Uncovering Spatiotemporal Dynamics from Non-Trajectory Data

Urban Data Visualization Workshop, IEEE VIS 2018

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DESIGNING *for* PEOPLE

Slides: michaeloppermann.com/slides/cityvis2018.pdf

Fit Leaking: "fitness activities, recorded for personal benefit emit into signals that reveal sensitive and confidential information"

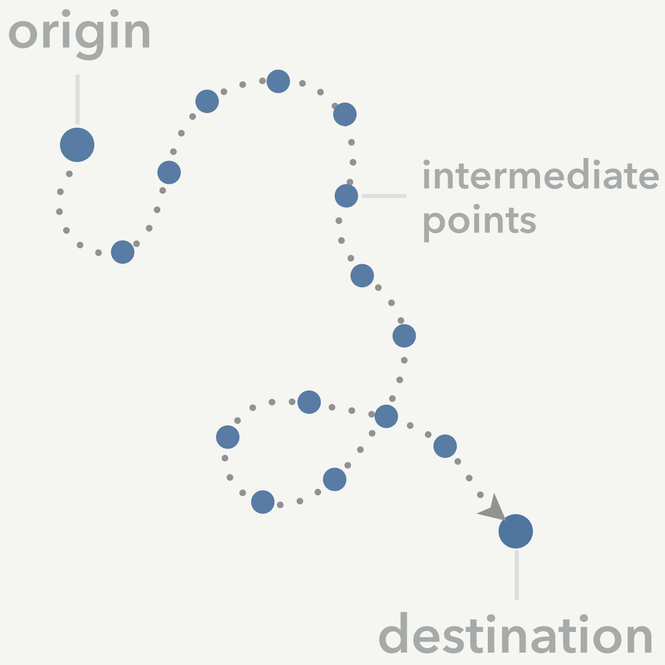
- John Scott-Railton

Bike Sharing

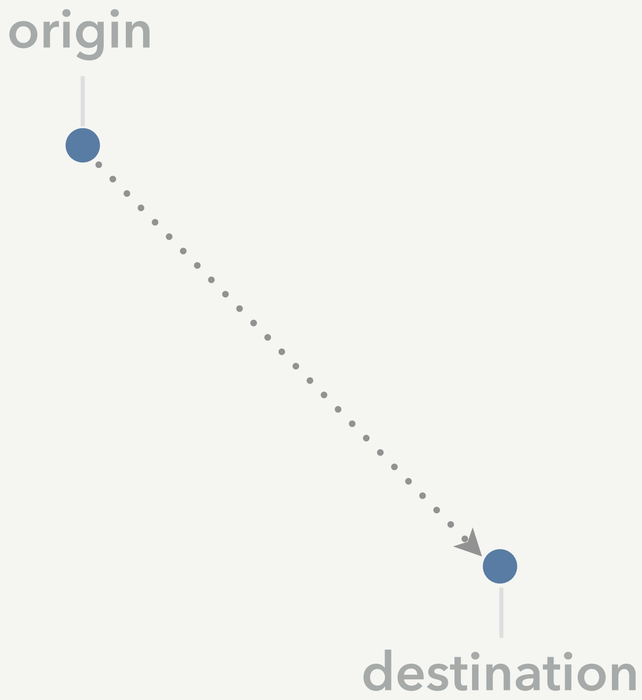
Building Occupancy

Spatiotemporal data

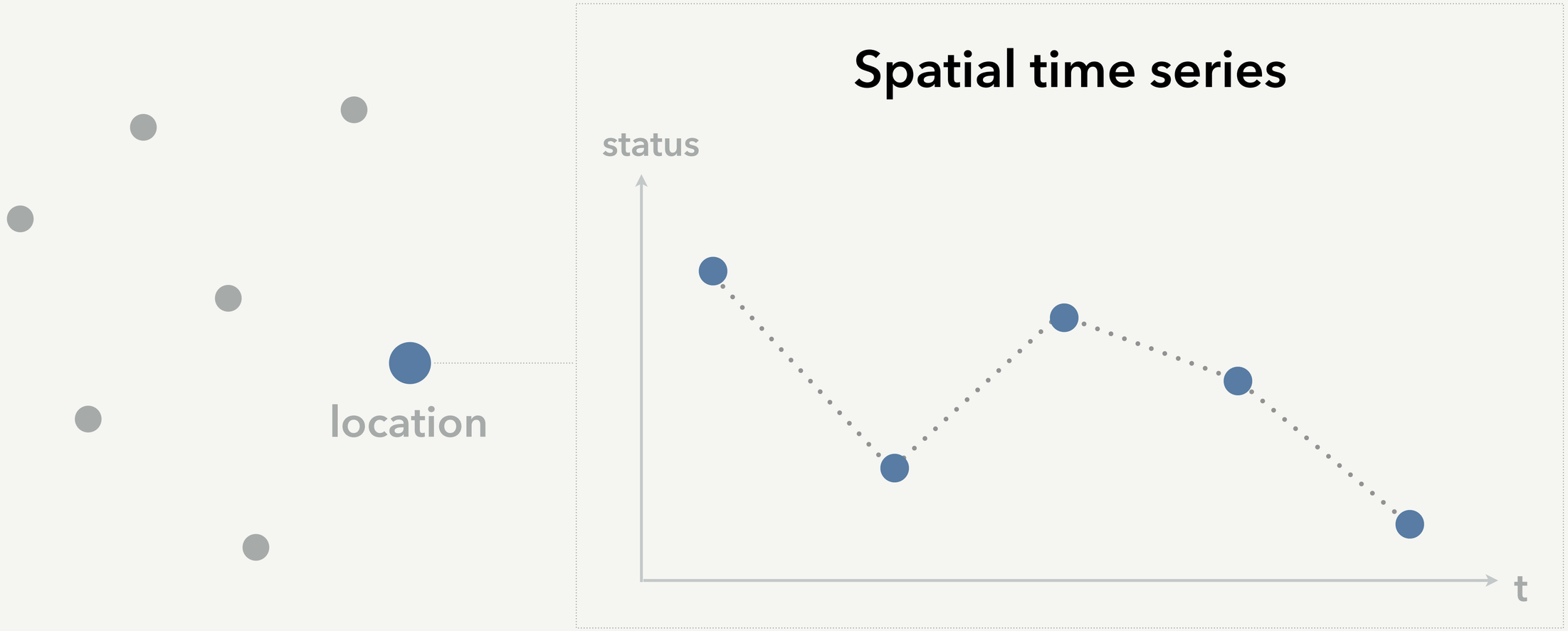
Trajectories

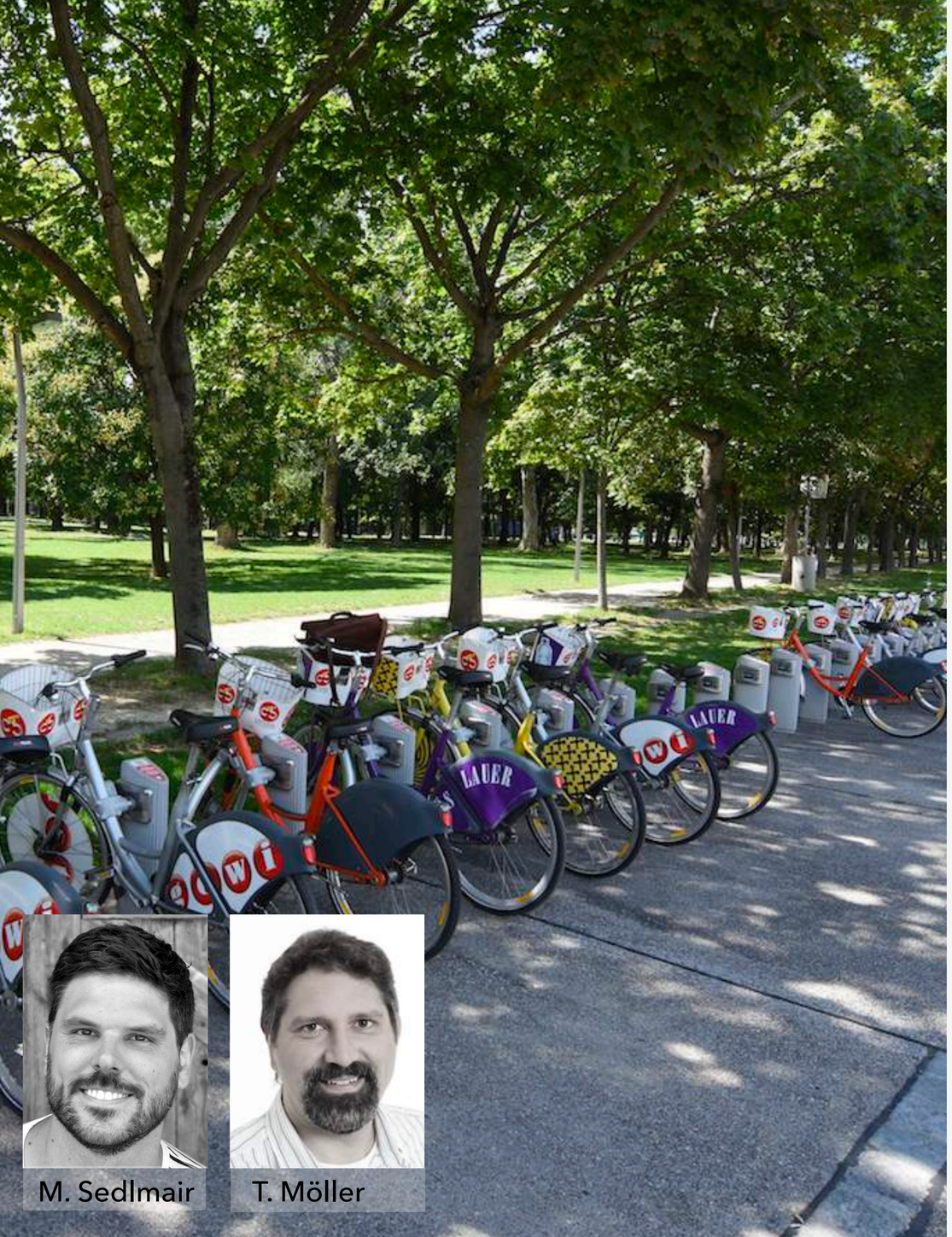


Origin–destination data



Spatial events / location-based counts





Bike Sharing Atlas

- Analyzed bike sharing in Vienna *(bike sharing operator as collaborator)*
- Traditional station-based networks
- Expanded from one to many cities
- Recorded station fill levels from >400 networks (21,500 stations)
- 15 min interval over 1.5 years
- Additional user groups: *politicians, city planners, general public, etc.*

[Bike Sharing Atlas: Visual Analysis of Bike-Sharing Networks.
Oppermann, Möller, Sedlmair. International Journal of Transportation (IJT), 6(1): 1-14, 2018]

Bike Sharing Atlas

OVERVIEW NETWORKS CHARACTERISTICS ABOUT FEEDBACK

Search Cities & Networks ...

