

R workflow integration by example: studying daily mobility

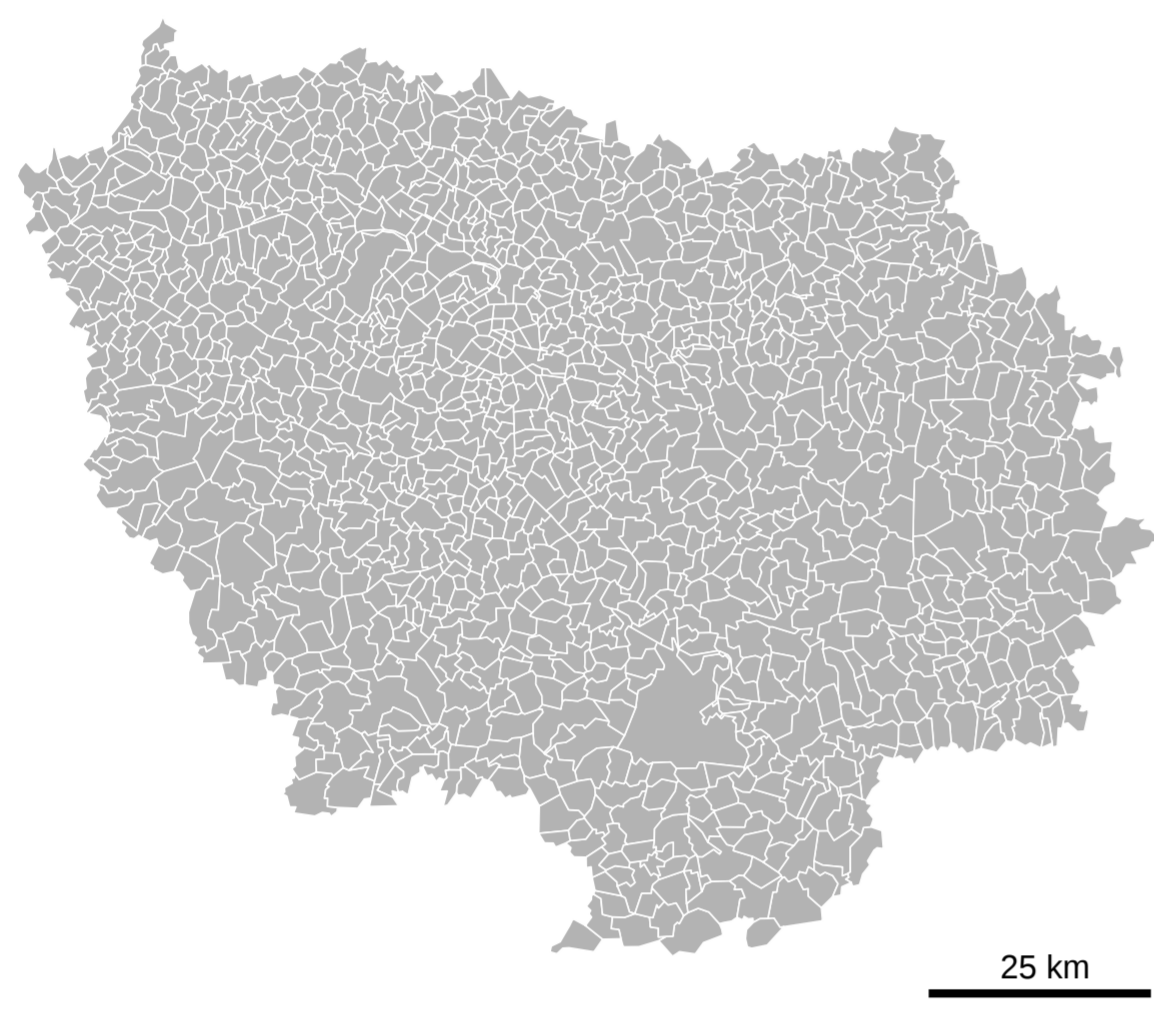
Geographers interested in **mobility patterns** and **spatial practices** need to process a wide variety of objects and to compute a wide variety of spatio-temporal measurements.

Formerly they needed to manipulate **several software packages**. With **R** it is now possible to **manipulate all kinds of geographical and non geographical information within the same platform**.

