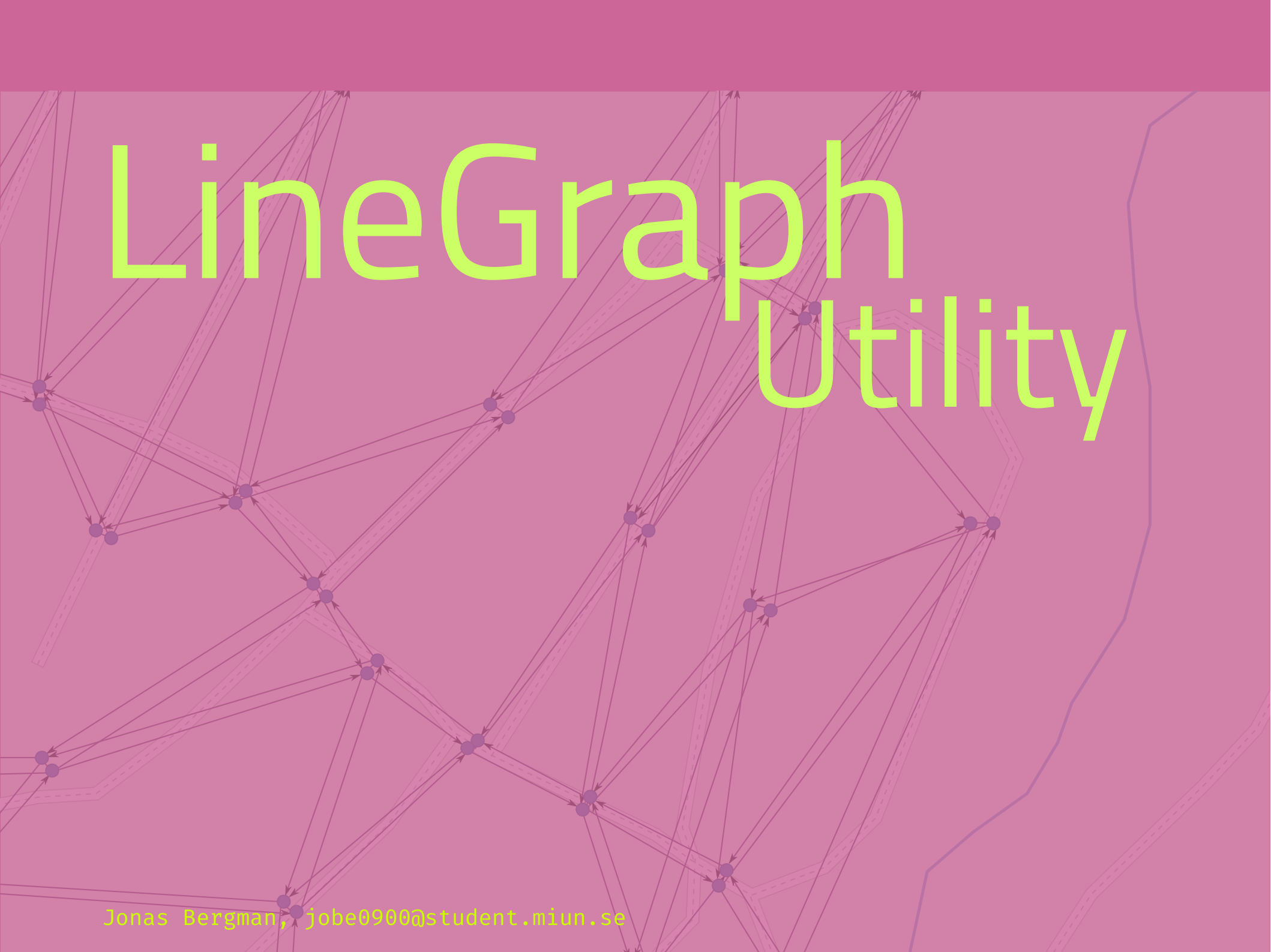
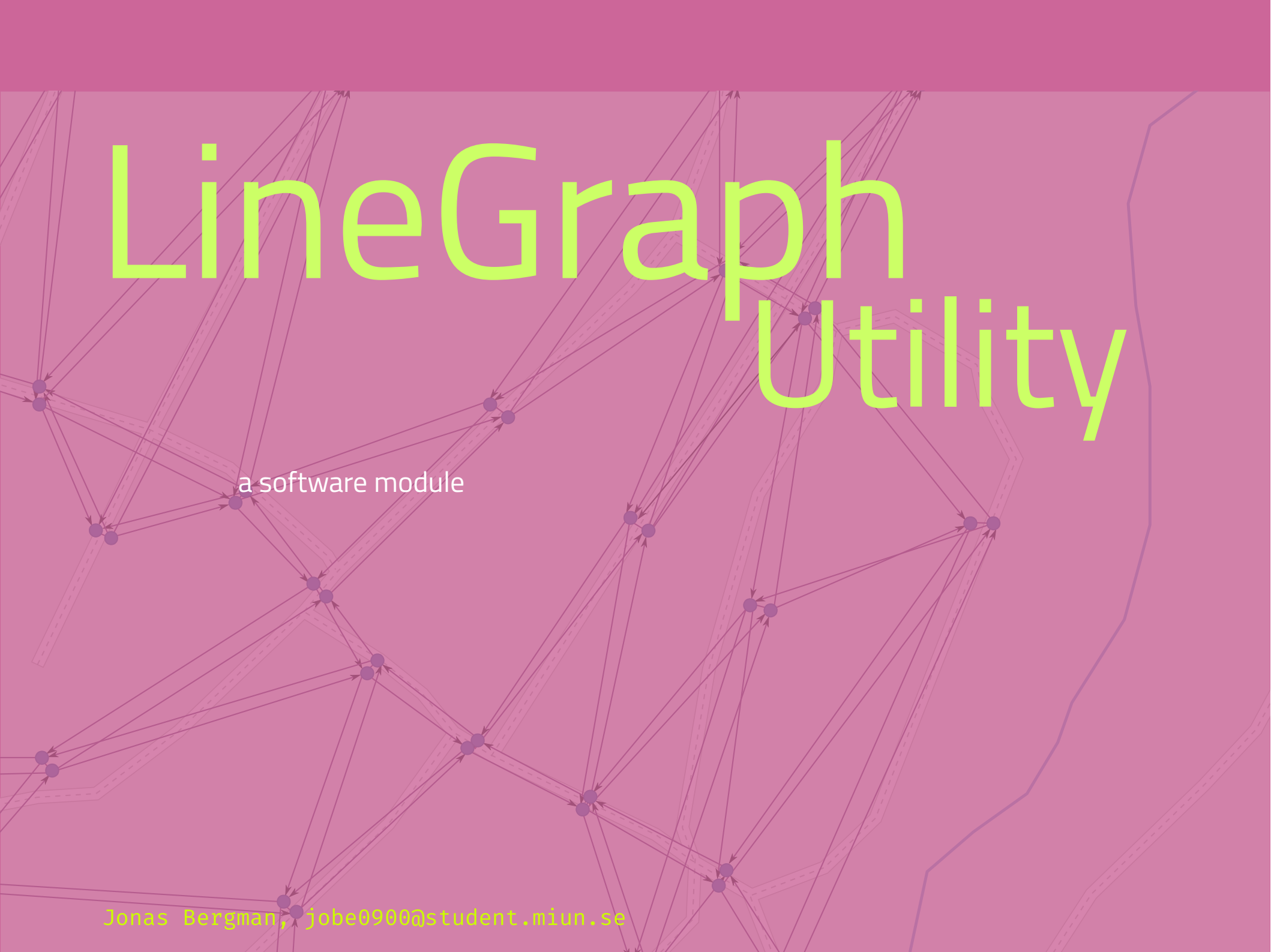


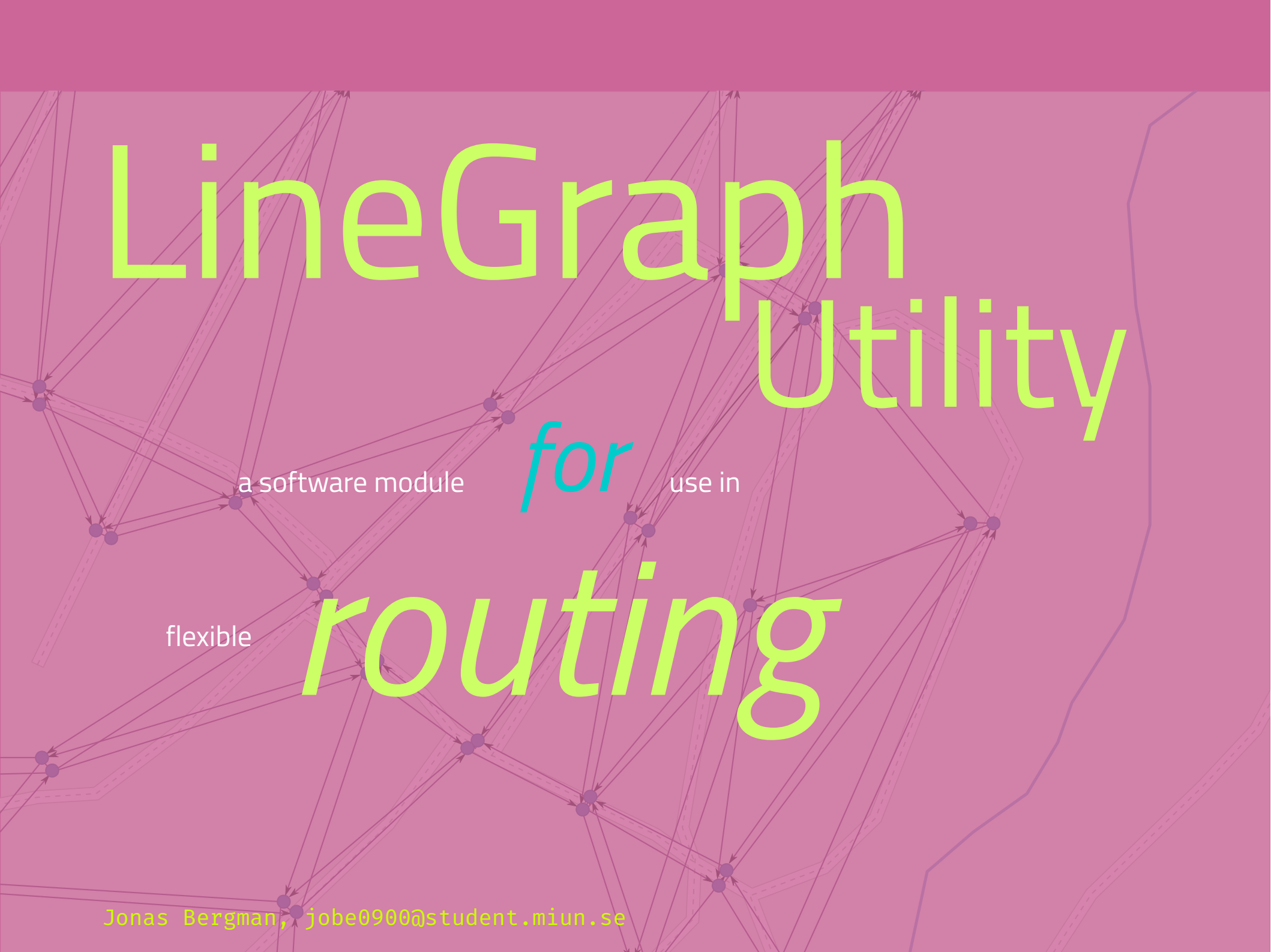
LineGraph Utility

The background of the slide features a light purple map of a road network. Overlaid on this map is a complex graph structure. The graph consists of numerous small, dark purple circular nodes. These nodes are interconnected by a dense web of thin, dark purple lines representing edges. Some of these edges are straight, while others follow the curves of the roads on the map. The overall effect is a technical visualization of a graph utility applied to a real-world spatial network.