Networks

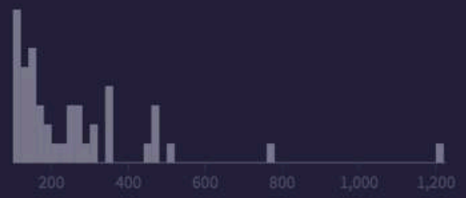
Explore bike-sharing networks worldwide.

46/467 NETWORKS

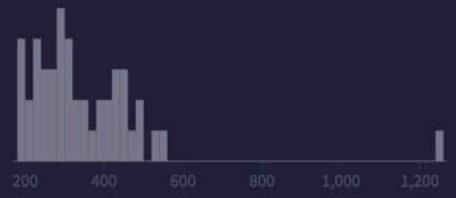
Number of stations 100 1226

Ø Distance to nearest station 0m 7268m

Number of stations

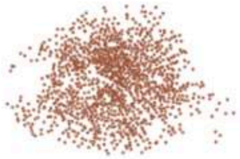


Ø Distance to nearest station [m]



Population (urban area)

Sort by Number of stations



Paris, FR

Velib | 1226 Stations

London, GB

Santander Cycles | 774 Stations

New York, NY, US

Citi Bike | 511 Stations

Chicago, IL, US

Divvy | 475 Stations

Barcelona, ES

Bicing | 465 Stations

Montreal, QC, CA

Bixi | 461 Stations

Mexico City, MX

EcoBici | 444 Stations

Washington, DC, US

Capital BikeShare | 357 Stations

Lyon, FR

Vélo'V | 346 Stations

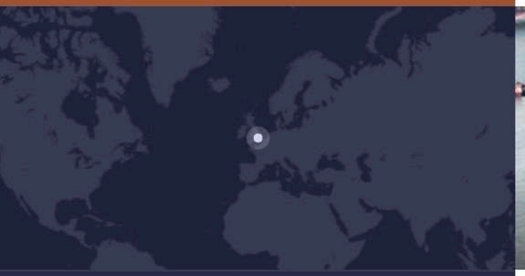
Bruxelles, BE

villo | 343 Stations

Bike Sharing Atlas

OVERVIEW NETWORKS CHARACTERISTICS ABOUT FEEDBACK

Search Cities & Networks ...



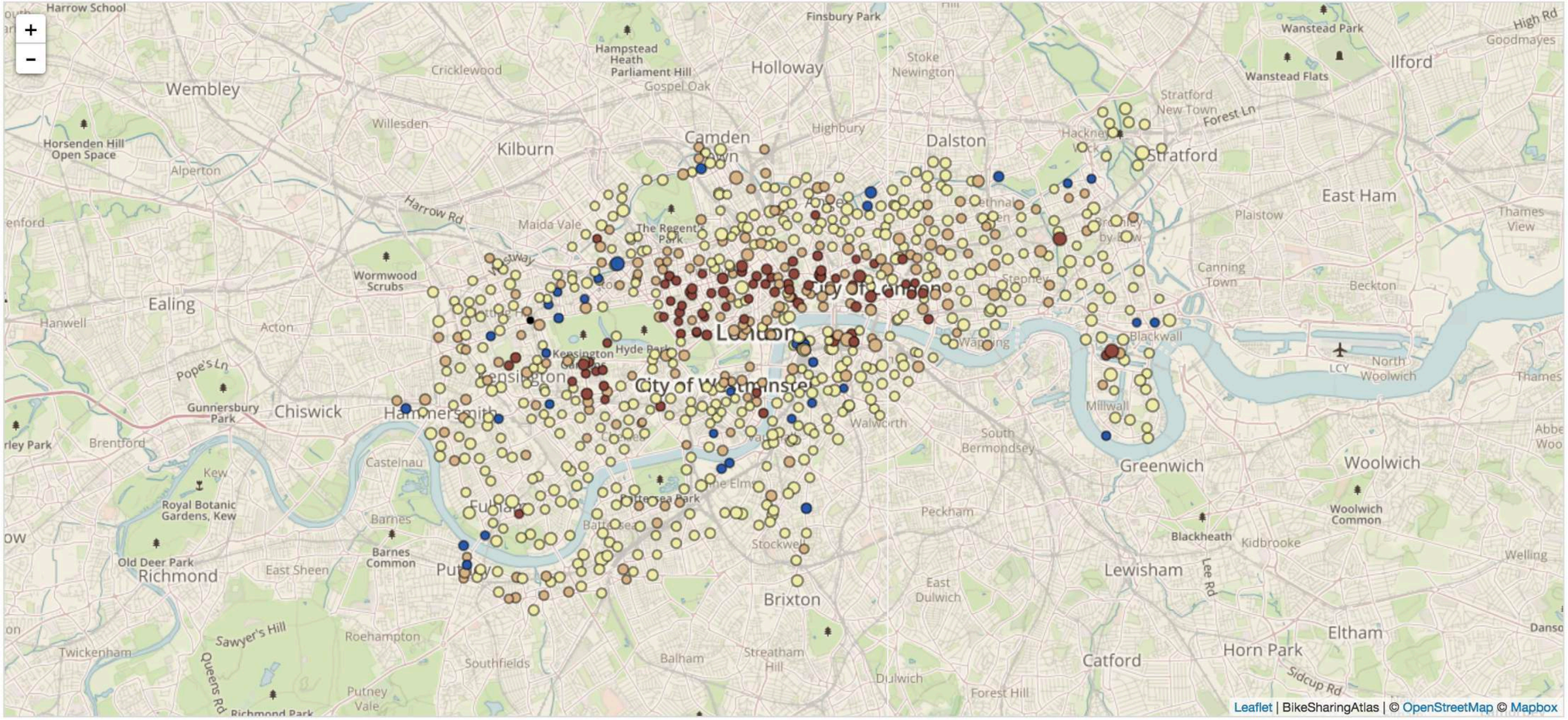
London

Capital of United Kingdom | 8.67mio inhabitants

SANTANDER CYCLES (774 STATIONS)

Stations | Route Planner | Price | Availability | Network Activity | Trips

Everything ok · Almost full or empty (15%) · Full · Empty



Elevation Profile

Weather

Avg. Temperature: 11 °C
Avg. Humidity: 77 %

Similar Networks

- Paris, FR
- New York, NY, US
- Chicago, IL, US

Bike Sharing Atlas

OVERVIEW NETWORKS CHARACTERISTICS ABOUT FEEDBACK

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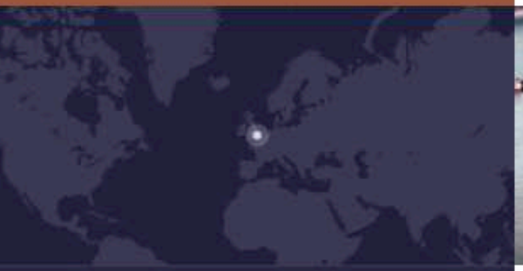

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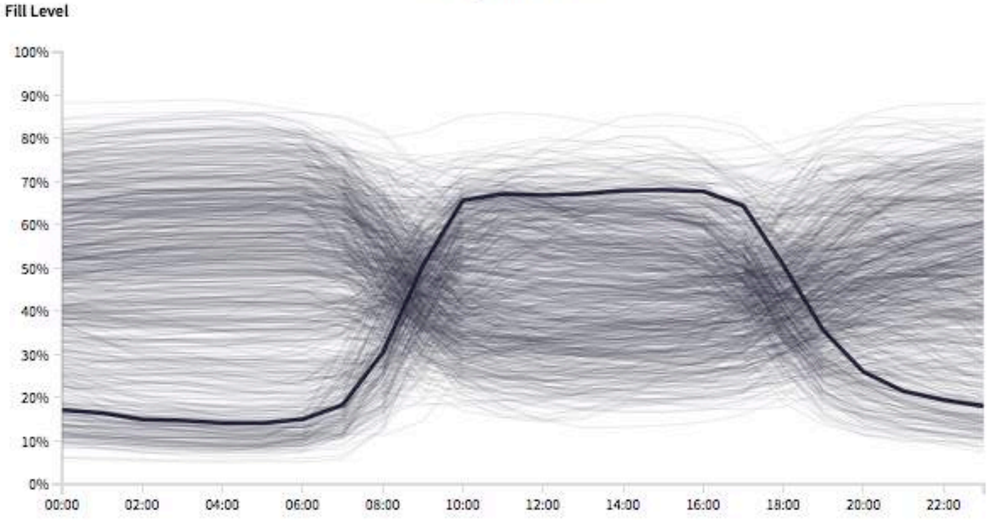
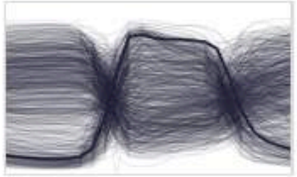
Average utilization

