Smallworld

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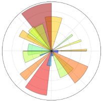
Introduction

Mimic the people's behavior in a big city :

Problems

- Everyday life planning ?
- Use of the transportation network ?

Tools we used :



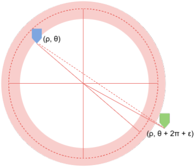
Topology – main steps

Subway network ∼ Parisian “metro”.

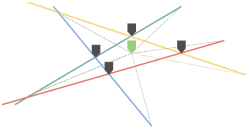
Steps

1. **Terminals** : line segments.
2. **Intersections** : point clustering.
3. **Stations** : points at regular intervals.
4. **Hubs** : stations crossed by many lines.
5. **Fast lines** : connect hubs together.

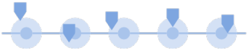
Topology – illustrations



(a) Terminals : originate in the suburbs, go through the center



(b) Intersections : move close intersections to their centroid



(c) Stations : sample the line and add noise

Topology – results

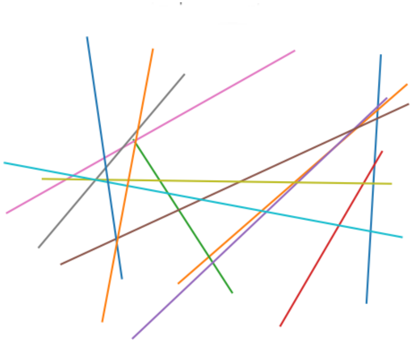


Figure: Terminals generation – subway lines are simple segments

Topology – results

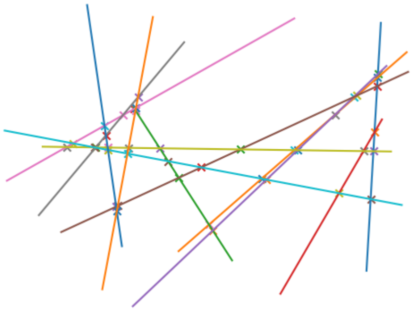


Figure: Intersection resolution – find where the lines cross using SymPy

Topology – results

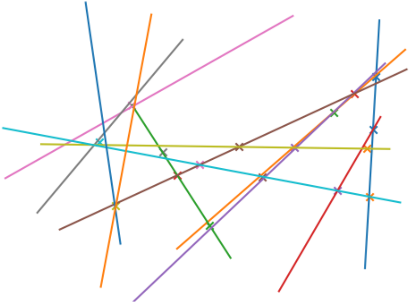


Figure: Intersection gluing – merge close intersections using a clustering algorithm (DBSCAN)

Topology – results

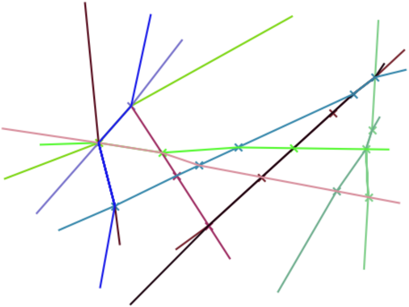


Figure: Line bending – bend te lines such that they cross glued intersections

Topology – results

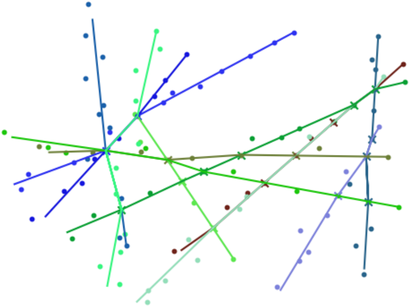


Figure: Stations – put stations at regular intervals plus a little noise

Topology – results

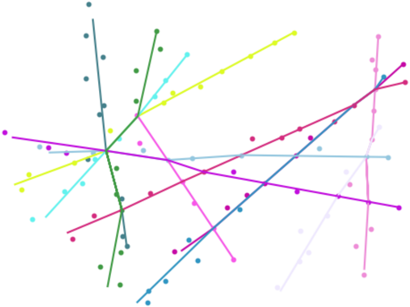


Figure: Stations gluing – merge close intersections with DBSCAN again

Topology – results

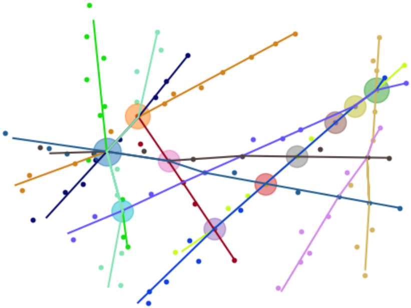


Figure: Hubs – find stations with many lines crossing them and generate fast lines