LineGraph Utility

The background of the slide features a complex directed graph. Nodes are represented by small purple circles, and edges are thin black lines with arrowheads indicating direction. The graph is dense and interconnected, with some nodes having multiple incoming and outgoing edges. The overall aesthetic is technical and network-oriented.

a software module

A complex network diagram with numerous nodes and directed edges, overlaid on a light purple background. The nodes are represented by small purple dots, and the edges are thin purple lines with arrowheads. The network is dense and interconnected, with some nodes having multiple incoming and outgoing connections. The overall style is technical and abstract, suggesting a network or graph structure.

LineGraph Utility

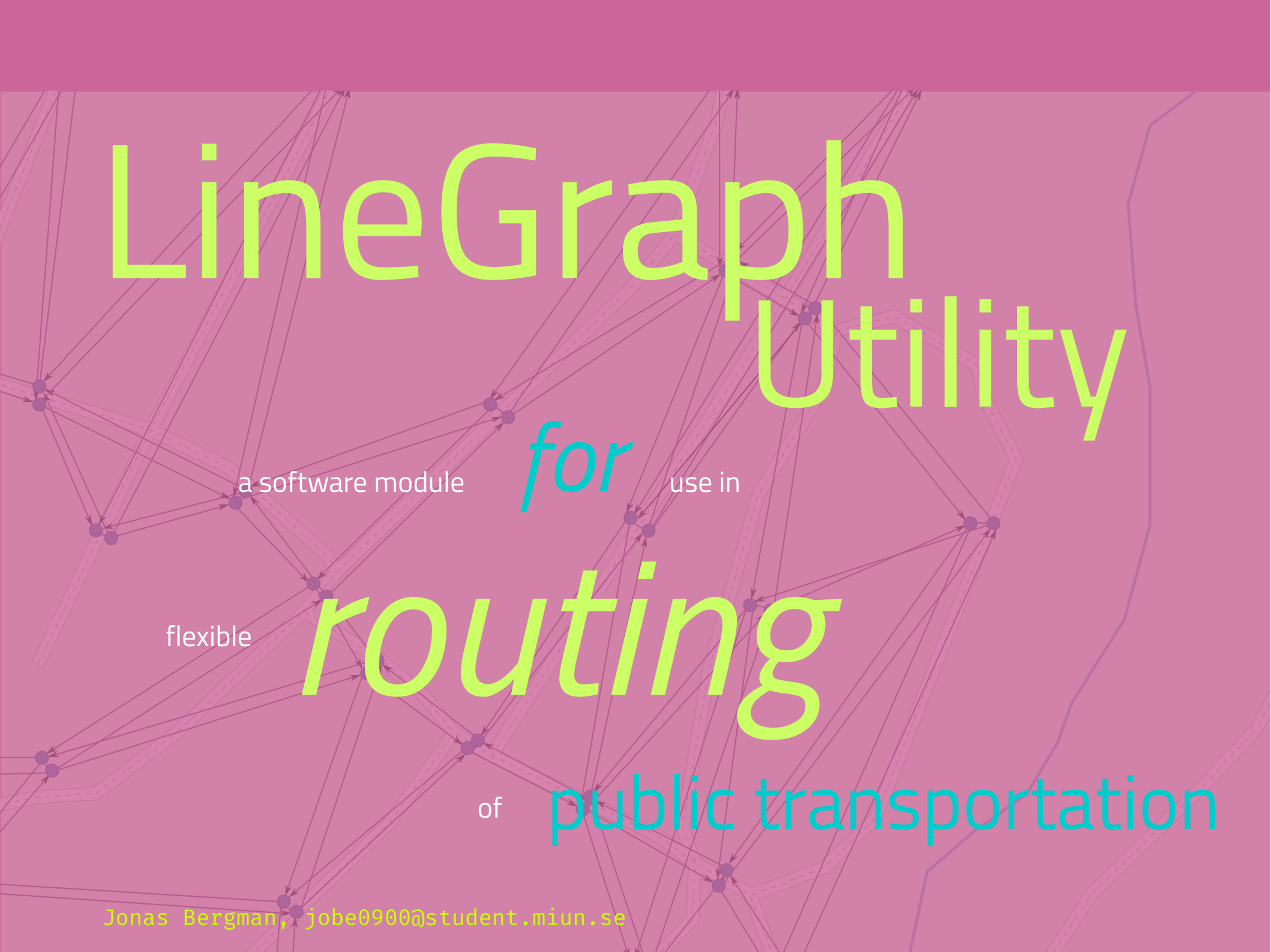
a software module

for

use in

flexible

routing

The background is a light purple map of a city area, overlaid with a complex network of dark purple lines and nodes. The lines represent roads or transit routes, and the nodes represent intersections or stations. The network is dense and interconnected, with many lines crossing each other.

LineGraph Utility *for* *routing* of public transportation

a software module use in
flexible

requirements



in: *map* data

in: *map* data

out: *line graph*

1 load *map* data

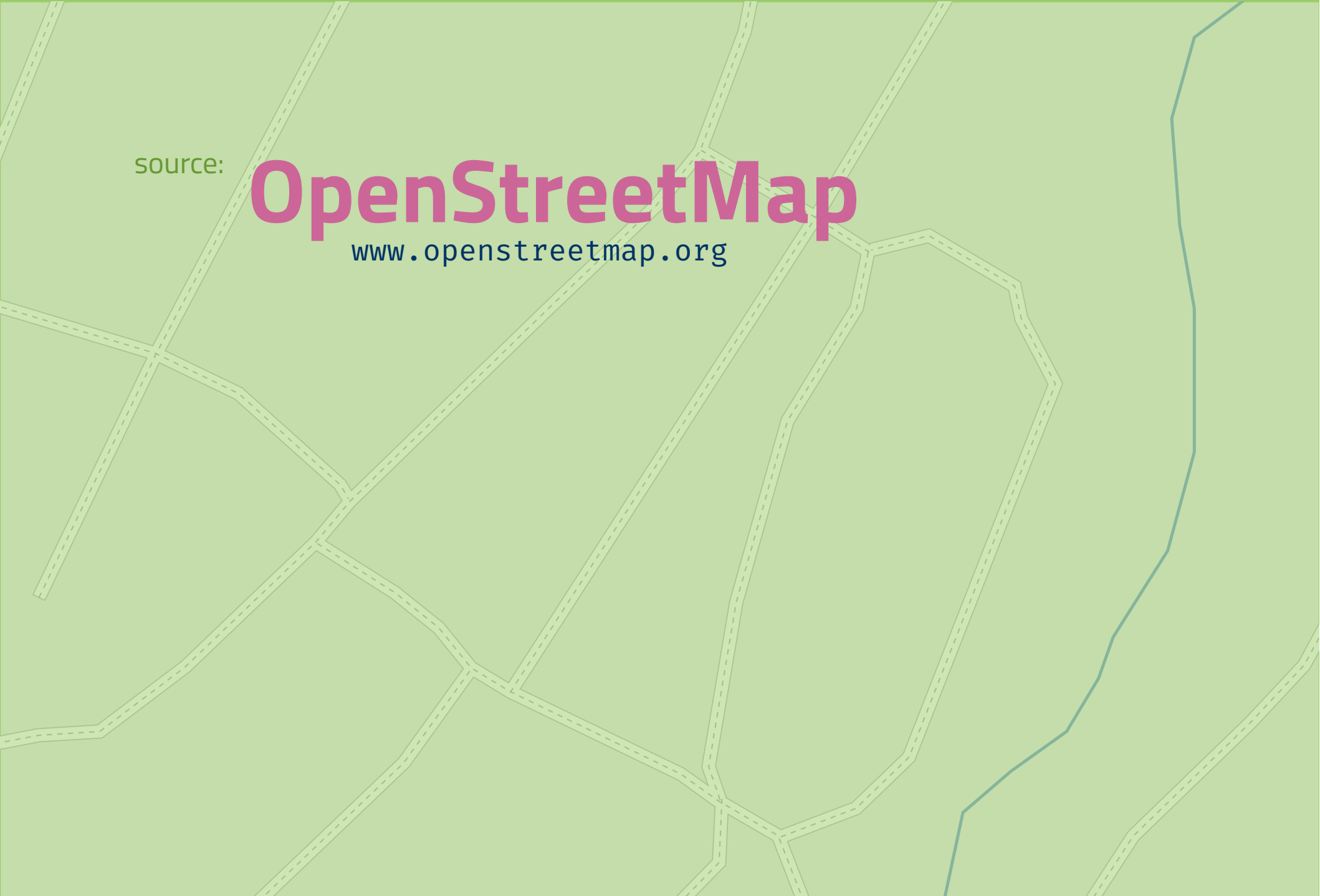
1. map



1. map

source:

OpenStreetMap
www.openstreetmap.org



1. map

source:

OpenStreetMap

www.openstreetmap.org

store:

PostGIS

www.postgis.net

1. map

source:

OpenStreetMap

www.openstreetmap.org

store:

PostGIS

PostgreSQL + spatial data extension

www.postgis.net

1. map

source:

OpenStreetMap

www.openstreetmap.org

load:

```
$ osm2pgsql
```

store:

PostGIS

www.postgis.net

PostgreSQL + spatial data extension

1. map

source:

OpenStreetMap

www.openstreetmap.org

load:

```
$ osm2pgsql -U user -d map_db -s -k mapdata.osm
```

store:

PostGIS

www.postgis.net

PostgreSQL + spatial data extension

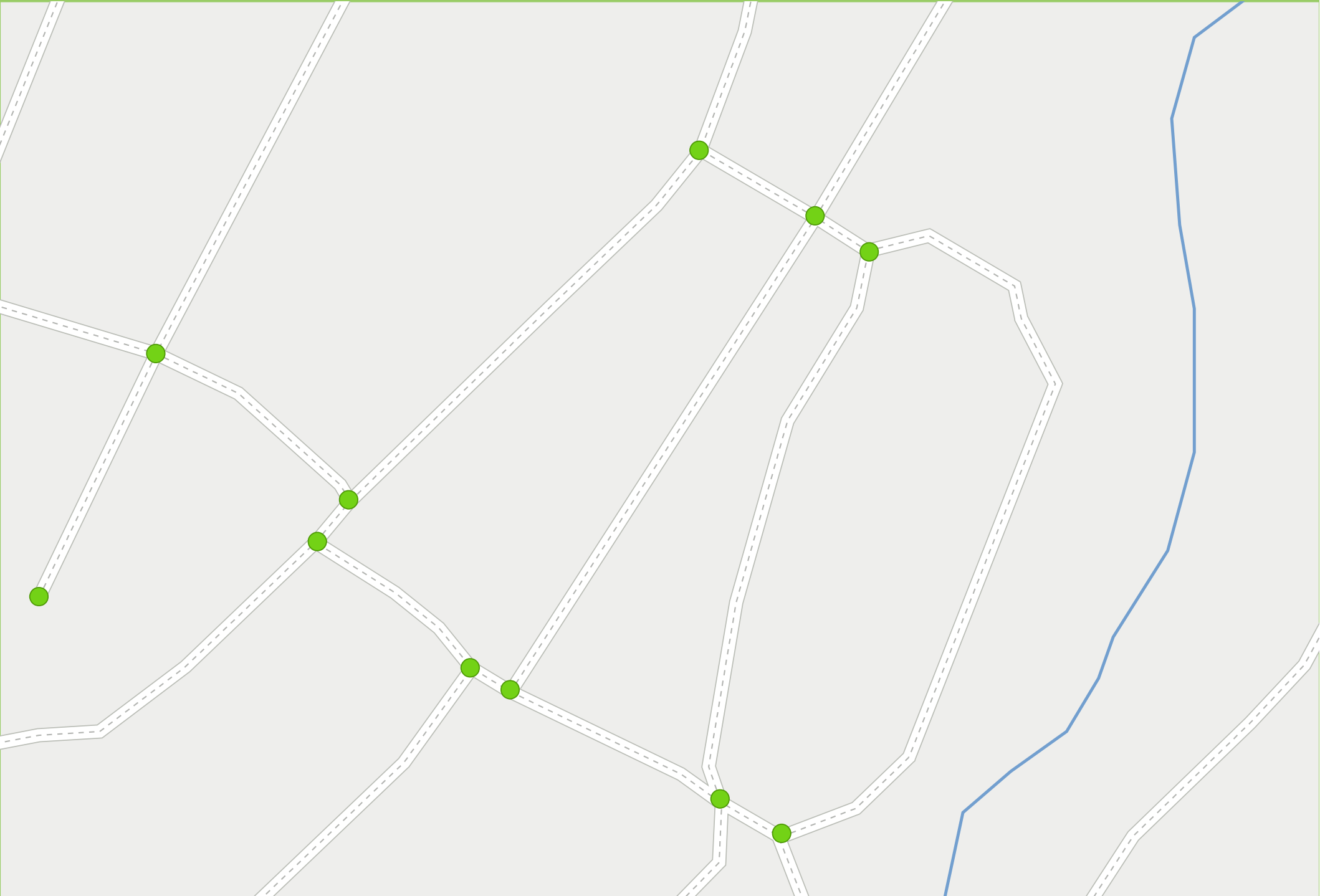
1 load *map* data

2 build *topology*

2. topology



2. topology



2. topology



2. topology



2. topology



2. topology



2. topology

tool:

postgis_topology



1 load *map* data

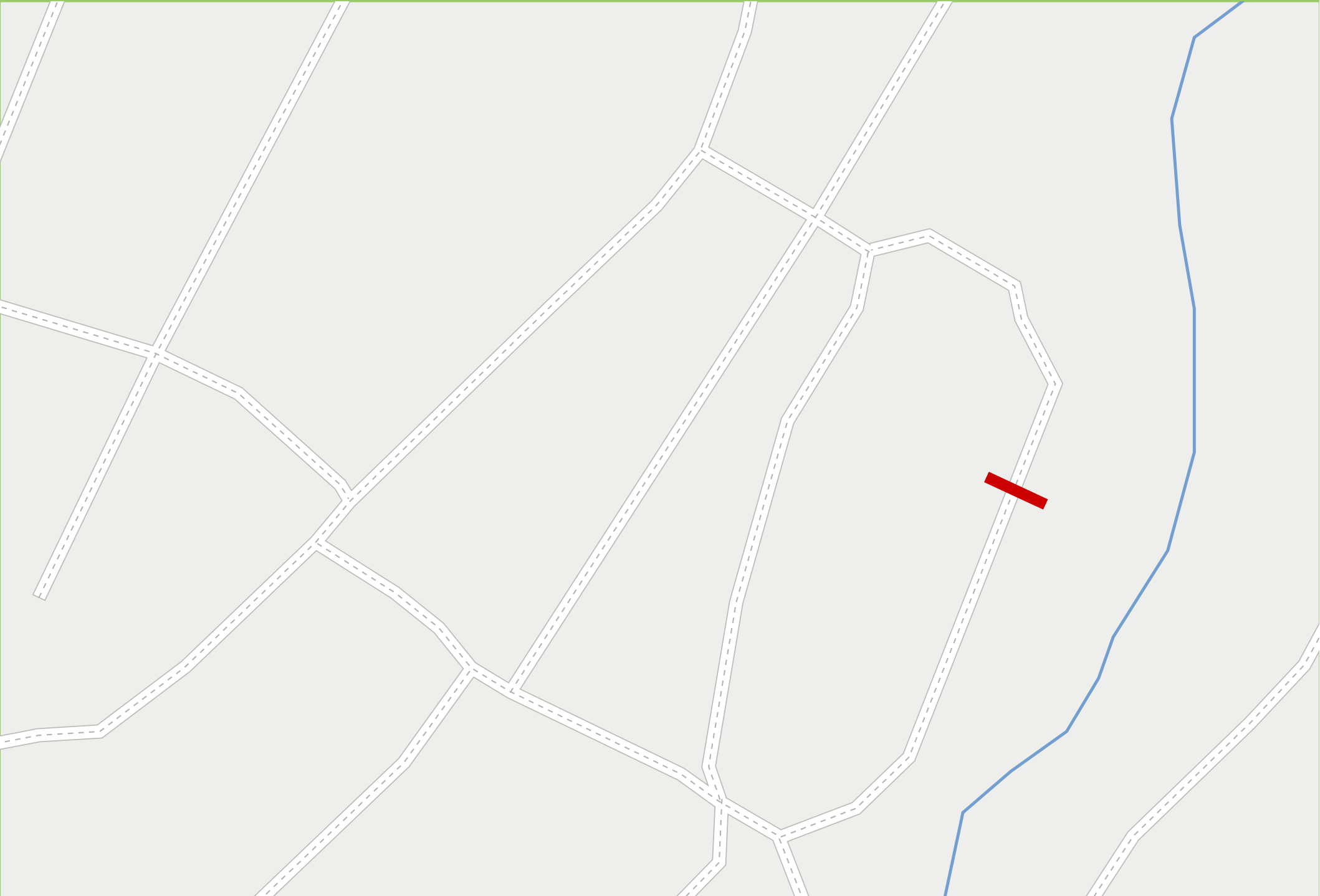
2 build *topology*

3 apply *restrictions*

3. restrictions



3. restrictions



3. restrictions



3. restrictions (directed graph)



3. restrictions (directed graph)



3. restrictions (directed graph)



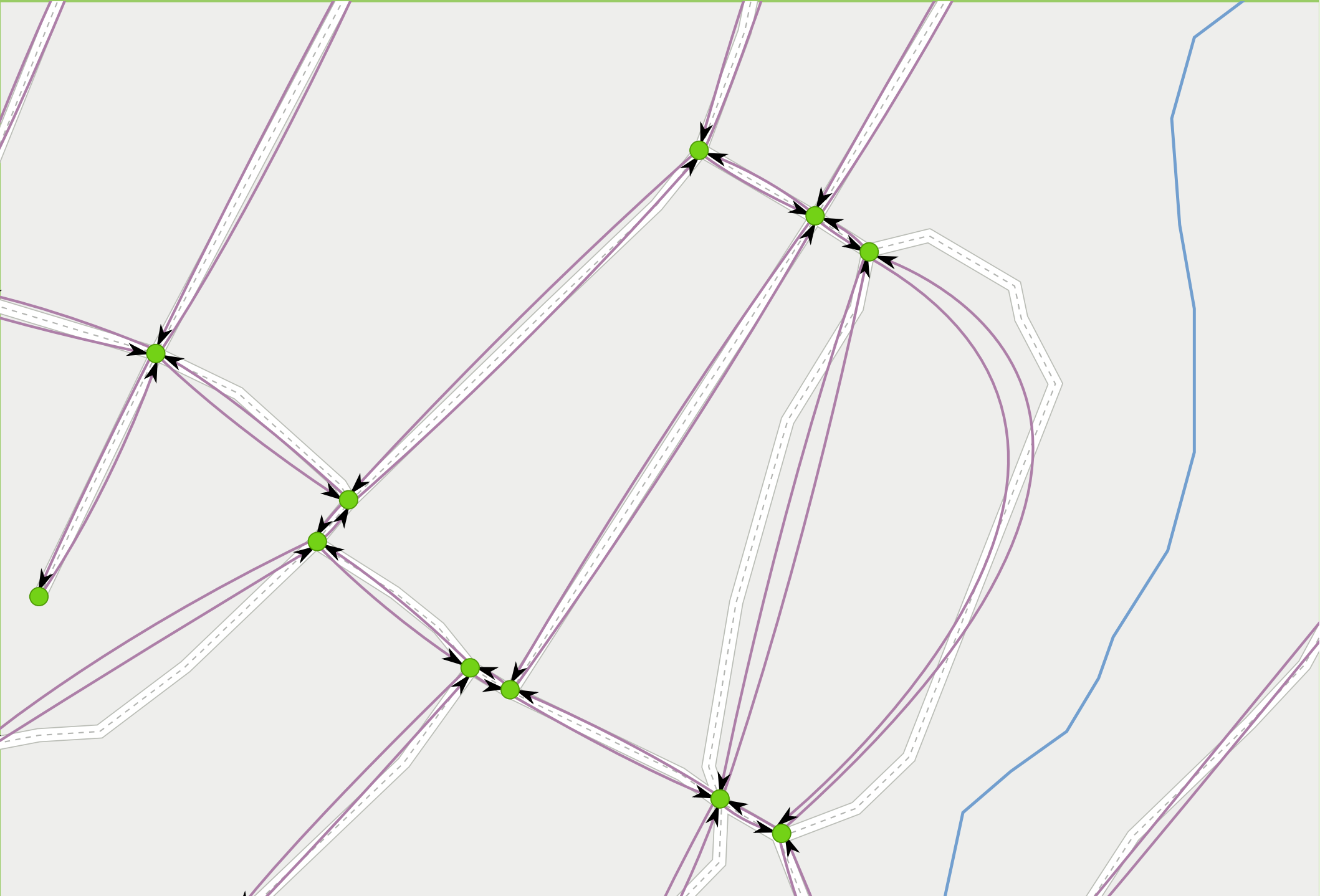
3. restrictions (directed graph)



3. restrictions (directed graph)



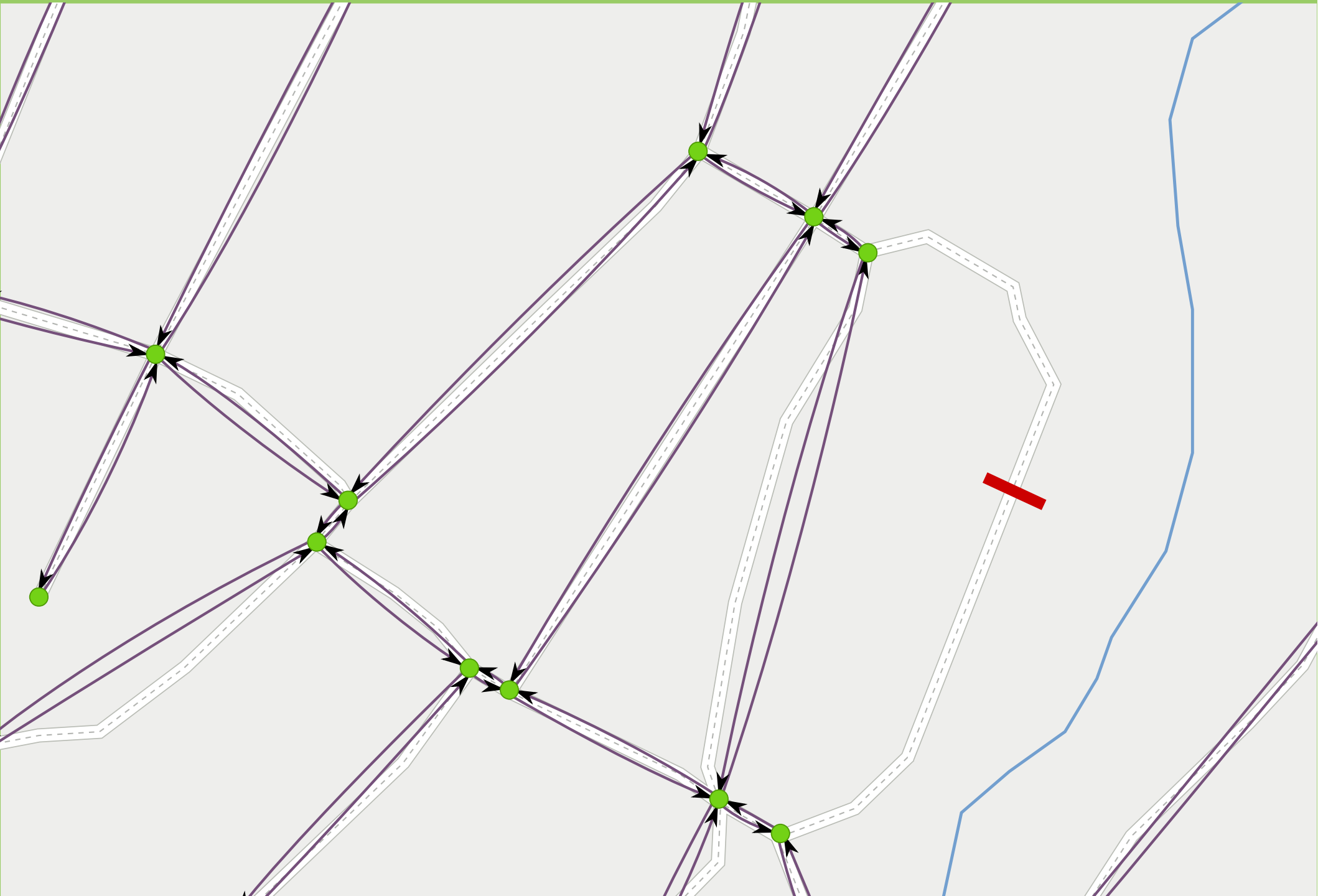
3. restrictions (directed graph)