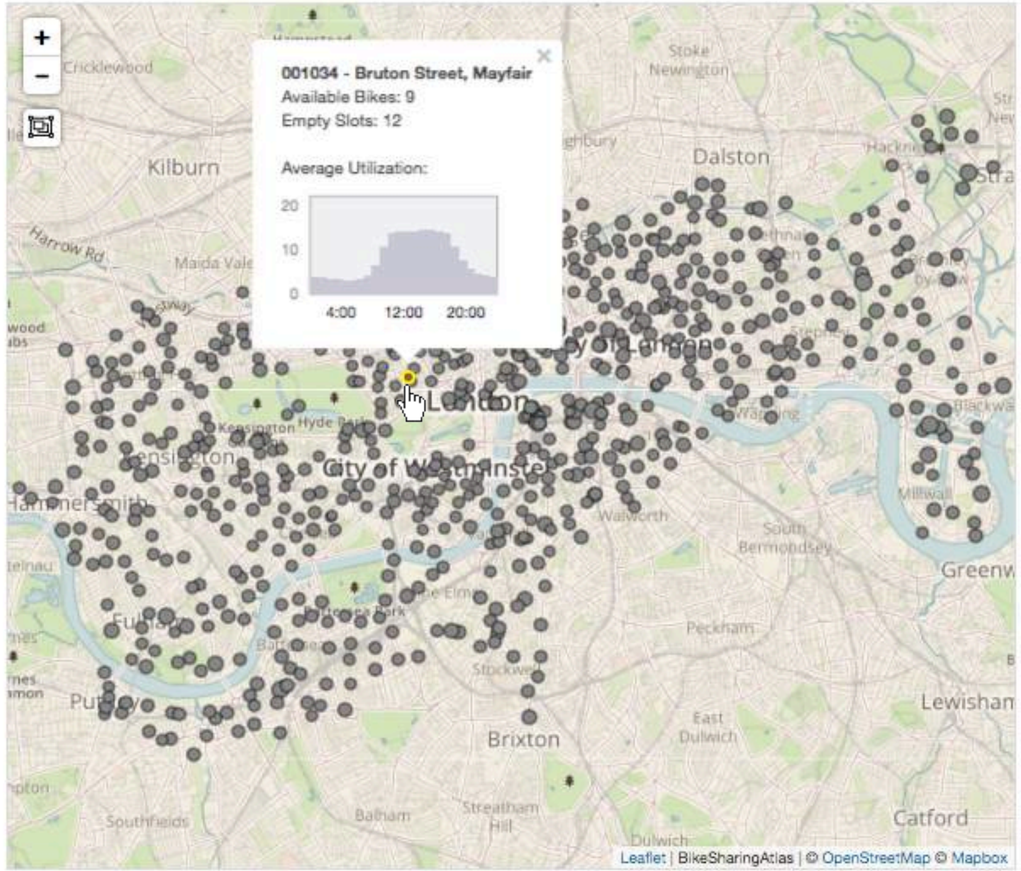


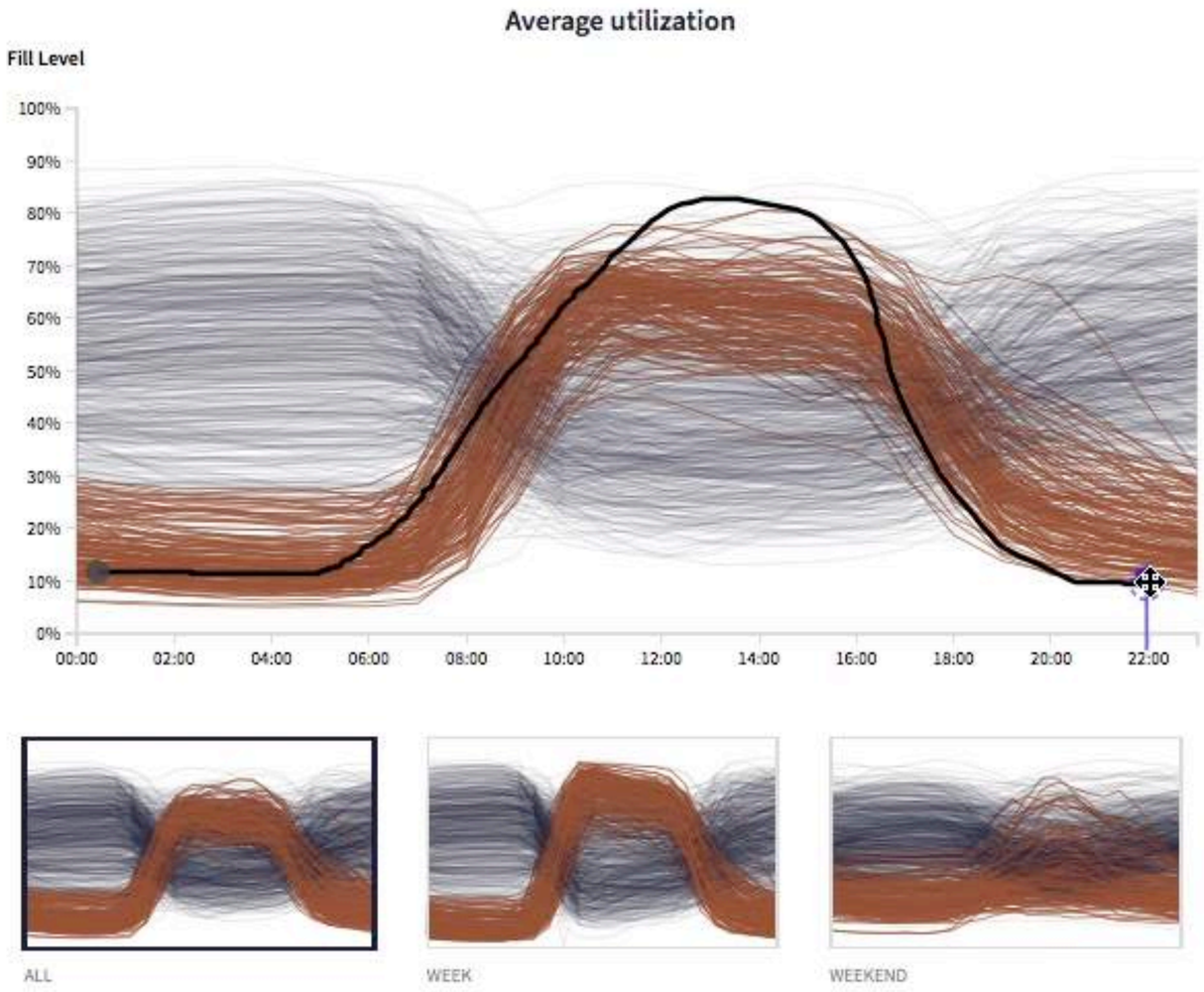
ALL

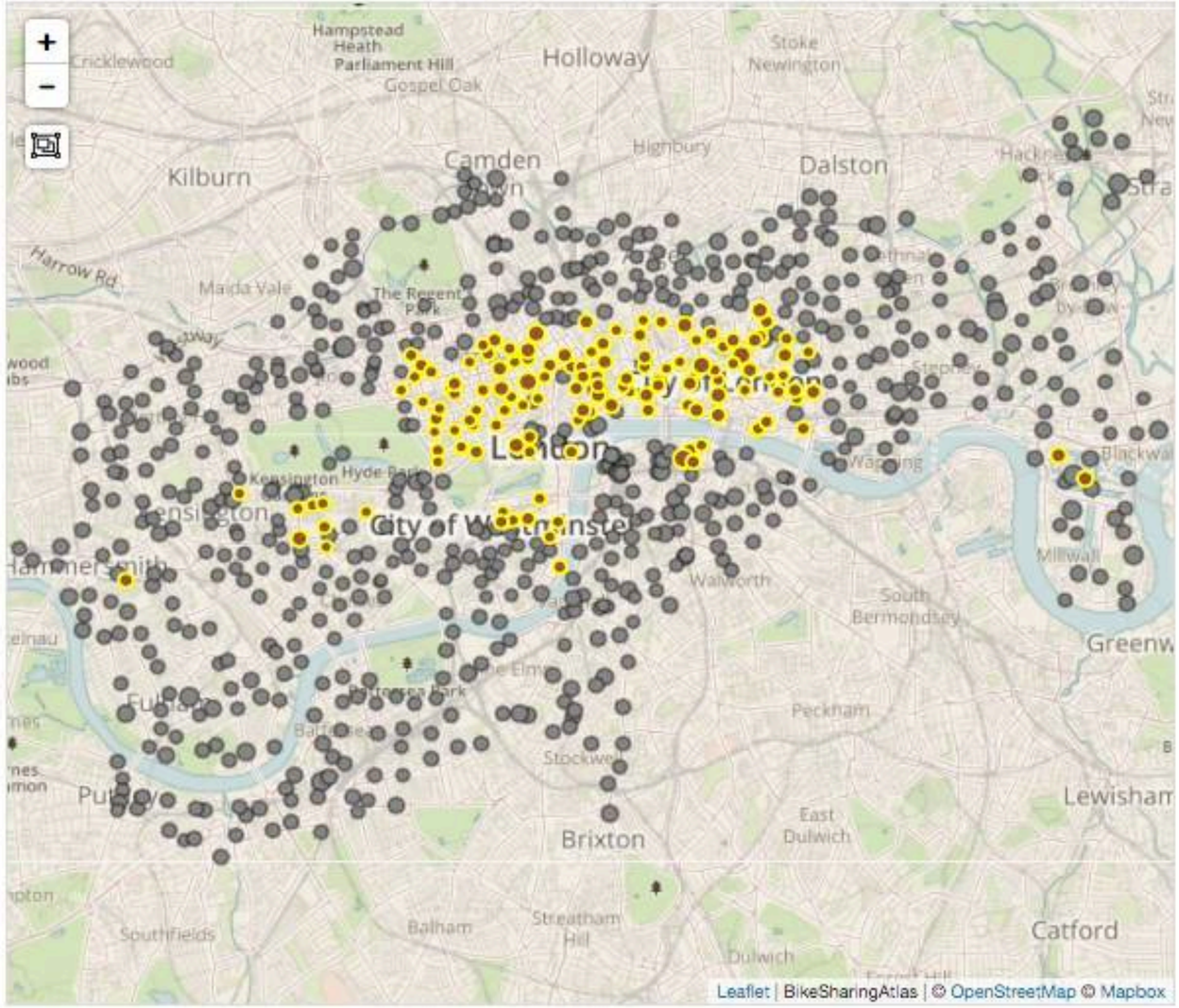


WEEK

WEEKEND



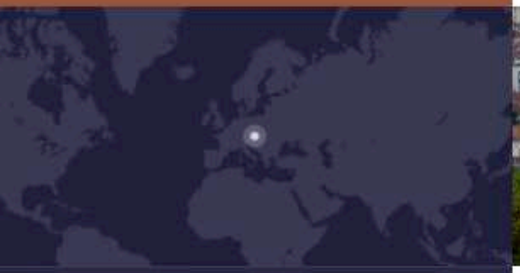

Average utilization
Fill Level
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
ALL
WEEK
WEEKEND