Toponymy – main steps

"Realistic" stations' names, *e.g.* "Place Edith Piaf", "Rue de la Chine" or "Saint Marcel"...

Steps

1. **Data collection** : collect from databases or manually.
2. **Combine elements together** : link words ("Place de la/le", "Saint(e)", "-"...).
3. **Do some tricks** : avoid things like "Place d'Arc" or "Avenue de Maupassant"...

"Best-of" : "Avenue Johnny Hallyday", "Gare Nabilla", "Rue du Swaziland"...

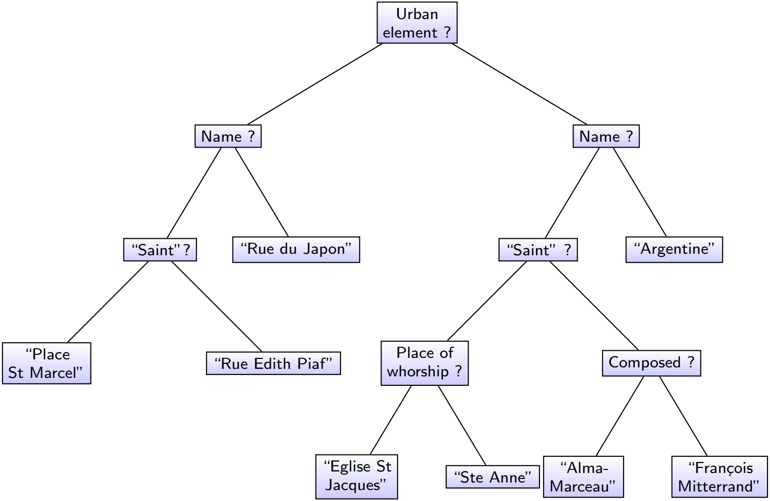


Figure: Simplified binary tree for name generation

Schedule – main steps

Station schedule ⇒ point to point travel times.

Steps

1. Travel times between stations $\propto$ line speed, distance.
2. Departure times from terminals $\propto$ moment of the day.
3. Propagate departure times along the line.

Not yet implemented...

Use the schedule to compute a shortest path that is sensitive to de day/hour of departure !

Schedule – illustration

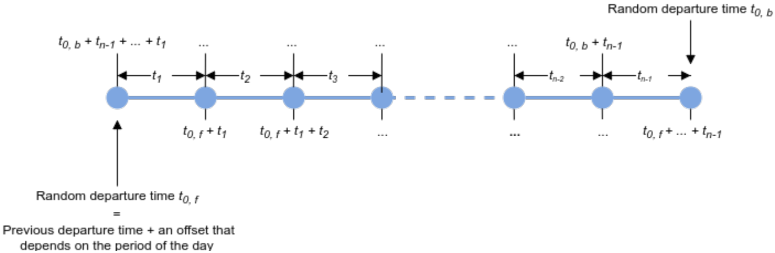

Random departure time $t_{0,b}$
$t_{0,b} + t_{n-1} + ... + t_1$
...
...
...
...
$t_{0,b} + t_{n-1}$
t_1
t_2
t_3
t_{n-2}
t_{n-1}
$t_{0,f} + t_1$
$t_{0,f} + t_1 + t_2$
...
...
...
$t_{0,f} + ... + t_{n-1}$
Random departure time $t_{0,f}$
=
Previous departure time + an offset that
depends on the period of the day

Figure: Computation of a line of the schedule for one subway line

Key ideas

- Families
- Work
- Activities
- Home
- Deplacement between those points !