Municipal base map

Household travel survey

From base map to adjacency matrix



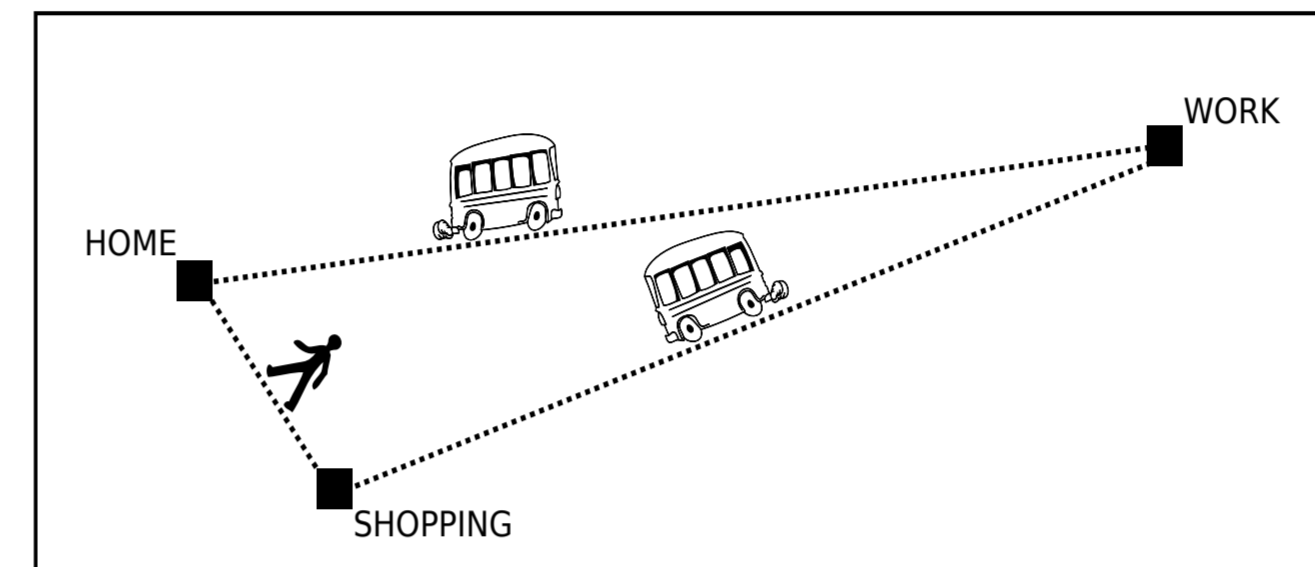
With `sp`, `spdep` and `maptools` packages, the municipalities base map is transformed into an **adjacency matrix**.

No need for a specific GIS software package, neither for computation nor for cartographic representation.

	MUNI 1	MUNI 2	MUNI 3	MUNI 4	...	MUNI n
MUNI 1	0	1	0	1	...	0
MUNI 2	1	0	1	0	...	1
MUNI 3	0	1	0	0	...	0
MUNI 4	1	0	0	0	...	0
...
MUNI n	0	1	0	0	...	0

Source: Institut d'Aménagement et d'Urbanisme d'Ile-de-France, Communes simplifiées, 2008

From table of trips to table of trips and activities



The **table of trips** is transformed into a **table with all the trips and activities** made during the sampled day, inserting in-between activities.

Specific problems of **temporal data manipulation** are solved by using the `chron` package.

	Purpose at origin	Purpose at destination	Mode of transport	Hour of departure	Hour of arrival
TRIP 1	Home	Work	Bus	9:00	9:30
TRIP 2	Work	Shopping	Bus	18:00	18:30
TRIP 3	Shopping	Home	Walking	19:30	19:40

	Type	Start	End
Activity 1	Home	4:00	9:00
Activity 2	Work	9:30	18:00
Activity 3	Shopping	18:30	19:30
Activity 4	Home	19:40	4:00