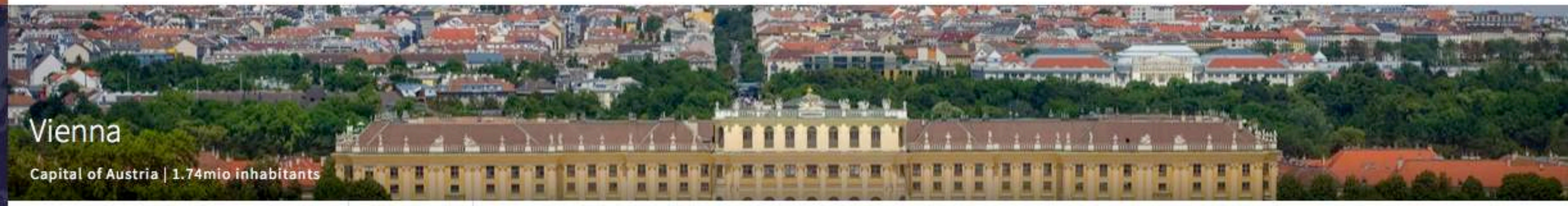

Hampstead Heath
Parliament Hill
Holloway
Stoke Newington
Gospel Oak
Kilburn
Camden Town
Highbury
Dalston
Harrow Rd
Maida Vale
The Regent's Park
Hyde Park
Kensington
City of Westminster
Hammersmith
Walworth
South Bermondsey
Greenw
Millwall
Peckham
Stockwell
Lewisham
East Dulwich
Brixton
Southfields
Balham
Streatham Hill
Dulwich
Catford
Leaflet | BikeSharingAtlas | © OpenStreetMap © Mapbox

Bike Sharing Atlas

OVERVIEW NETWORKS CHARACTERISTICS ABOUT FEEDBACK

Search Cities & Networks ...





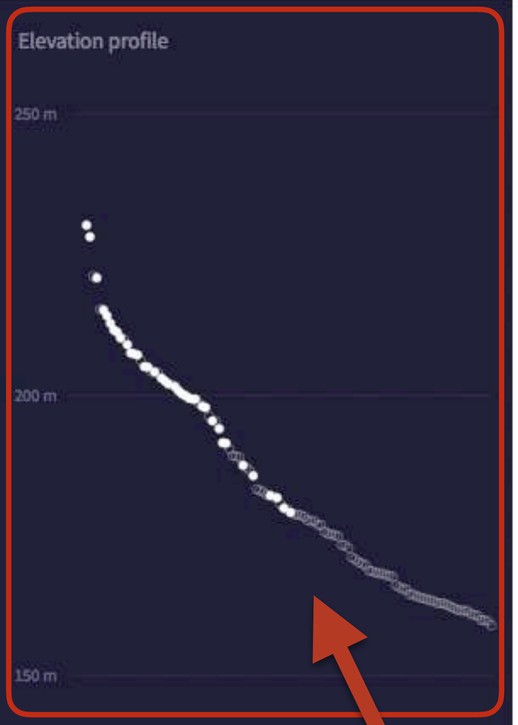
Vienna

Capital of Austria | 1.74mio inhabitants

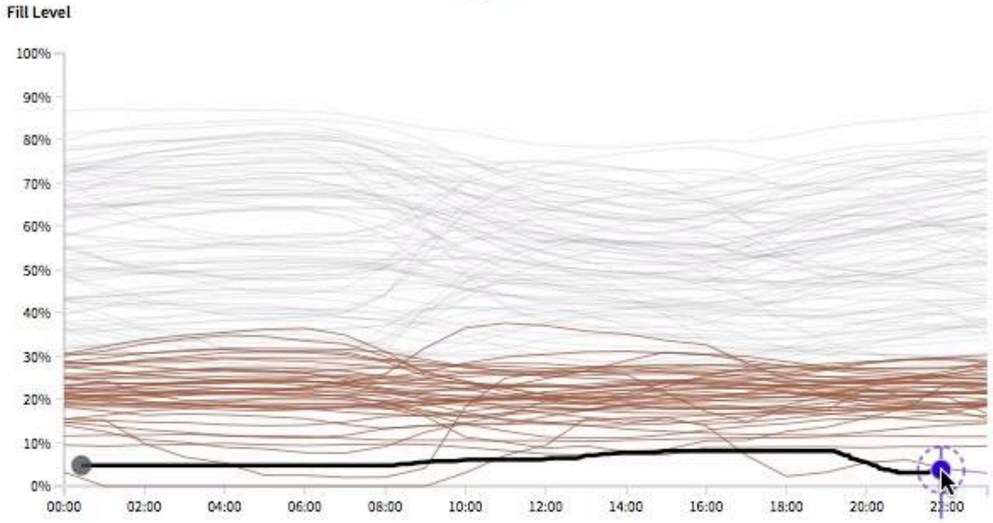
CITYBIKE WIEN (121 STATIONS)

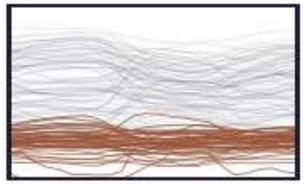
Stations | Route Planner | Price | Availability | Network Activity | Trips