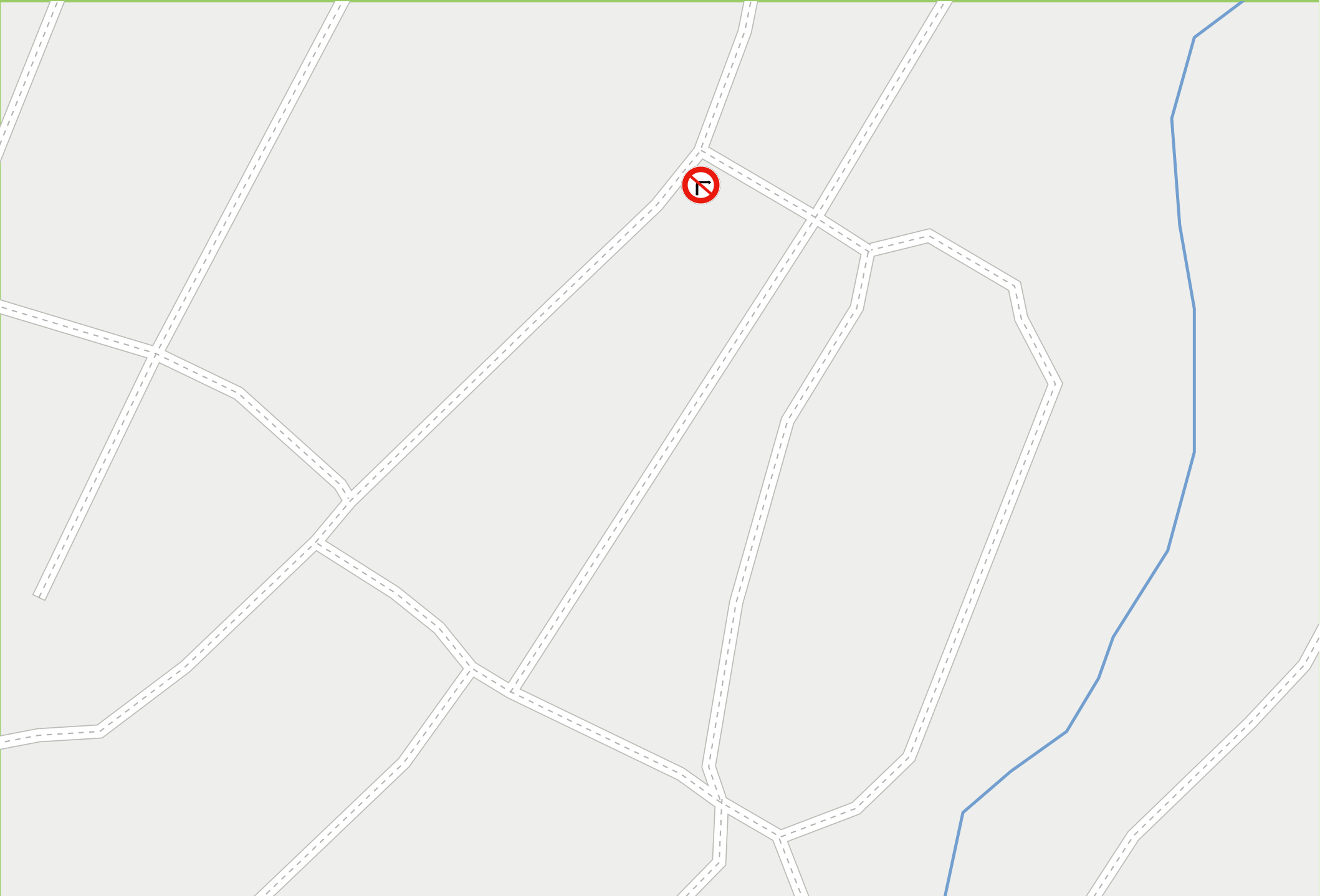
3. restrictions



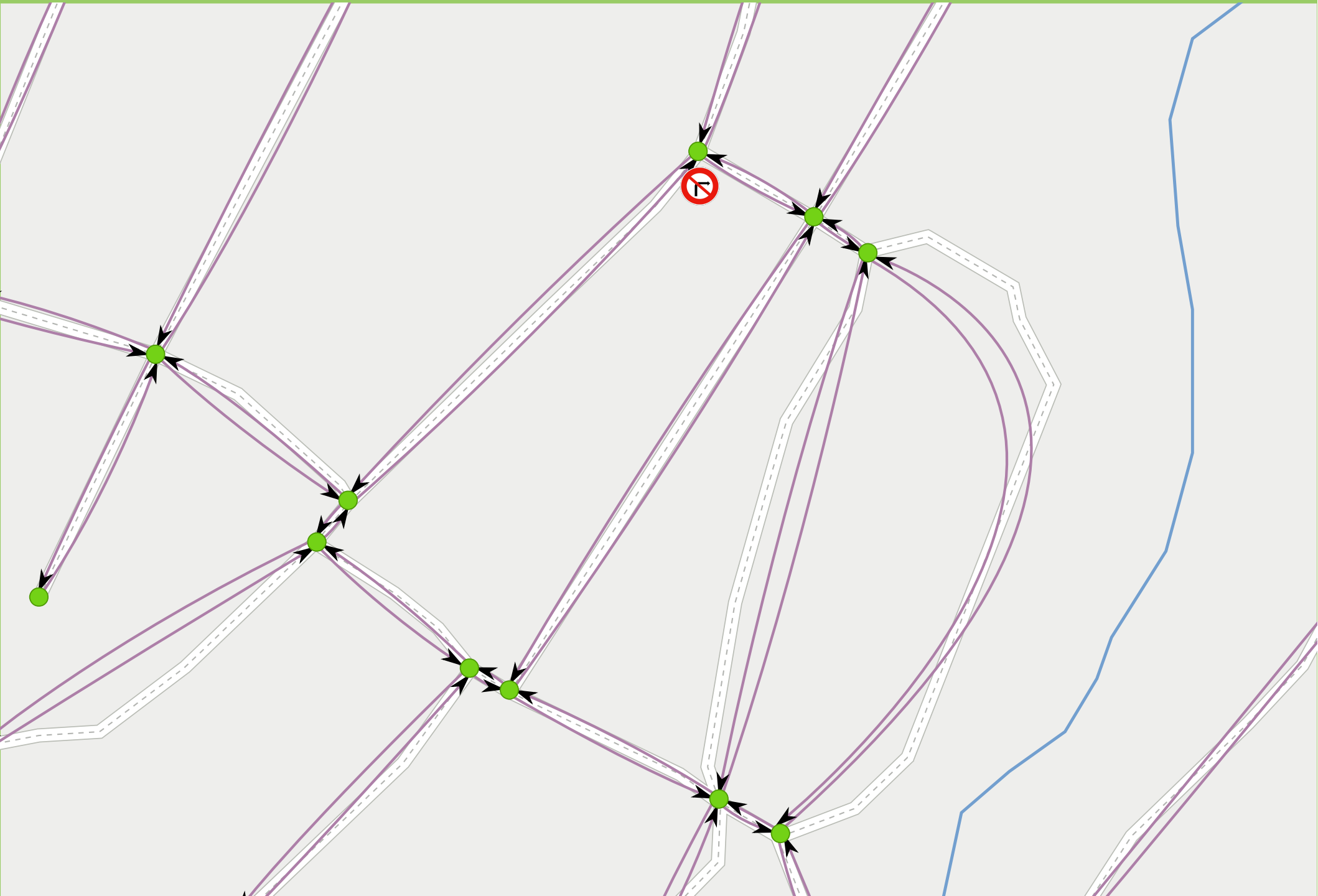
3. restrictions



3. restrictions



3. restrictions



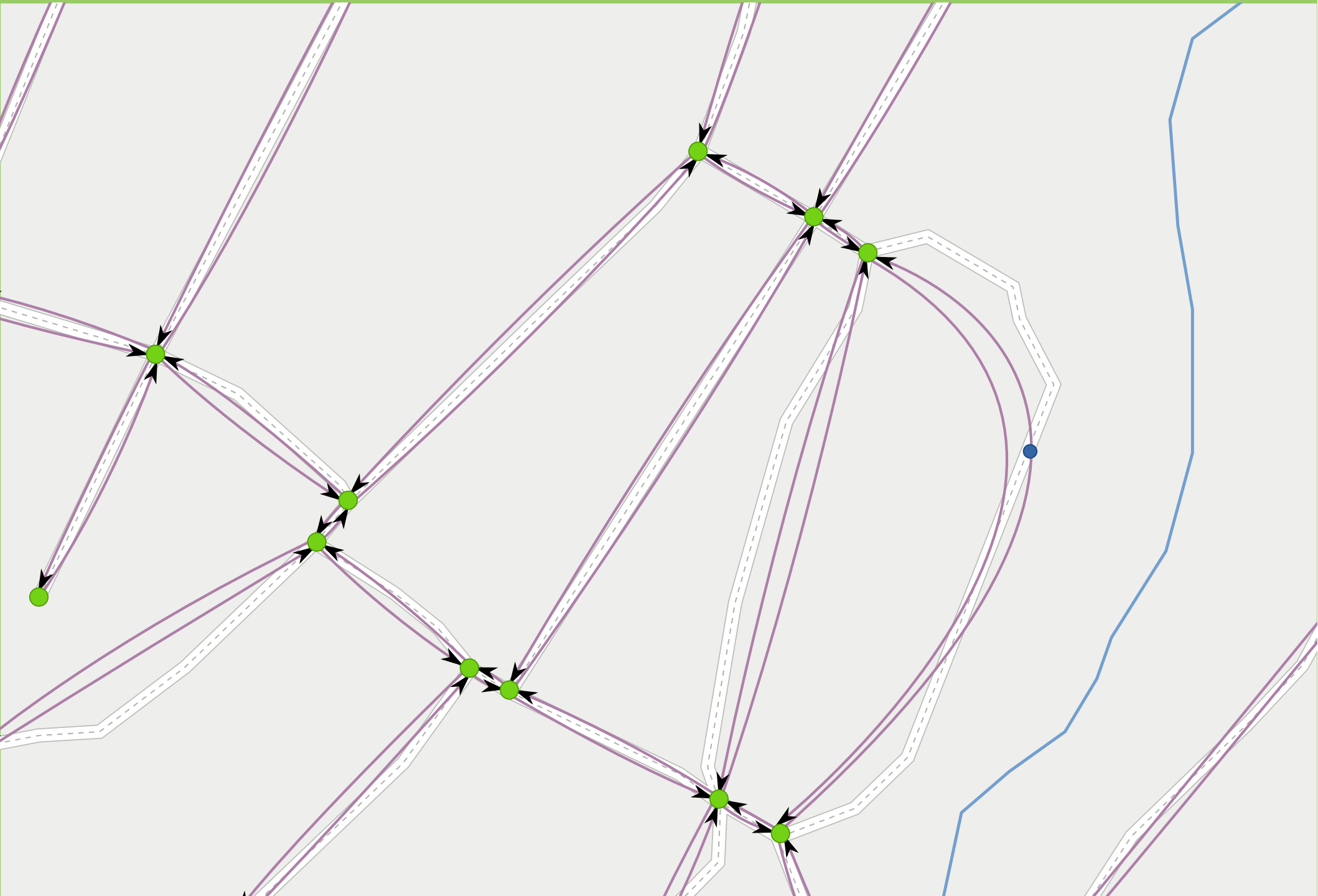
1 load *map* data

2 build *topology*

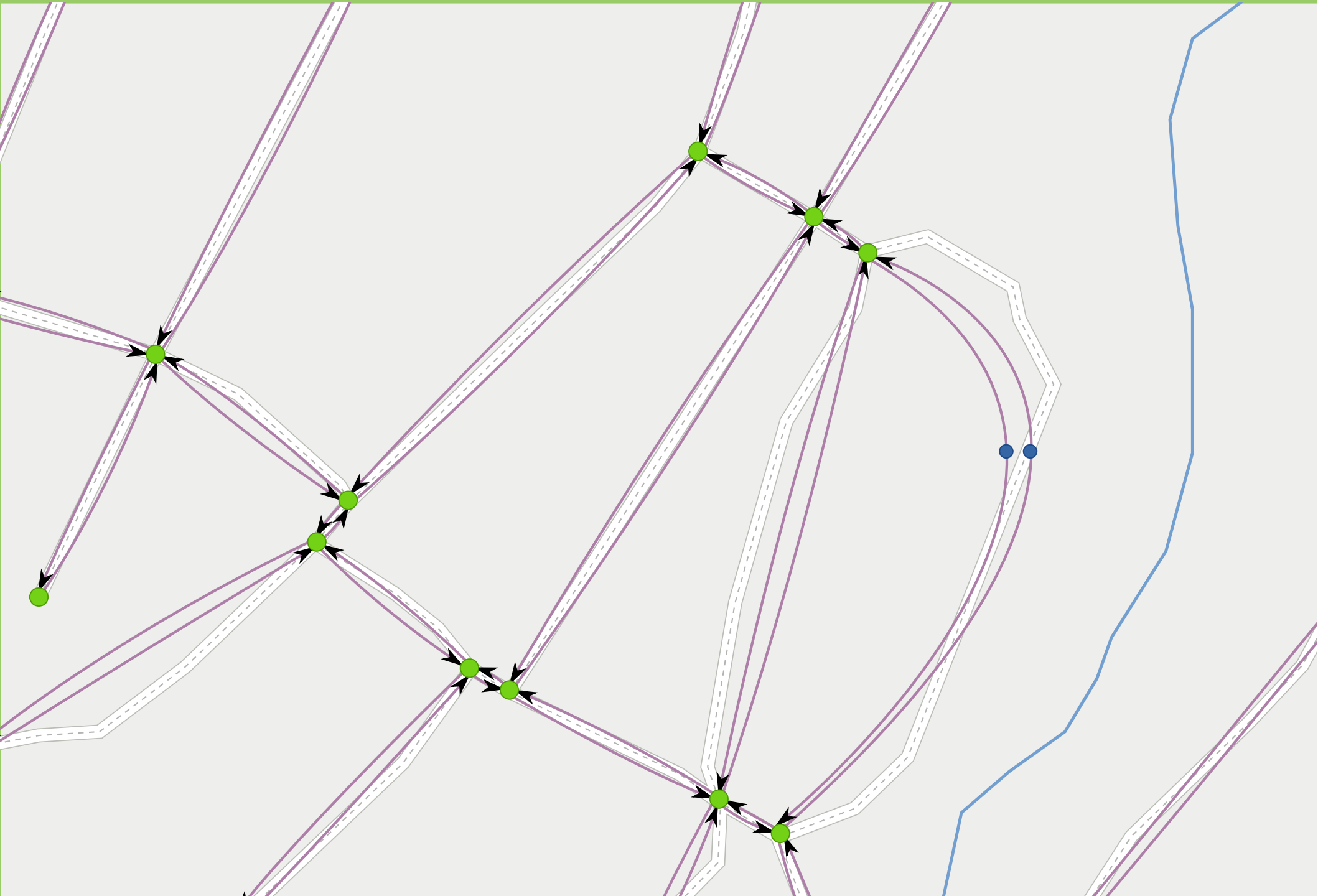
3 apply *restrictions*

4 build *line graph*

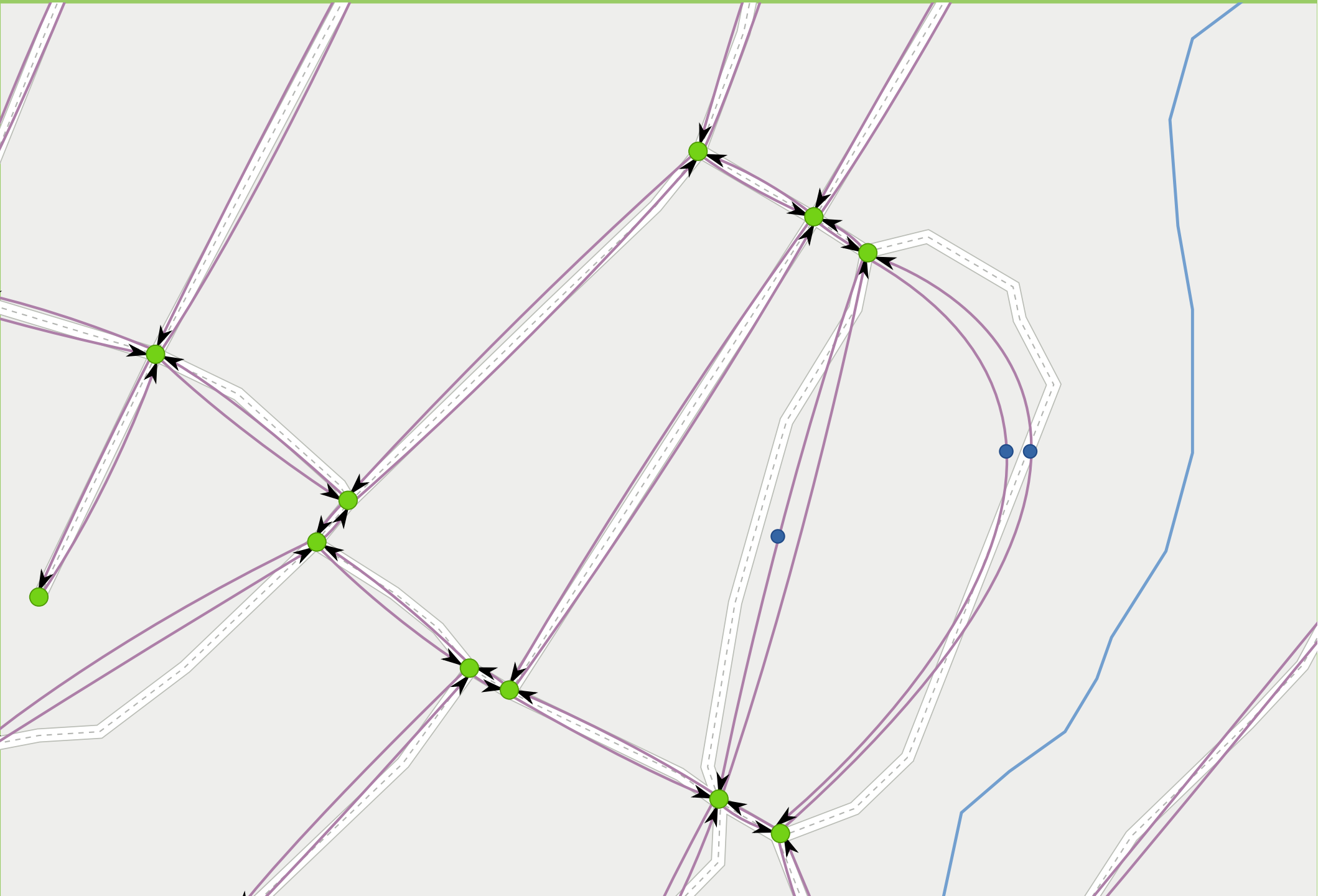
4. line graph