Localisation ideas

Center : working
Subbурbs : housing
(all probabilistic)

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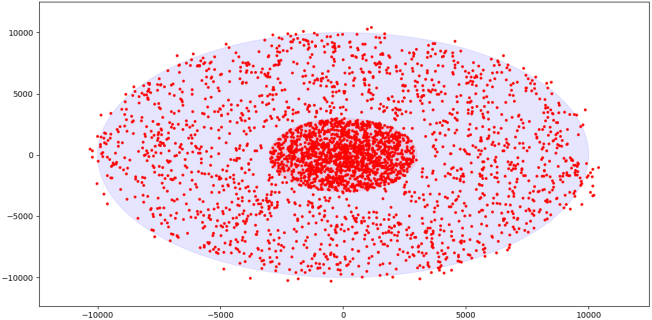
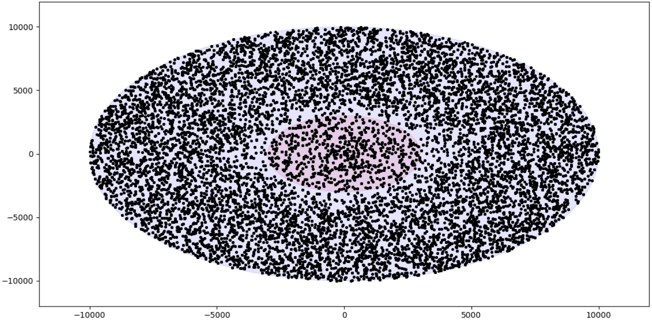
(all probabilistic)



Localisation ideas

Center : working
Subburbs : housing
(all probabilistic)



Activities

For now : uniform generation + some more on the hubs

A person

- Id
- Age
- Work type and informations
- Work location
- Home location
- Family
- Typical activities
- Planning

Persons models

How to differentiate

Typical activities
Days worked
Work location distribution

Persons type

- Students : work near home location, ludic activities, student weak
- White collar : working in center, groceries, different work shedule
- Unenmployed, outdoor work . . .

Generating families

- one or two parents
- several childs

modularity

Proba of being single
Number of child proba repartition
Monoparental families...

Planning

Being at work during worktime
Random activity on day activity
Going back to home to sleep

demonstration

Modularity

Depending on other people, family
More activities
Special activities only on some locations
Special events (worldcup etc...)

Merger of the two projects – roadmap

What we got

- Pairwise shortest paths between stations.
- Series of travels from one point to another.

What we want

- Retrieve the itinerary for each travel !

Merger of the two projects – illustration

Travel from x to y :

s_x, s_y the stations

Shortest_path(s_x, s_y)

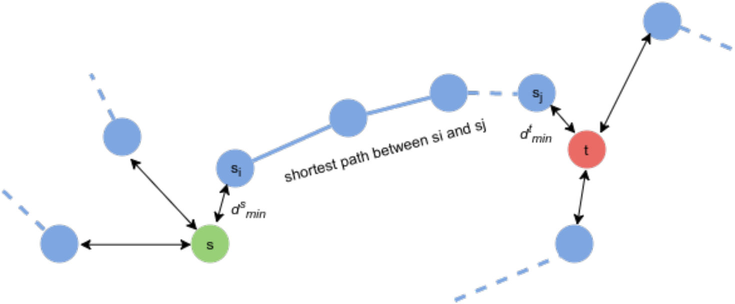


Figure: Computation of point-to-point shortest paths

Merger of the two projects – result

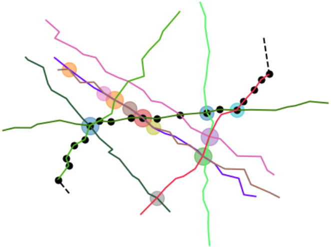


Figure: P2P shortest path with SymPy and NetworkX

Use of the different lines

How many persons use it ? Schedules ? Breakdown sensibility ?

Conclusion

- Complex and quite "realistic" city with many adjustable parameters.
- But define "realistic" ? Which metric could we use ?
- Possible refinements : animated visualization, wider range of public transport, wider range of socio-professional categories, real-time shortest path using subway schedules...