Elevation profile



Average utilization

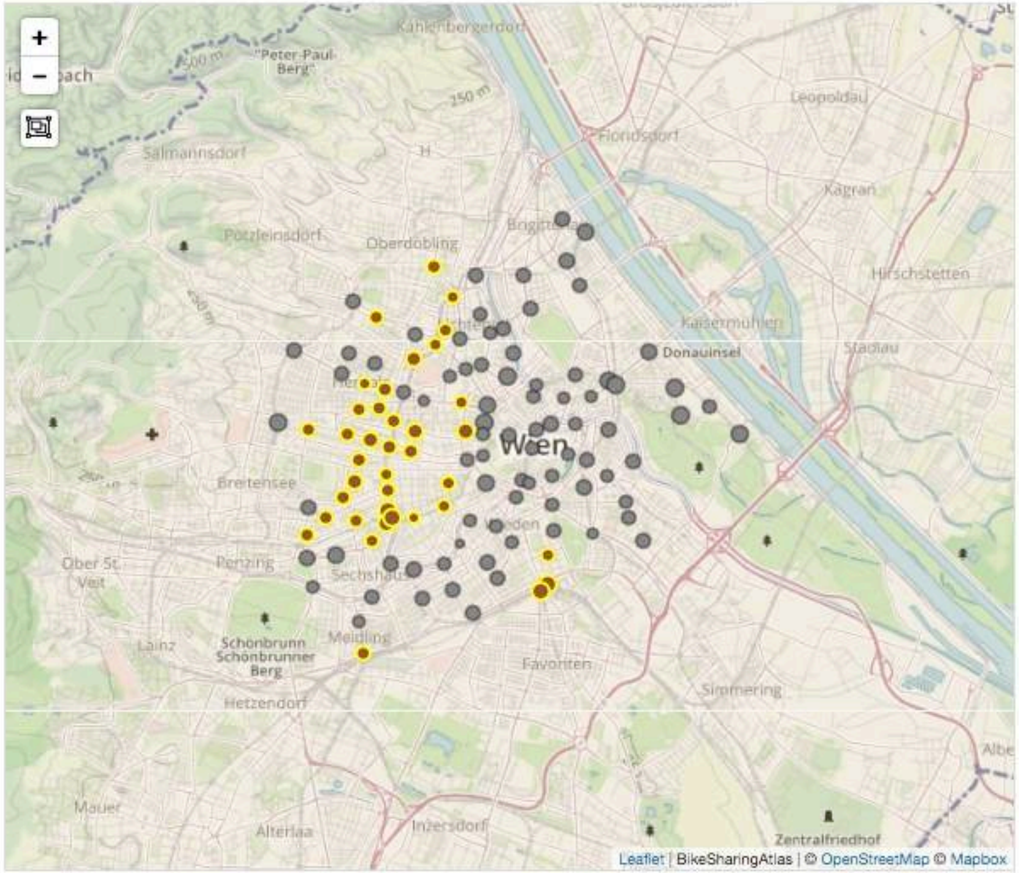


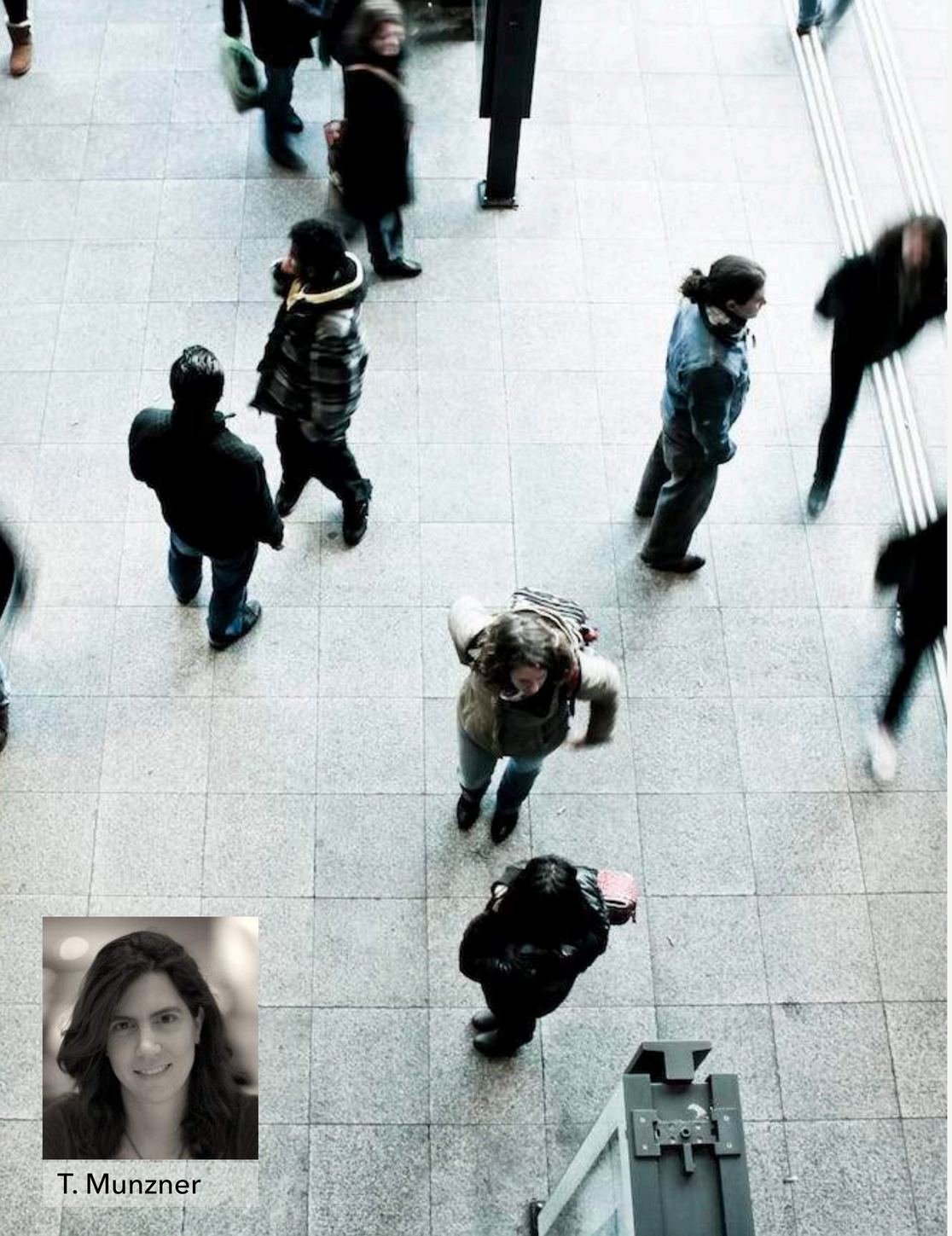


ALL

WEEK

WEEKEND

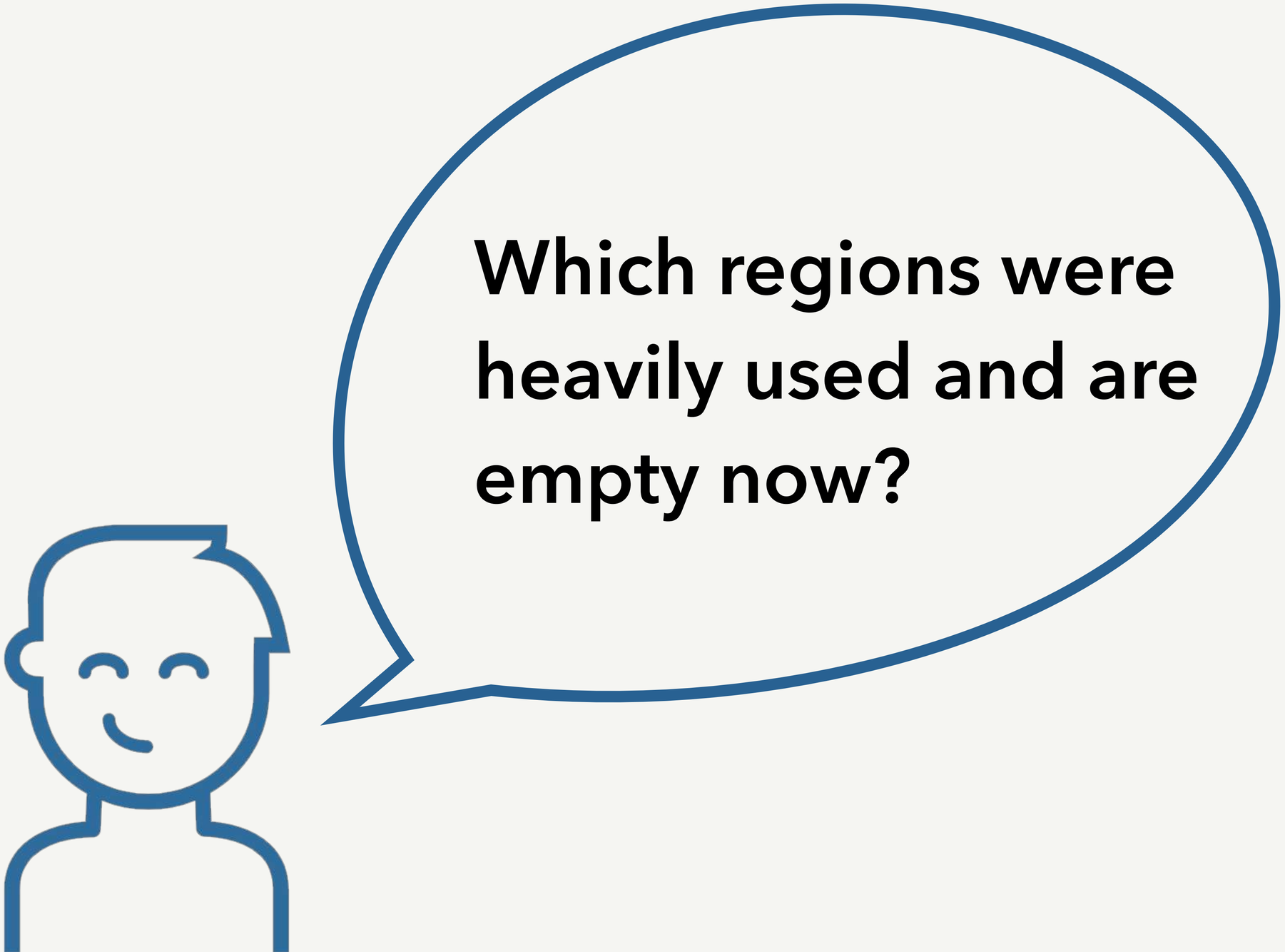


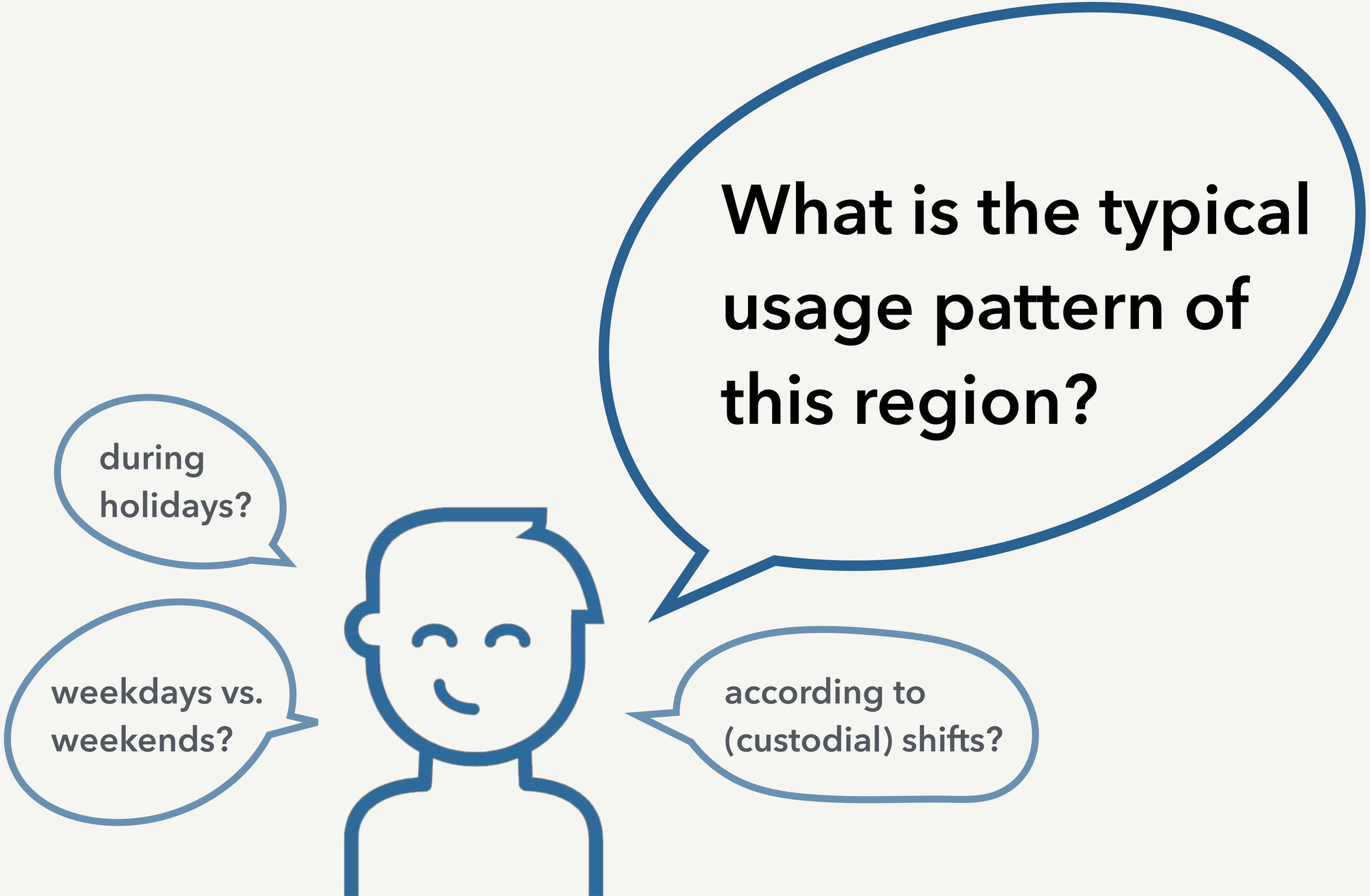


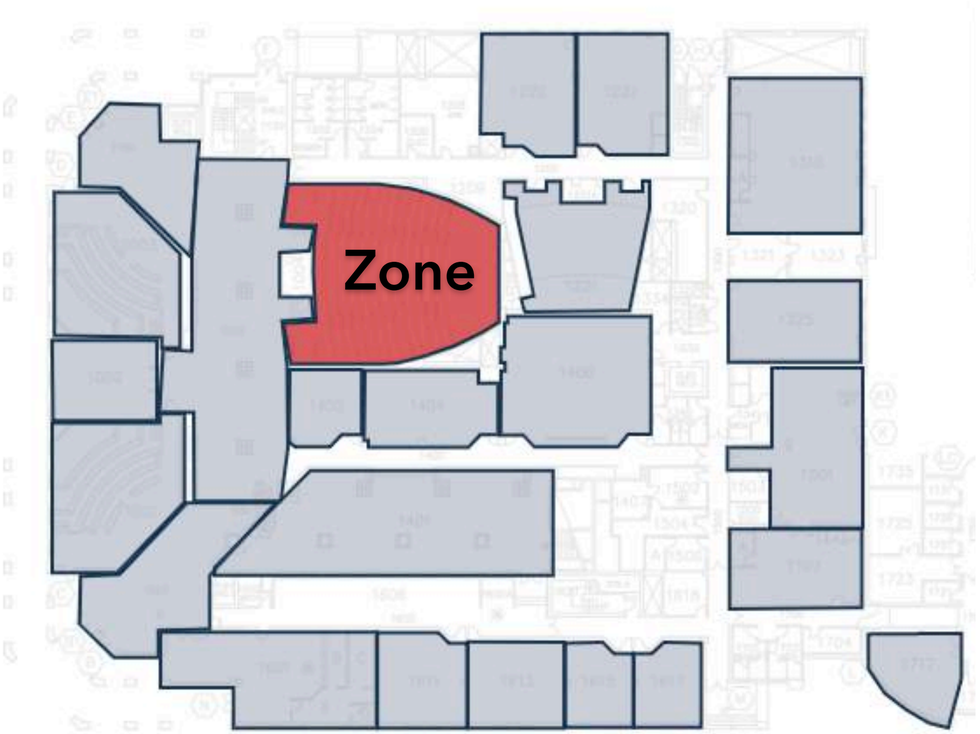
Ocupado: Visual analytics for occupancy applications

- Visual and predictive decision-support tools for facilities management
- Stakeholders:
  - Custodial services
  - Building manager
  - Facilities planner
  - Energy manager

Which regions are busy/quiet now?


Which regions were heavily used and are empty now?


What is the typical usage pattern of this region?
during holidays?
weekdays vs. weekends?
according to (custodial) shifts?



Data acquisition & processing

- Estimate building occupancy by using Wi-Fi connections *(in collaboration with start-up: Sensible Building Science)*
- No movements or individual devices are recorded
- Only zone-based counts every 5 min → *spatial time series*
- Rough proxy depends on Wi-Fi coverage; good spatial precision if zone large enough