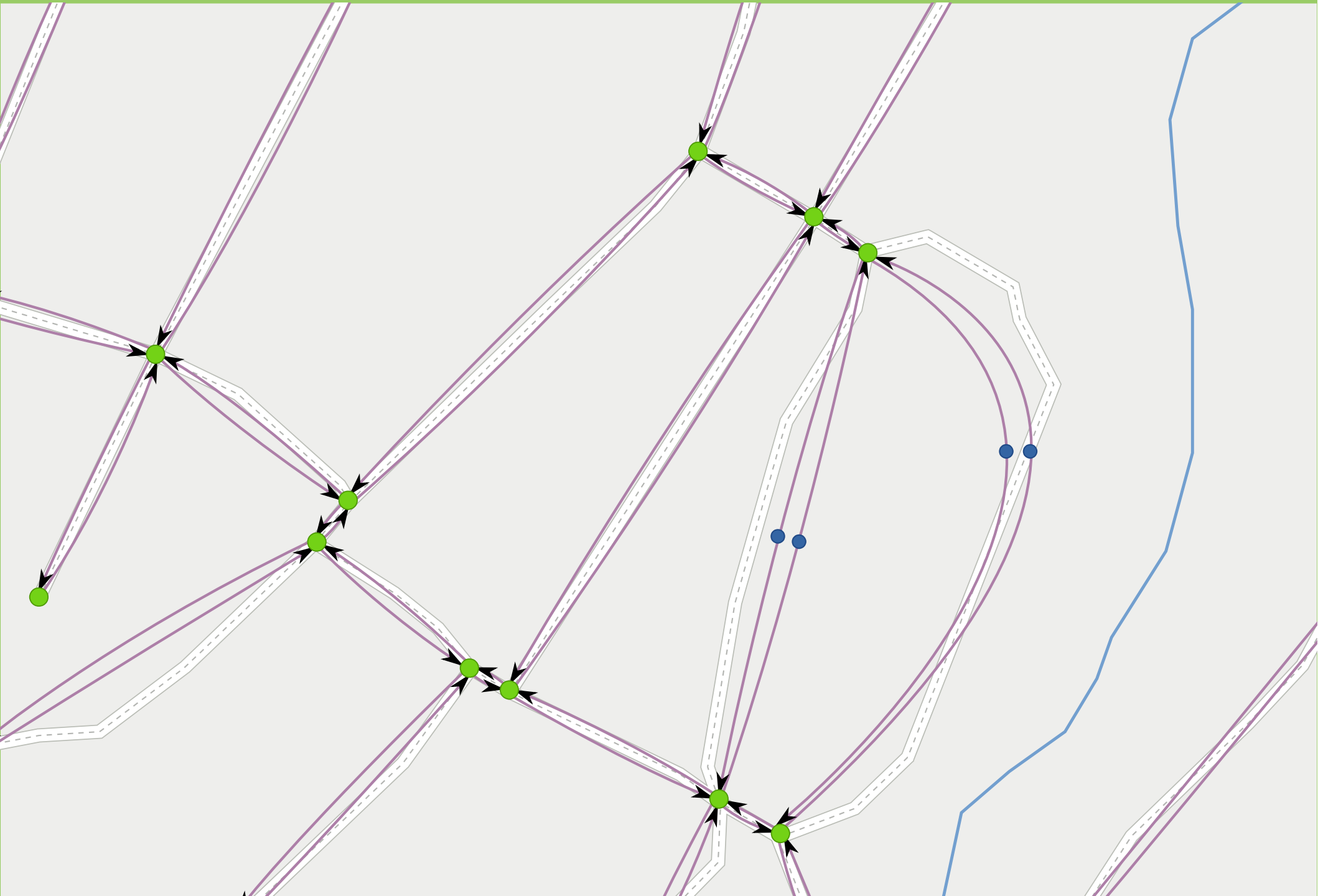
4. line graph



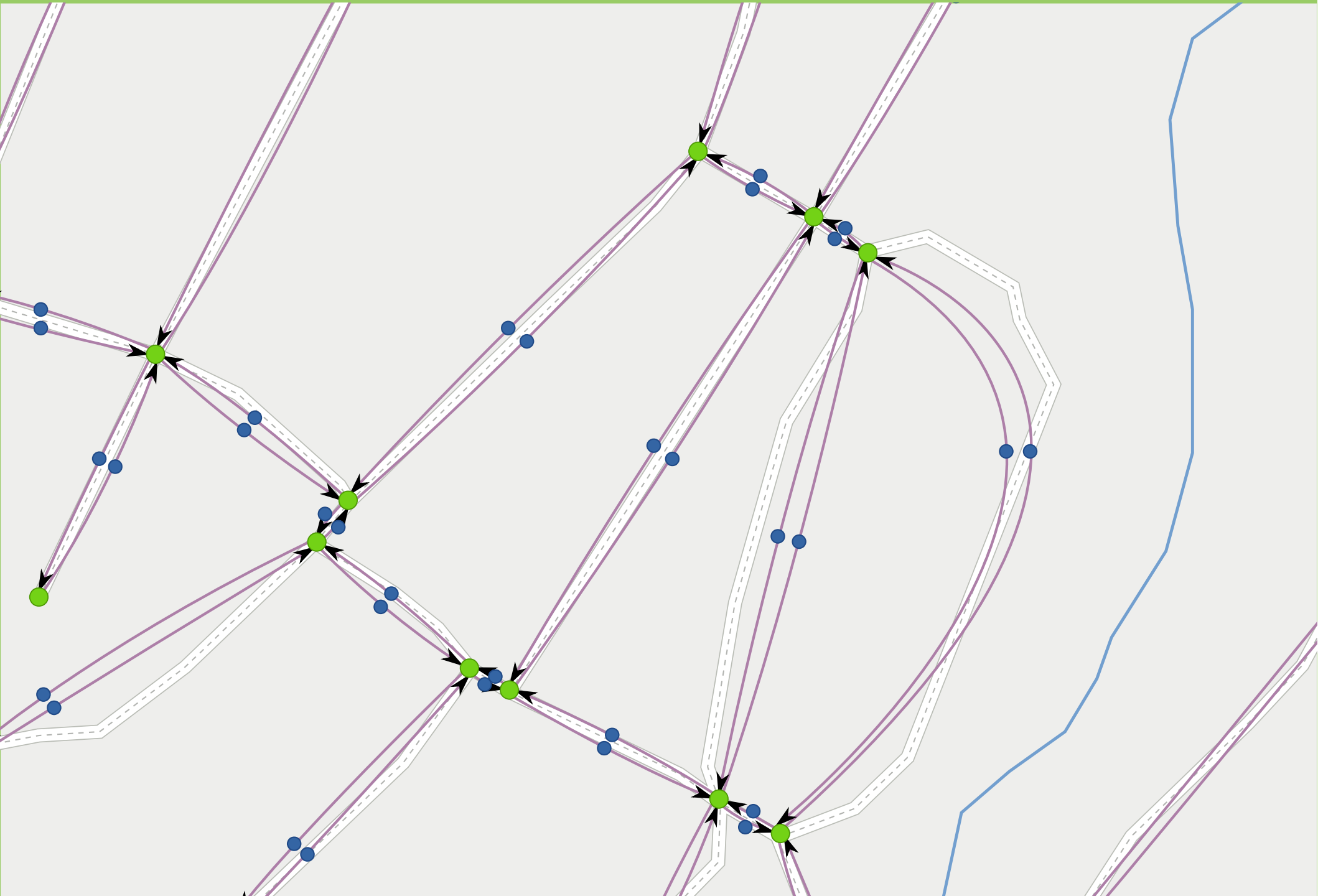
4. line graph



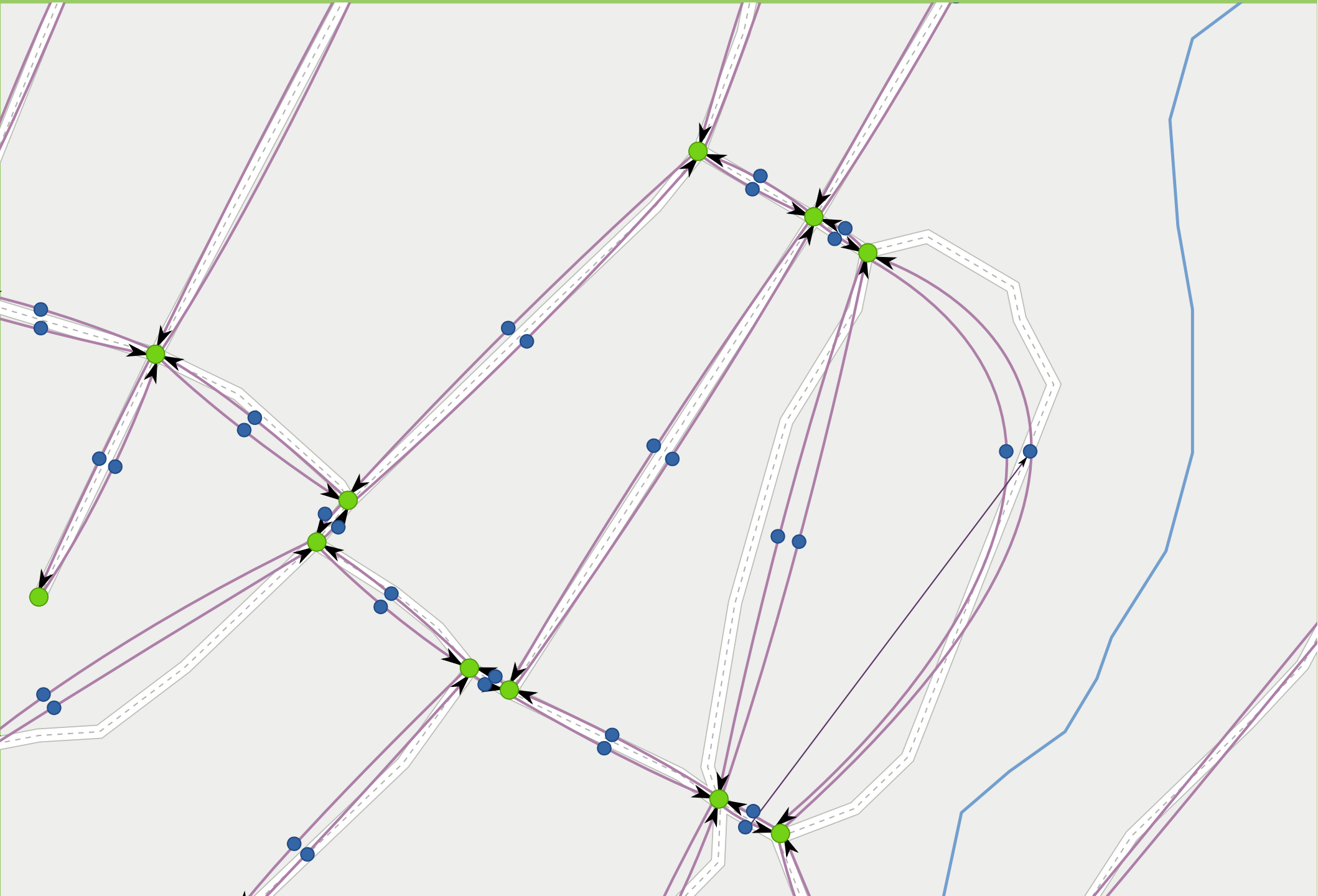
4. line graph



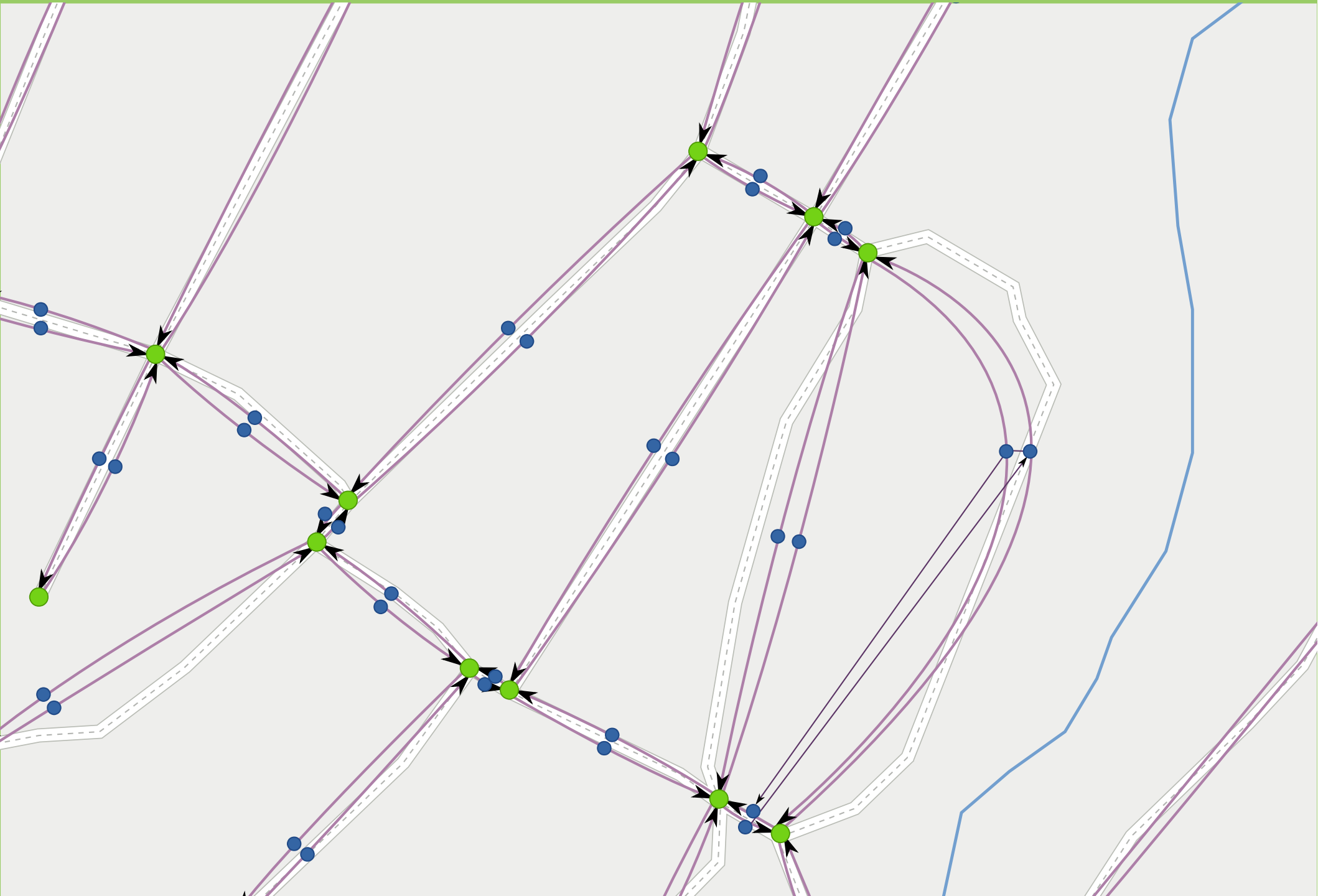
4. line graph



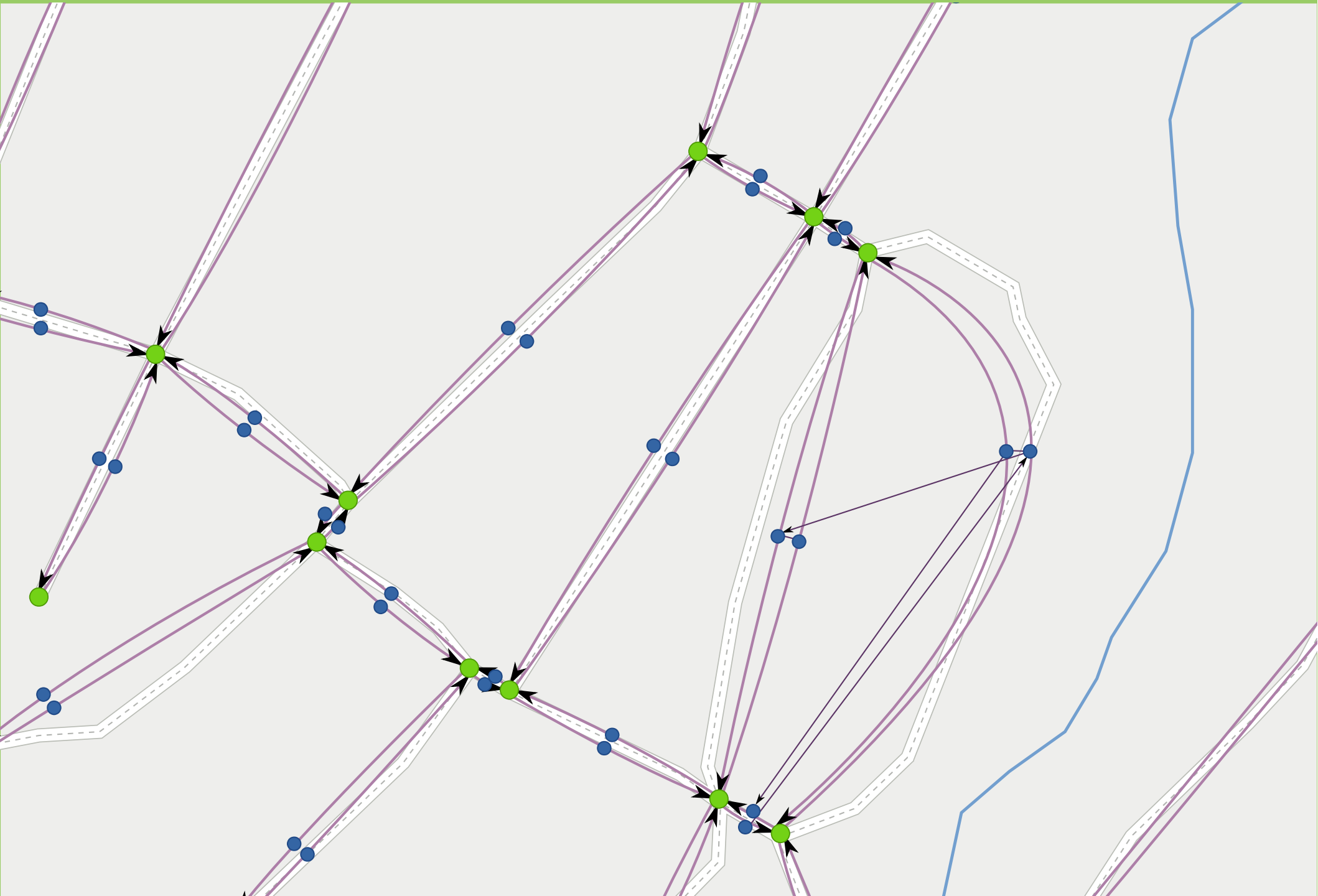
4. line graph



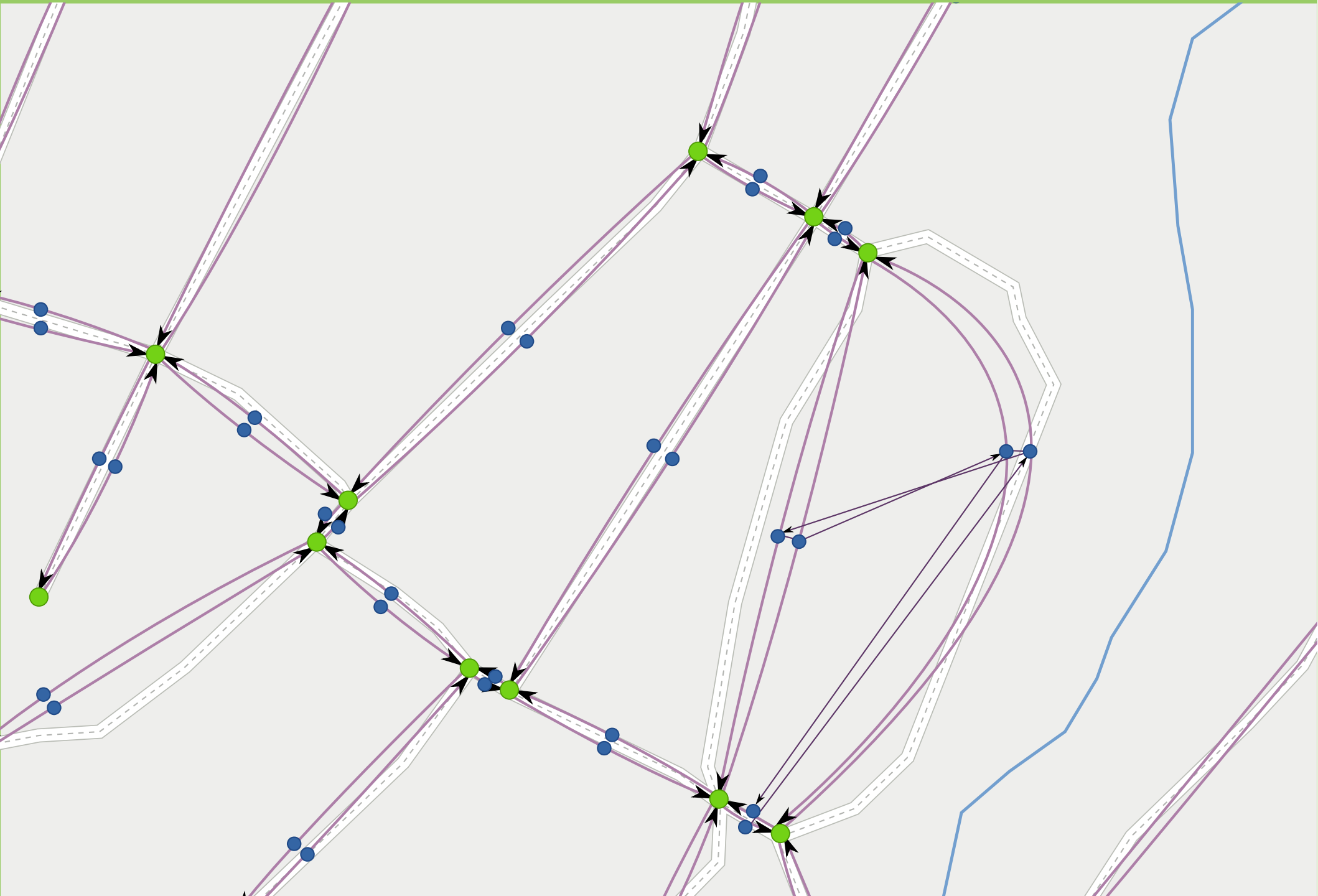
4. line graph



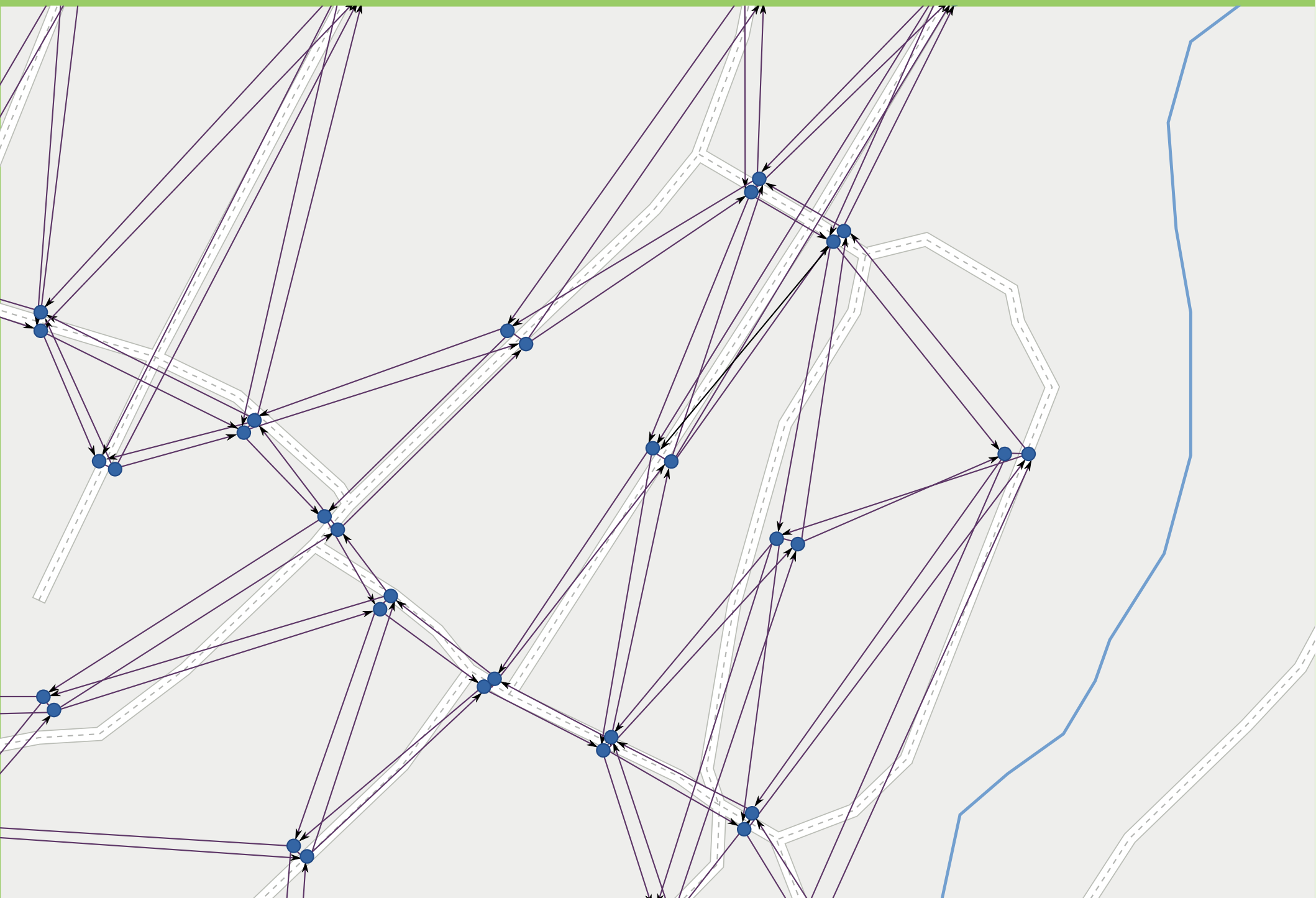
