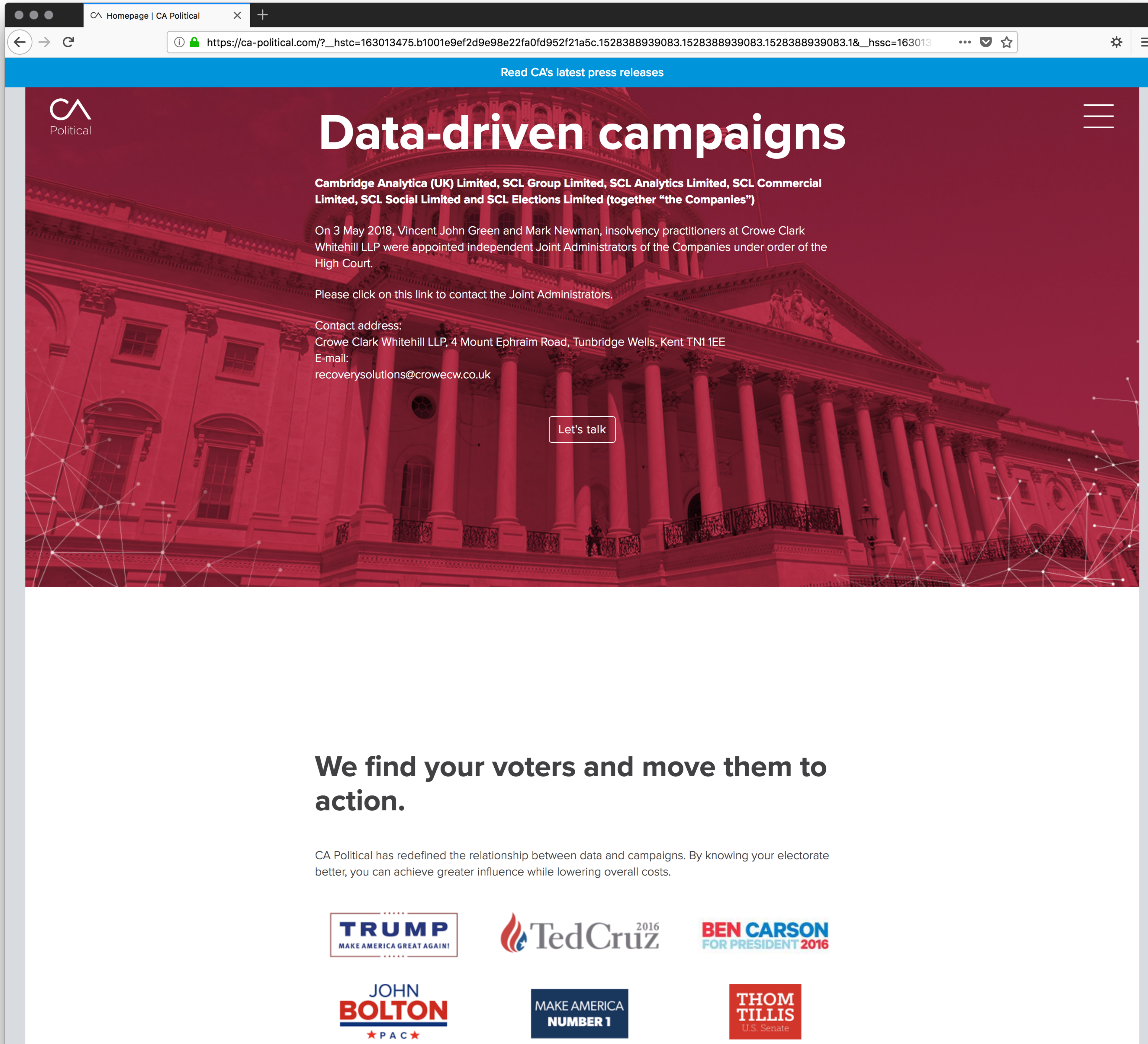
Mentol Nomad
Subterranean Hit...
FIND FRIENDS


Homepage | CA Political

https://ca-political.com/?__hstc=163013475.b1001e9ef2d9e98e22fa0fd952f21a5c.1528388939083.1528388939083.1528388939083.1&__hssc=16301