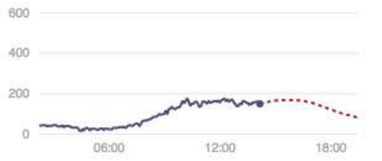
OCUPADO
custodial services

UBC-V / Forest Sciences

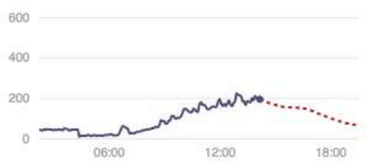
Live

trend | typical day

Floor 4 — normal activity

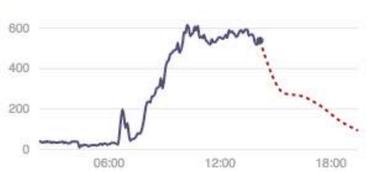


Floor 3 — busier than usual

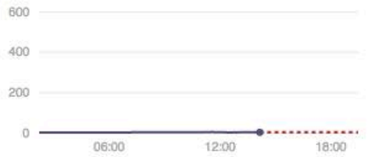


Floor 2 — busier than usual

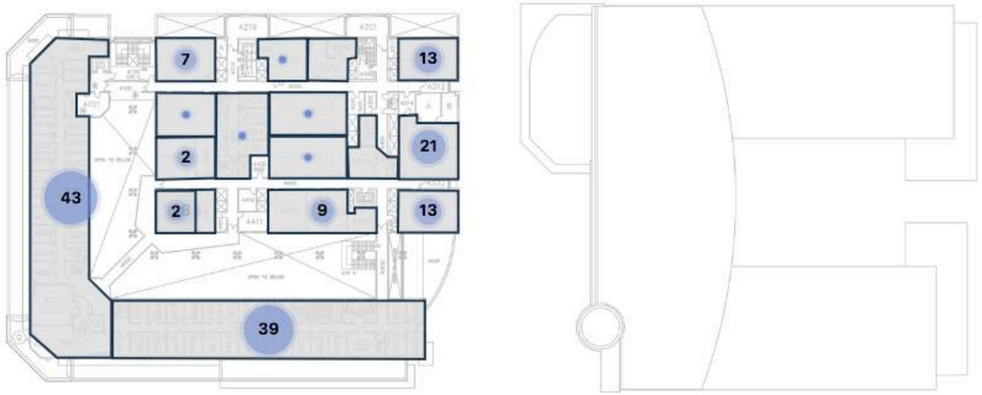
Floor 1 — busier than usual



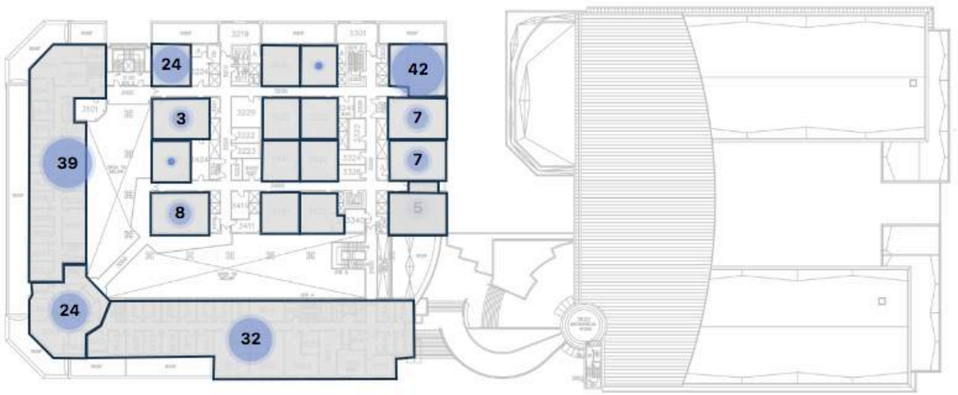
Basement — normal activity



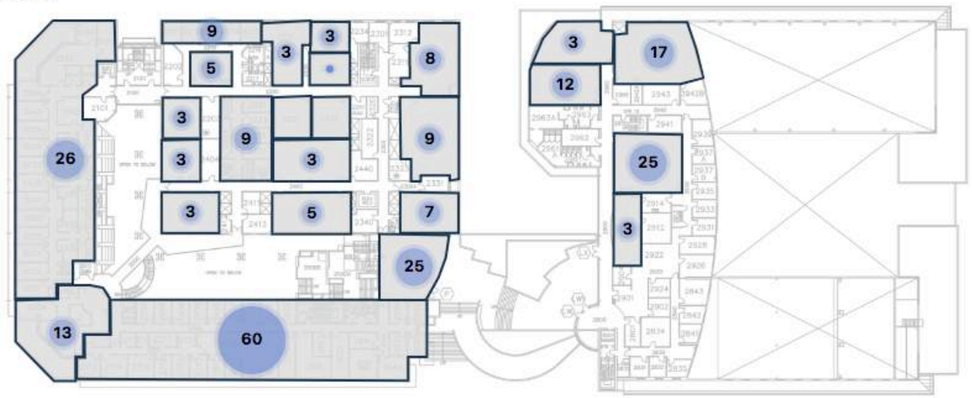
Floor 4



Floor 3

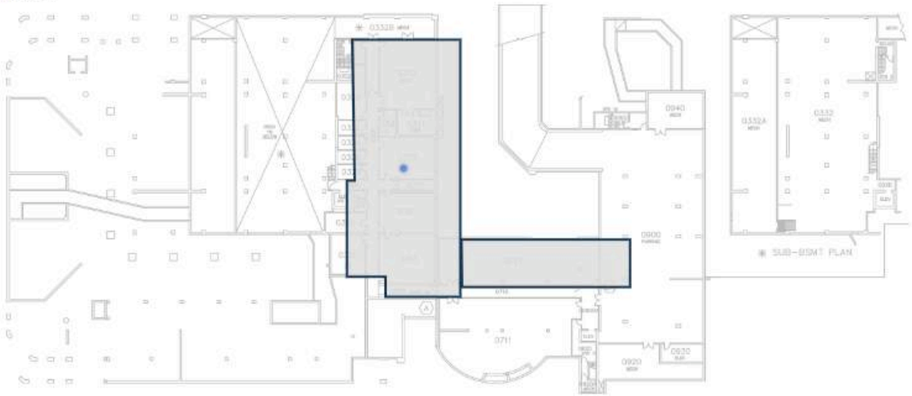


Floor 2



Floor 1

Floor -1



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custodial services

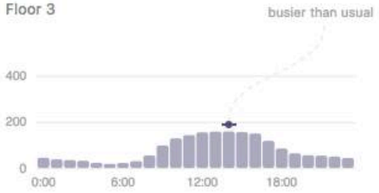
UBC-V / Forest Sciences

Live

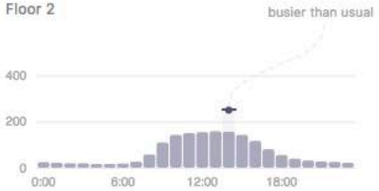
trend | typical day

Floor 4 — normal activity

Floor 3 — busier than usual



Floor 2 — busier than usual



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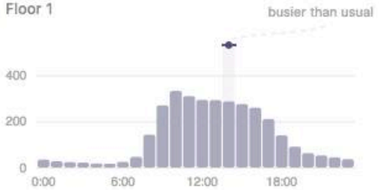