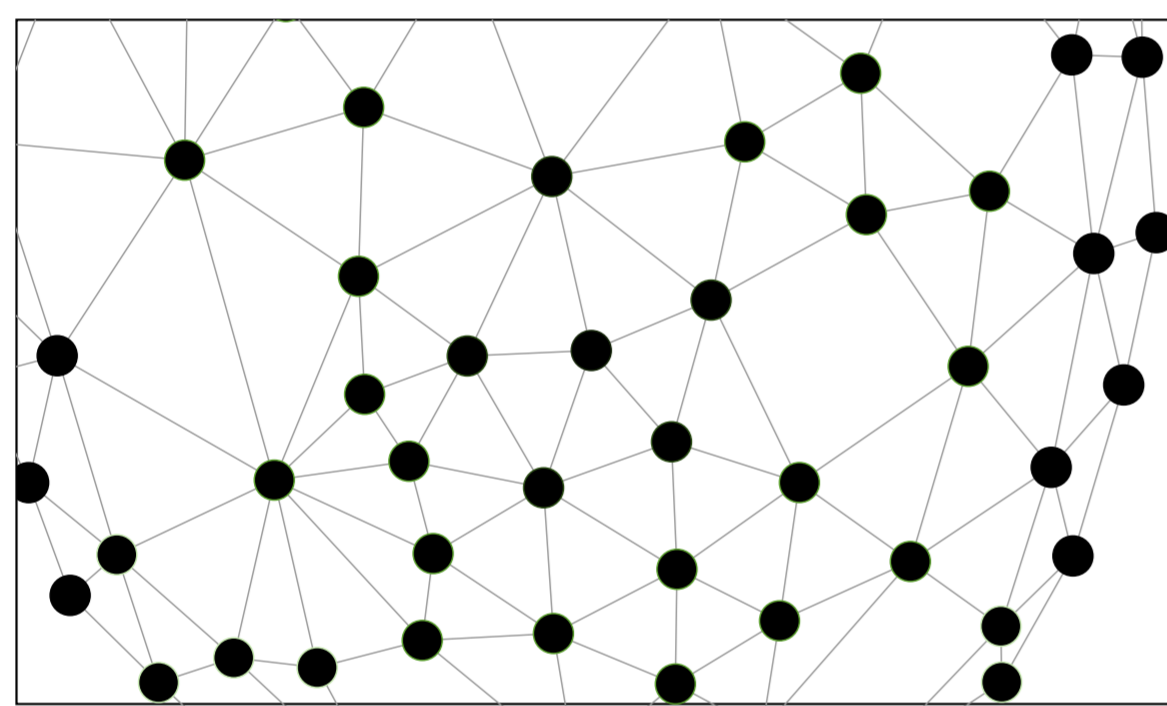
Source: Direction Régionale de l'Équipement d'Ile-de-France, Enquête Globale Transport 2001-2002

From adjacency matrix to topological distances

	MUNI 1	MUNI 2	MUNI 3	MUNI 4	...	MUNI n
MUNI 1	0	1	0	1	...	0
MUNI 2	1	0	1	0	...	1
MUNI 3	0	1	0	0	...	0
MUNI 4	1	0	0	0	...	0
...
MUNI n	0	1	0	0	...	0

With the `igraph` package, the adjacency matrix is transformed into an undirected graph. Then **shortest path** from each vertex (i.e. municipality) to each other is computed, creating a 1300*1300 matrix, which is a matrix of **topological distances**.

No need for a specific graph software package, neither for computation nor for representation.



From table of trips and activities to STS format

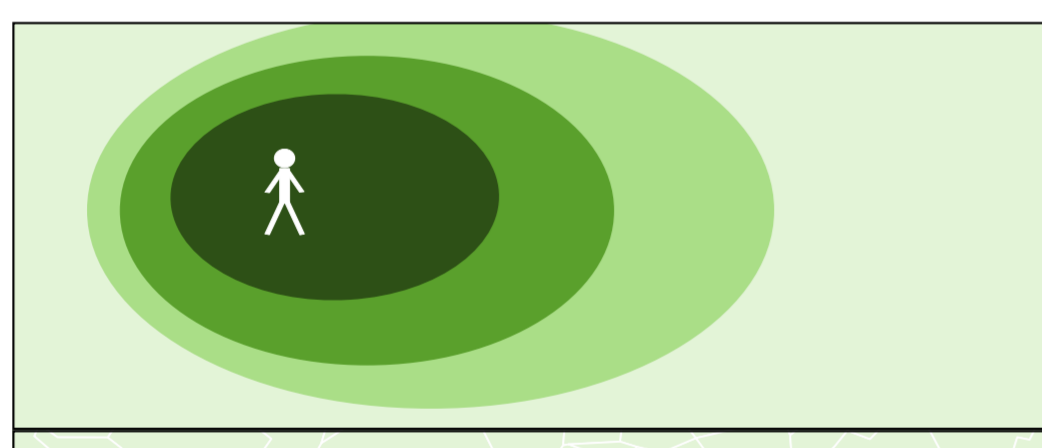
	State	Start	End
Activity 1	Home	4:00	9:00
Trip 1	Home-Work	9:00	9:30
Activity 2	Work	9:30	18:00
Trip 2	Work-Shopping	18:00	18:30
Activity 3	Shopping	18:30	19:30
Trip 3	Shopping-Home	19:30	19:40
Activity 4	Home	19:40	04:00

