Estimation of flow trajectories in a multiple lines network

Case studies with *transports publics de la région lausannoise* (tl) data

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Introduction

Context

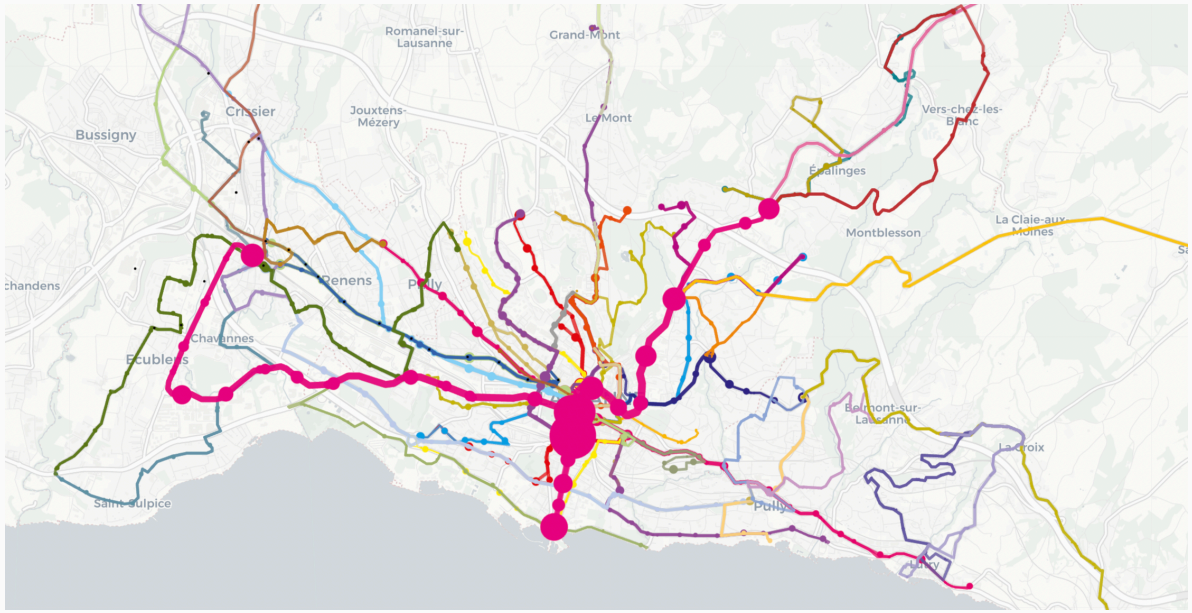
The tl dataset, used by Romain Loup for his PhD:

- 1 year of data (2019).
- 115 millions of passengers.
- 42 bus and subway lines.
- 1361 stops and 497 “superstops”.
- Every journey data: traveling time, waiting time, embarking and disembarking passengers at each stops, etc.

Context

```
##   stop_id  stop_name line_id direction order embarkment disembarkment
## 1 MALAD_N  Maladière       1         A     1     164558             0
## 2 MTOIE_E    Montoie       1         A     2     136236         12705
## 3 BATEL_E  Batelière       1         A     3     203045         13409
## 4 RTCOU_E Riant-Cour       1         A     4     156015         24909
```

```
##    stop_id  stop_name line_id direction order embarkment disembarkment
## 42 RTCOU_O Riant-Cour       1         R    19      23634        132201
## 43 BATEL_O  Batelière       1         R    20      13707        168884
## 44 MTOIE_O    Montoie       1         R    21       4259        128255
## 45 MALAD_N  Maladière       1         R    22          0        146798
```



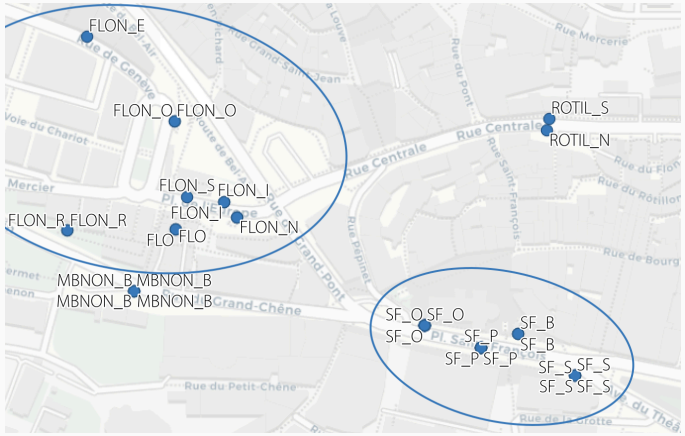
The multiple lines network

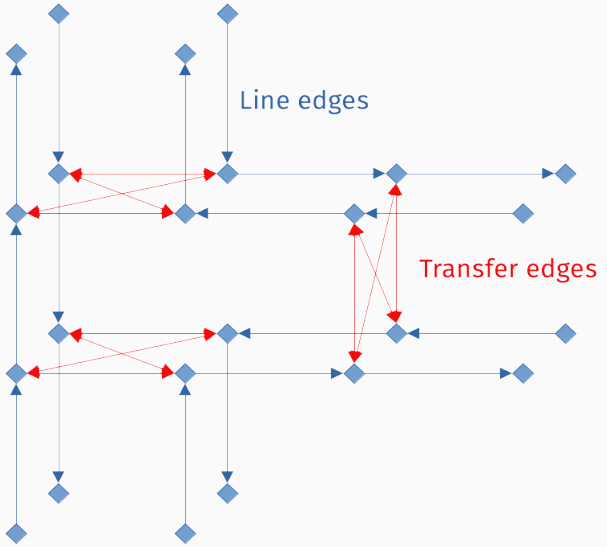
Having only lines data, we have a disconnected oriented graph.

In addition to line edges, it is possible to construct transfer edges to make the graph connected, by using, e.g.,

- Superstops names,
- Pedestrian time,
- Distance.

This is what we call a multiple lines network.





The problematic

This dataset offers multiple axes of research. In this presentation, we will focus on one question:

> *Knowing (1) the network structure and (2) the number of passengers embarking and disembarking at each stop, can we deduce trajectories of the passengers in the network ?*

The problematic

Short answer: No.

Thank you for your attention !

Questions ?

The problematic

Exact trajectories are impossible to know, but with additional hypotheses, we can estimate them.

We will divide this problematic into two parts:

- The estimation of trajectories on a single line.
- The estimation of trajectories on the multiple lines network.

The single line problem

Formal problem definition

Let a line (in one direction), which have n stops. Let $\boldsymbol{\rho}_{\text{in}} = (\rho_i^{\text{in}})$ and $\boldsymbol{\rho}_{\text{out}} = (\rho_i^{\text{out}})$ be two vectors representing, respectively, the passengers entering and leaving the line at each stops.

References i