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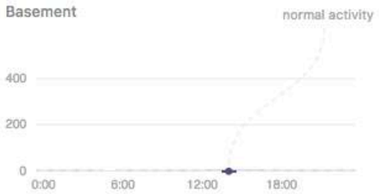
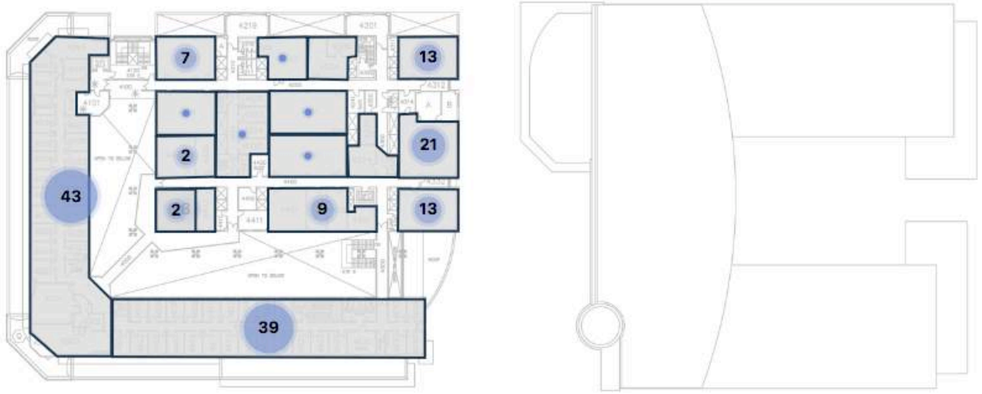


Floor 4



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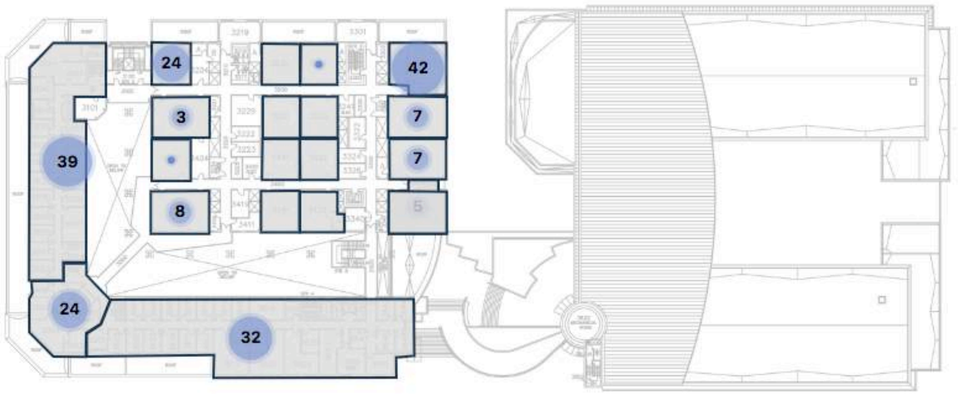
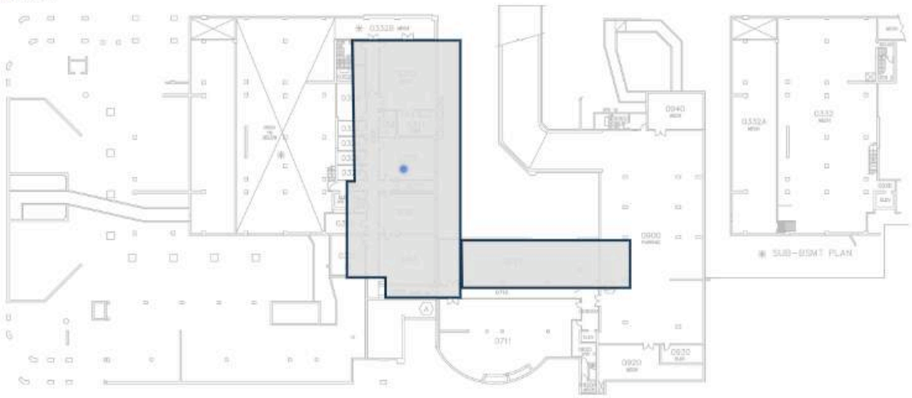


Floor 2

Floor 1

Floor -1



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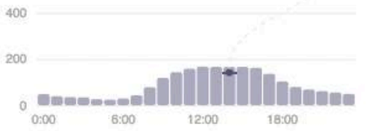
2am 6am 10am 2pm

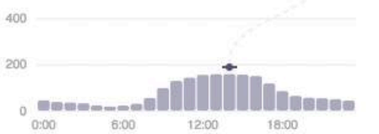
Mean

trend typical day

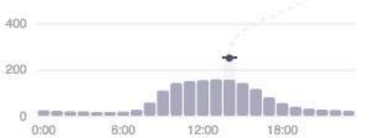
Floor 4 normal activity



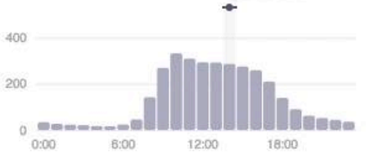
Floor 3 busier than usual



Floor 2 busier than usual



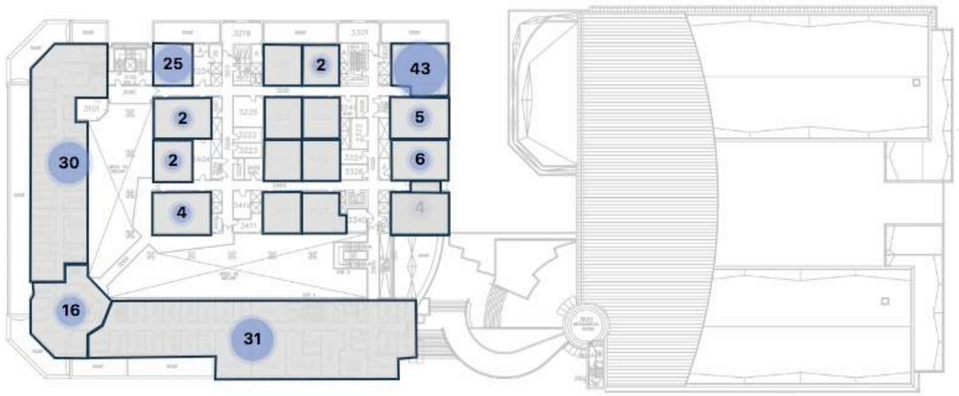
Floor 1 busier than usual



Basement normal activity

Floor 4

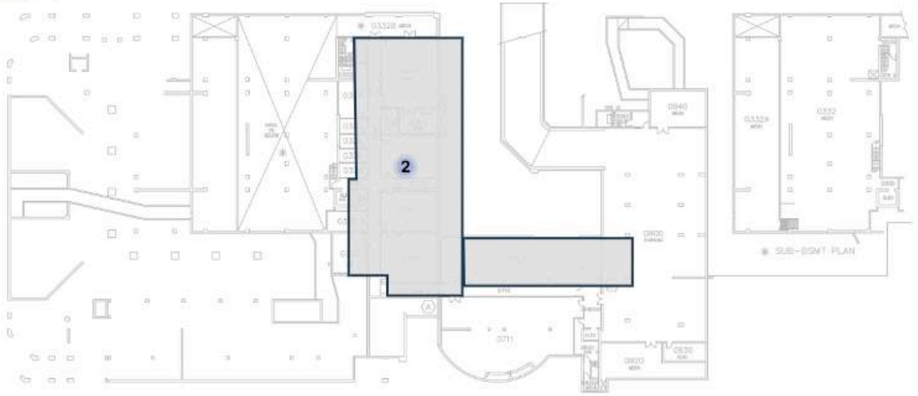
Floor 3



Floor 2

Floor 1

Floor -1



Implications of using non-trajectory data

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- Many analysis questions can be answered without trajectories (privacy & ethics)
- Flexible aggregation and normalization
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Slides: michaeloppermann.com/slides/cityvis2018.pdf