The **table of trips and activities** (n_i rows for each individual) is transformed into a "**state-sequence**" format :

- rows are **sequences of trips and activities** realized during 24 hours (1 row for each individual)
- columns are **5 minutes time slots** dividing the 24 hours of the day

	4:00	4:05	4:10	4:15	...	9:00	9:05	...	3:55	4:00
Individual 1	Home	Home	Home	...	...	Trip	...	...	Home	Home
Individual 2	Home	Home	Home	...	...	Work	...	...	Home	Home
...

From topological distances to classes of distance

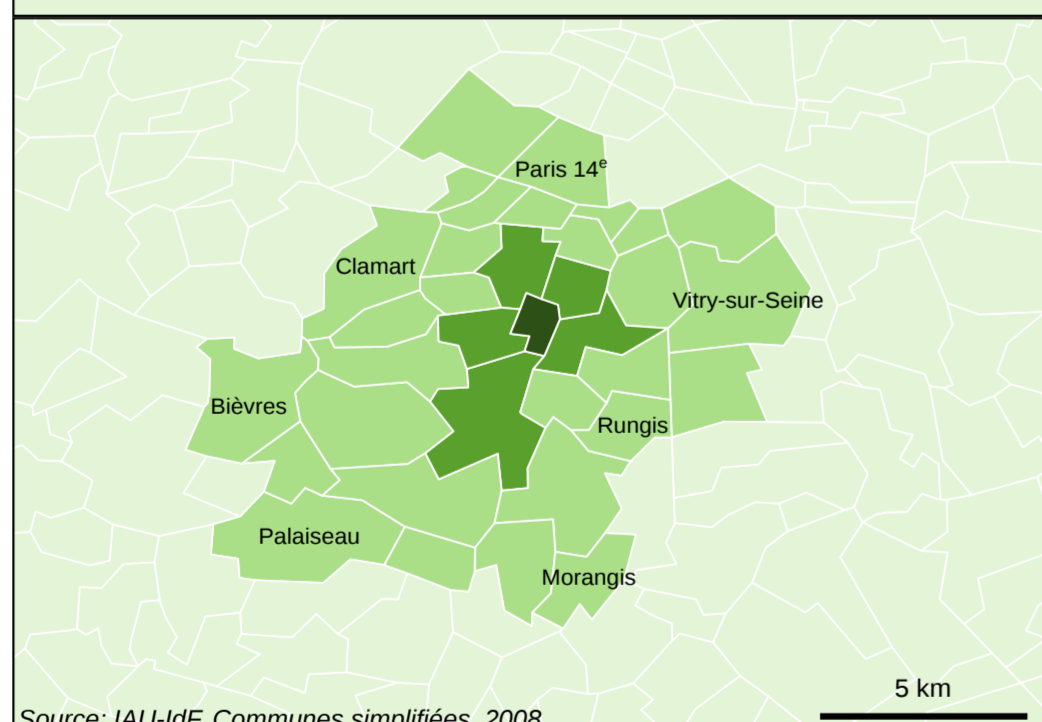


Topological distances are then used to compute a **relative zonal classification**. This classification is **peculiar to each individual**, based on the distance from his/her home municipality.