Read CA's latest press releases

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

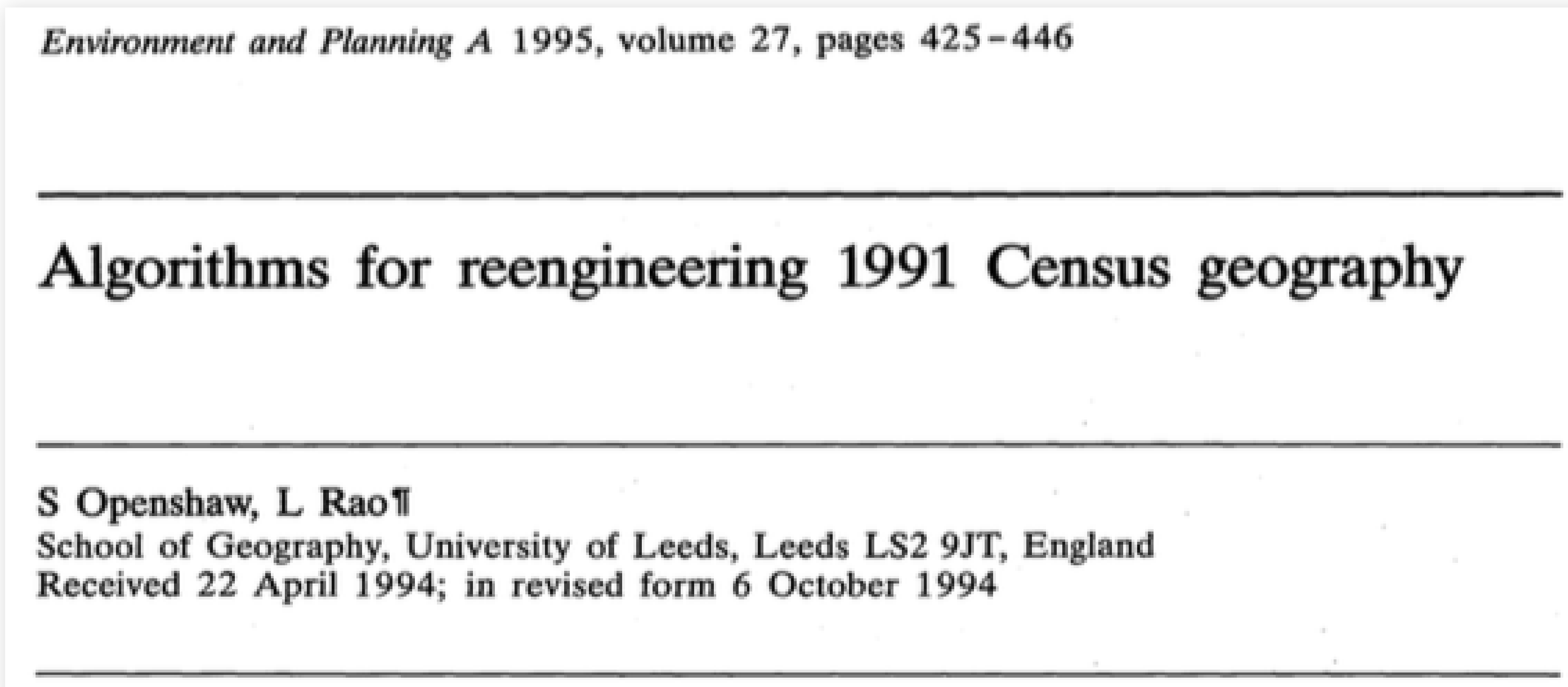
Let's talk

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.

Regionalisation

Census geographies



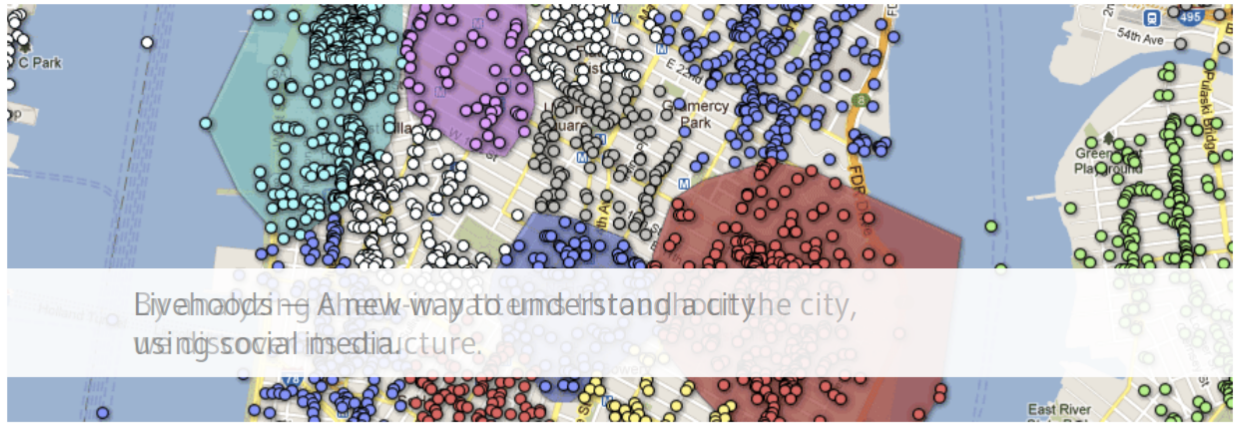
Environment and Planning A 1995, volume 27, pages 425–446

Algorithms for reengineering 1991 Census geography

S Openshaw, L Rao¶
School of Geography, University of Leeds, Leeds LS2 9JT, England
Received 22 April 1994; in revised form 6 October 1994

Livehoods

Home Maps About Research Press Contact



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

Current Maps

NYC > New York City

SFO > San Francisco

PIT > 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.**

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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**

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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

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