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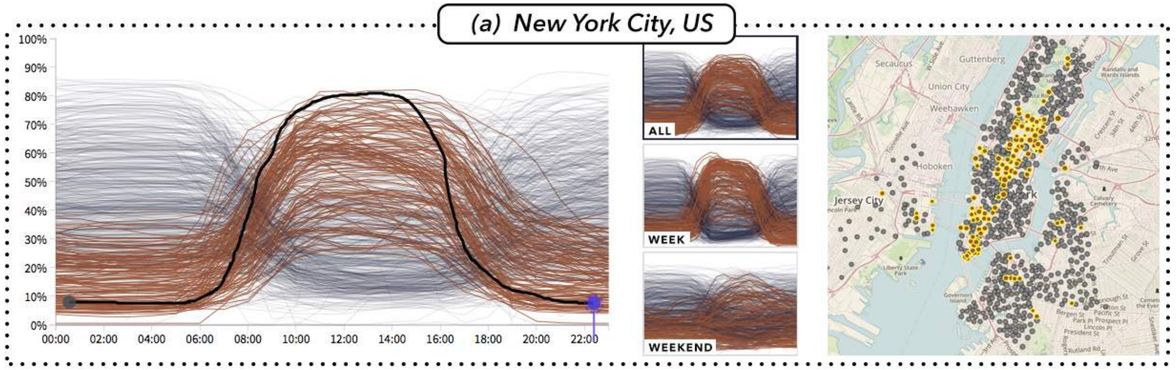
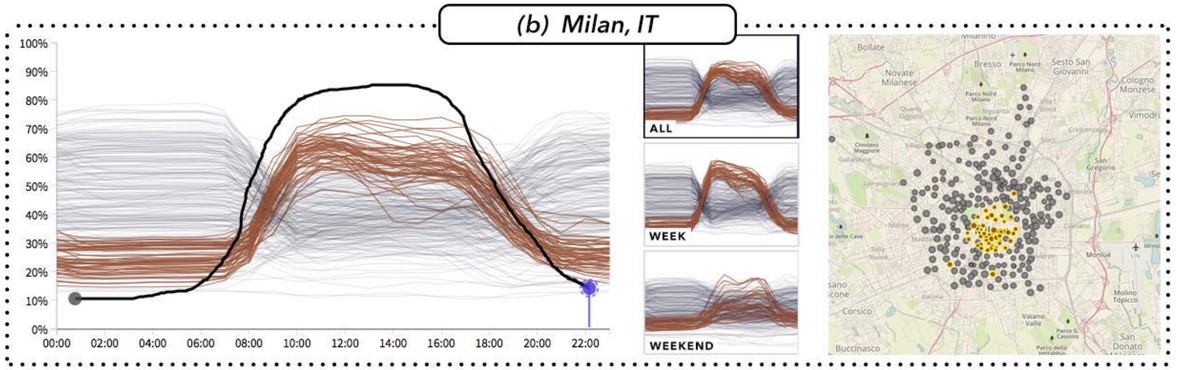
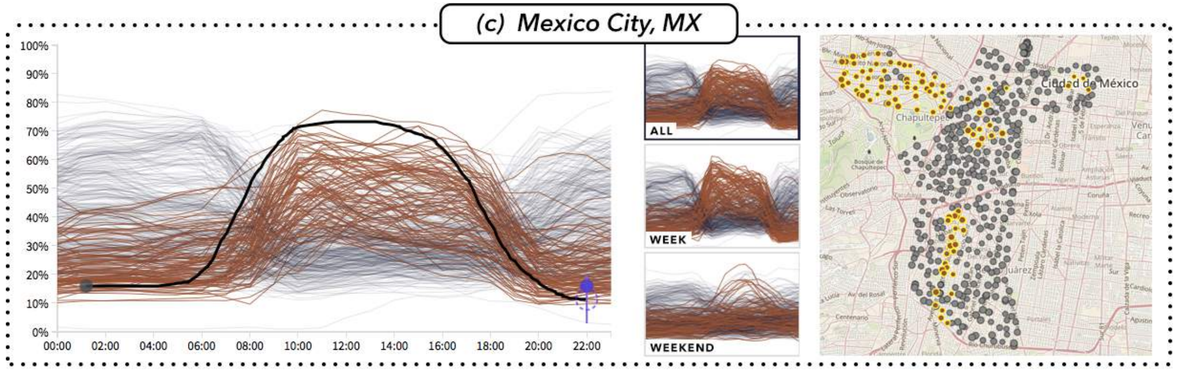
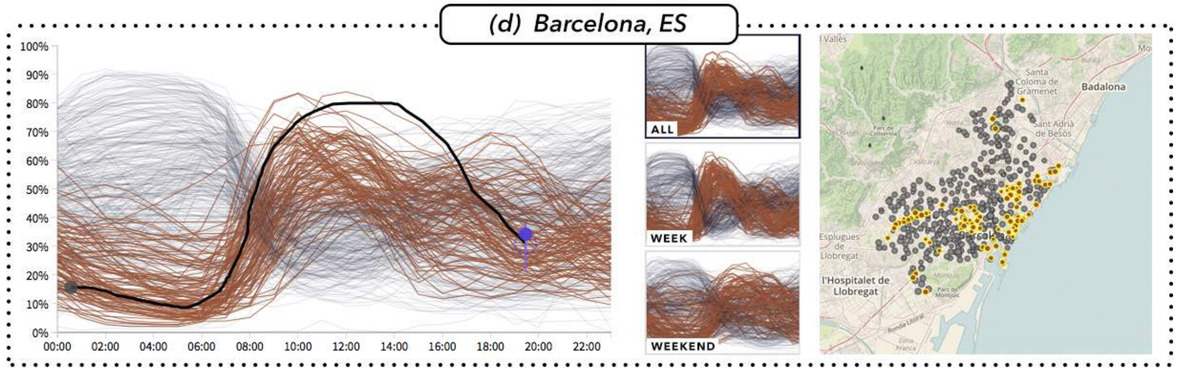
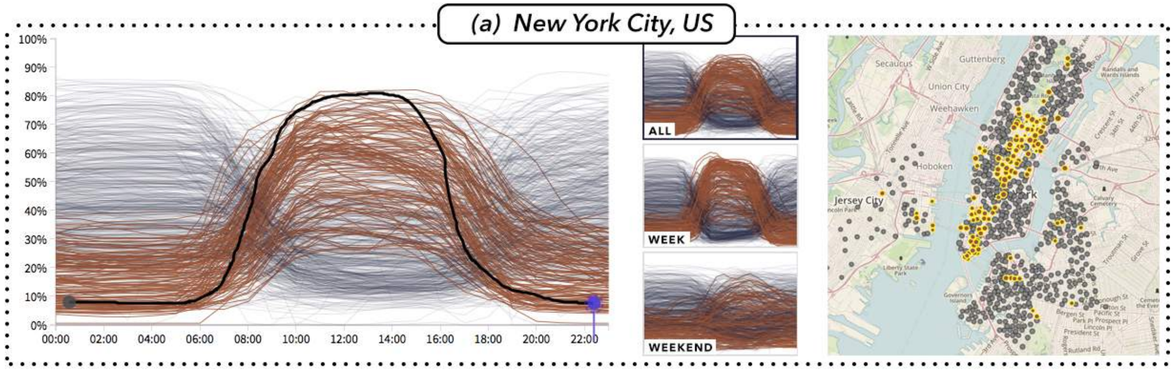
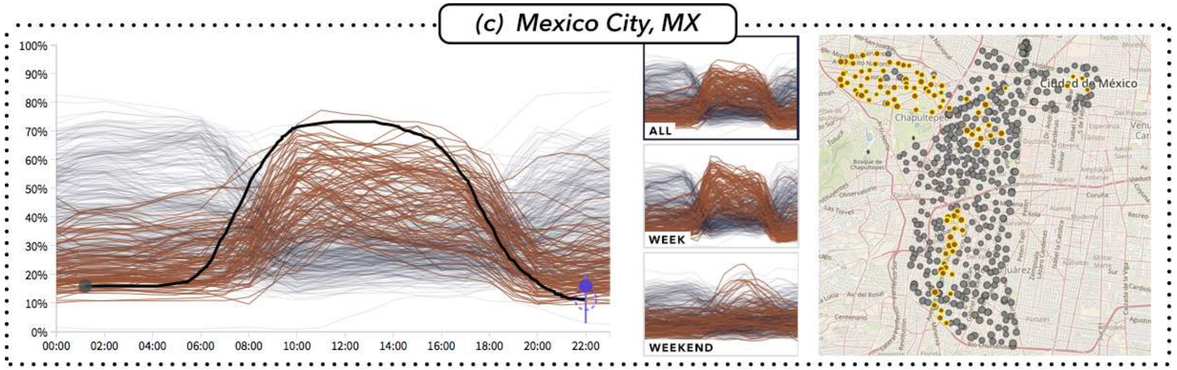
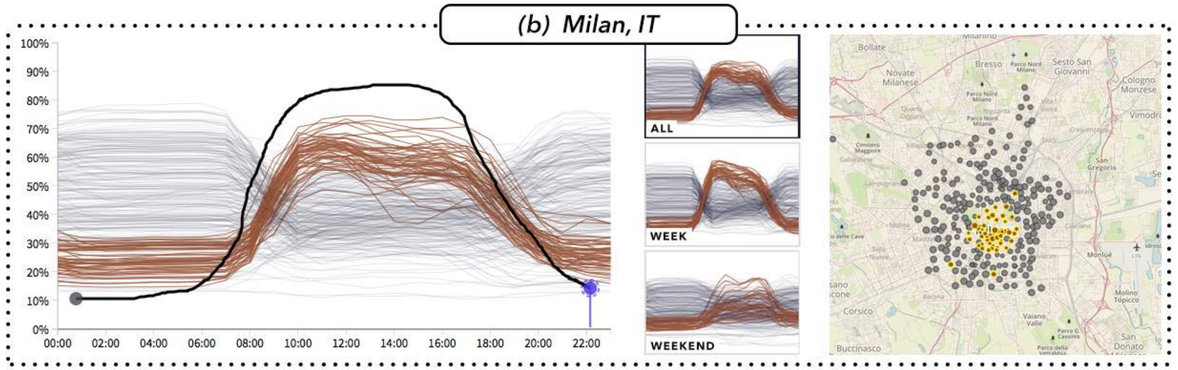
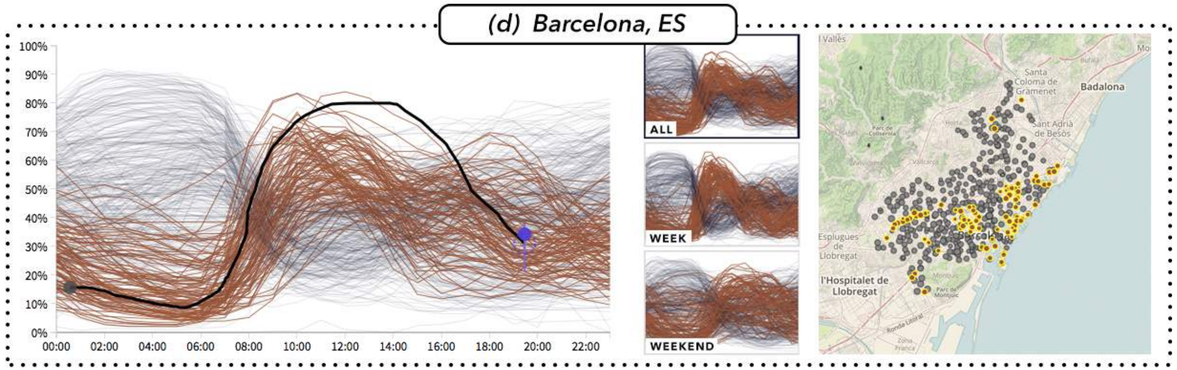
DESIGNING *for* PEOPLE

Commuting behaviours worldwide





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