Classification by topological distance

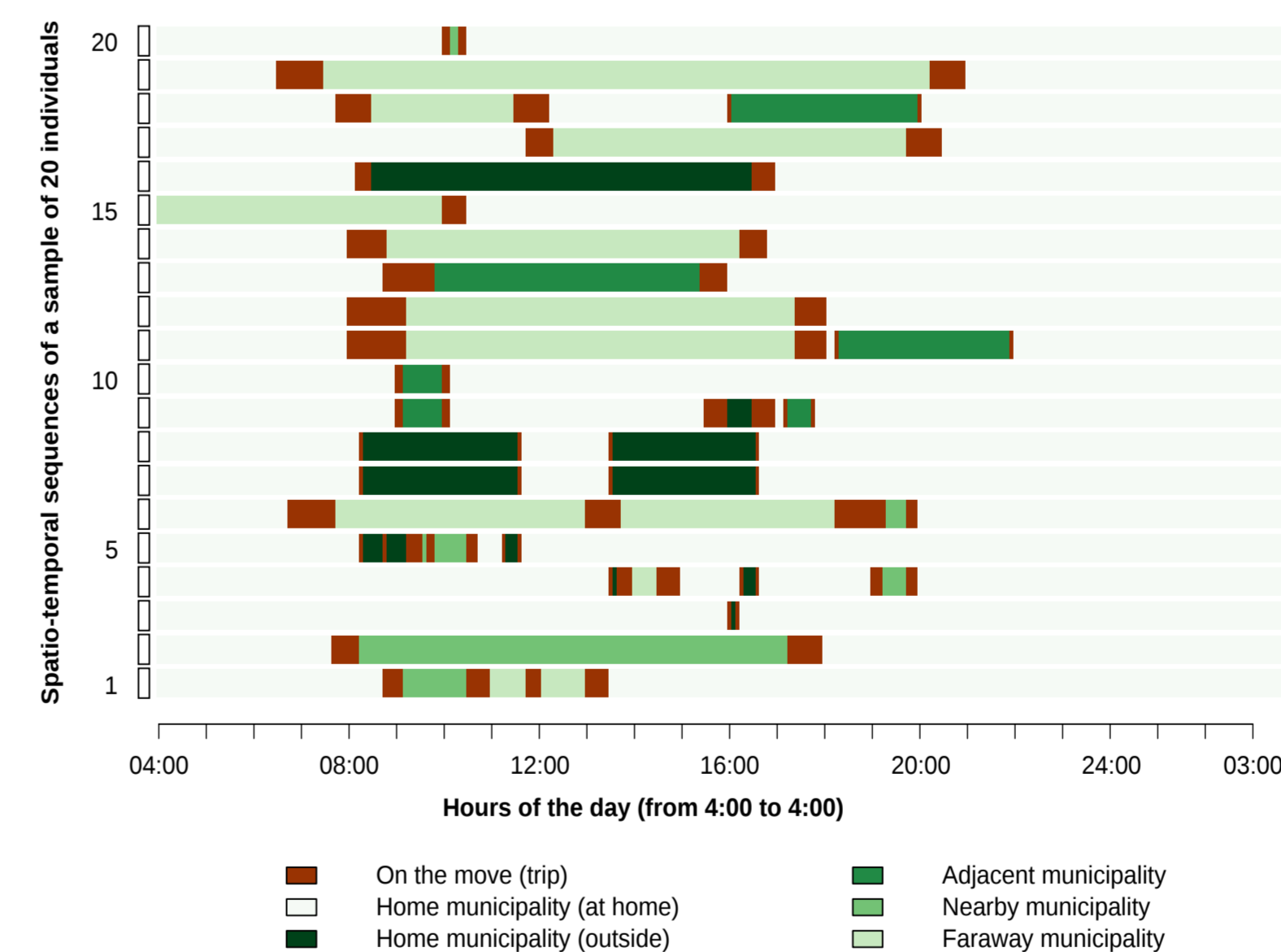
ex. Bourg-la-Reine inhabitants

- Home municipality $dist = 0$
- Adjacent municipality $dist = 1$
- Nearby municipality $dist = [2 ; 3]$
- Faraway municipality $dist > 3$



Source: IAU-IdF, Communes simplifiées, 2008

From STS format to TraMineR sequences



The `TraMineR` package is used to create and handle **spatio-temporal sequences**.

The **relative classification** of distances helps defining individuals' mobility states in a 6 modalities typology, **mixing places and activities**.

RESULTS

Two kinds of sequential measures are computed to prepare a **classification of individuals' patterns of mobility**:

- 1/ time spent in each state
- 2/ sequential turbulence