4. line graph



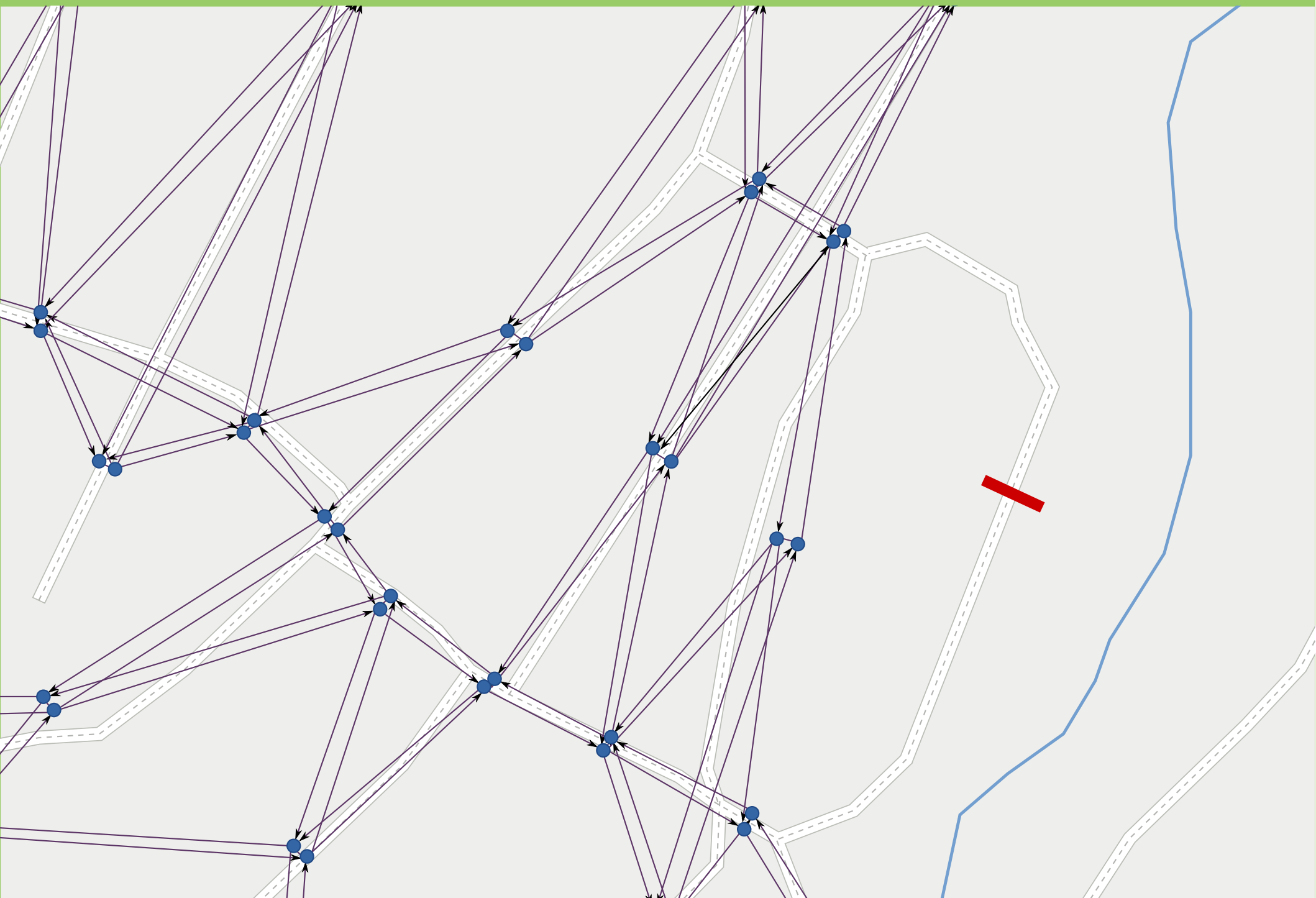
4. line graph



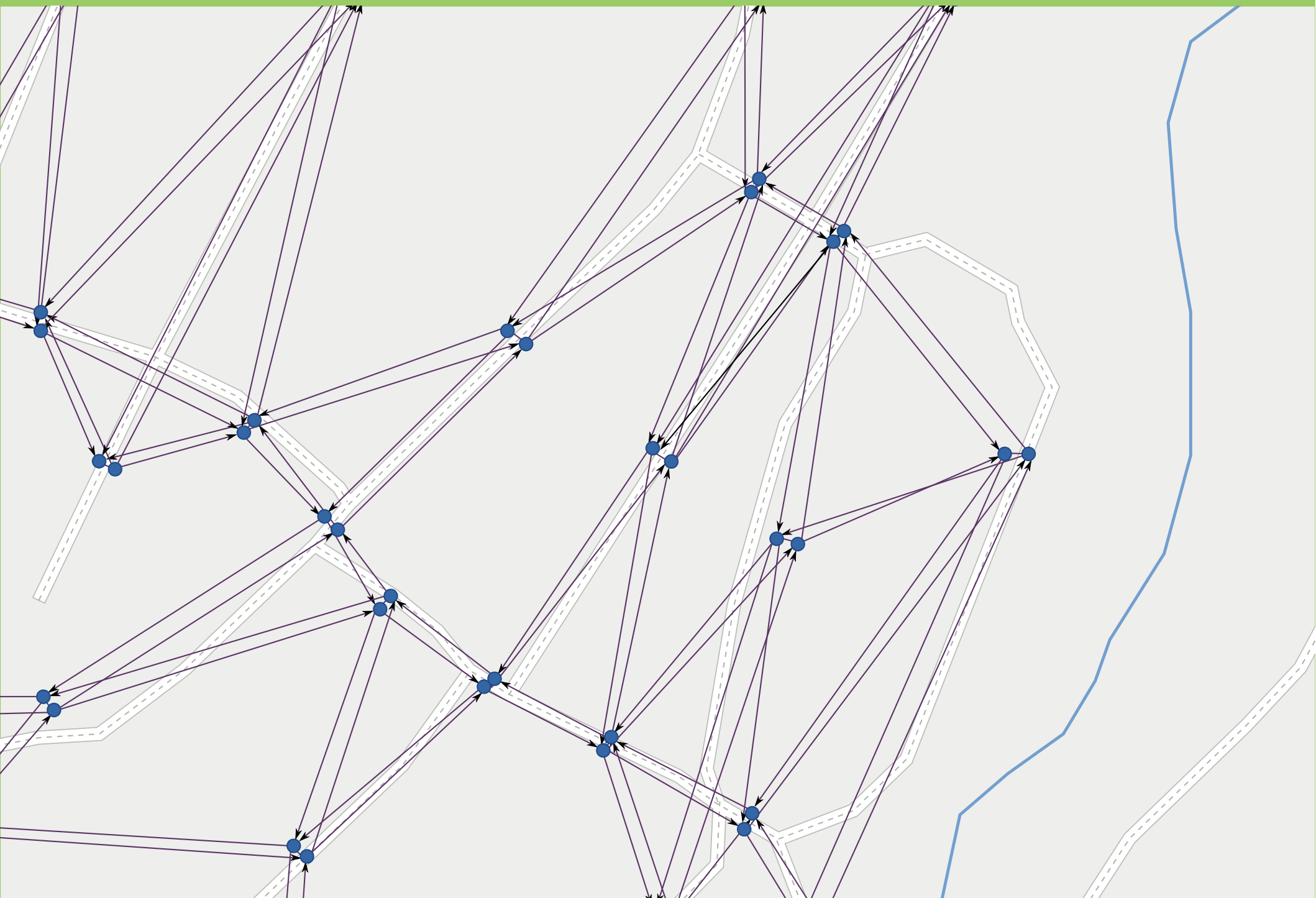
4. line graph



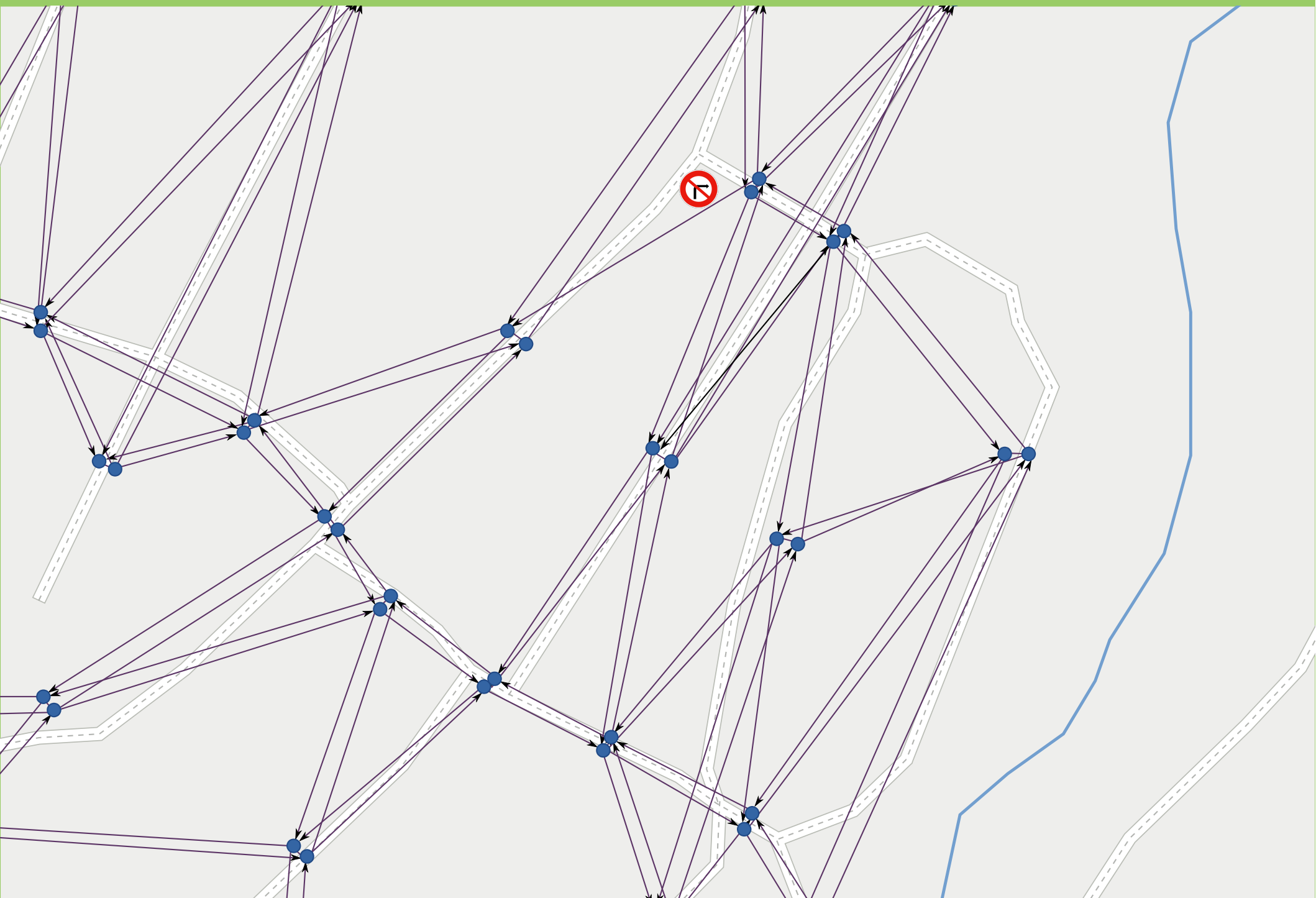
4. line graph



4. line graph



4. line graph



4. line graph

tool:

Boost graph library

```
typedef boost::adjacency_list  
    < boost::listS, boost::vecS, boost::directedS,  
        LineGraphNode, LineGraphLine >  
    LineGraphType;
```



remarks

preliminary

preliminary

load *map* data

preliminary

load *map* data

build *topology*

preliminary

load *map* data

build *topology*

on demand

preliminary

load *map* data

build *topology*

on demand

apply *restrictions*

preliminary

load *map* data

build *topology*

on demand

apply *restrictions*

build *line graph*

configurable

configurable

json

file
for

settings

configurable

json

file
for

settings

database

configurable

json

file
for

settings

database, vehicle properties

configurable

json

file
for

settings

database, vehicle properties,
road speeds

configurable

json

file
for

settings

database, vehicle properties,
road speeds, surfaces

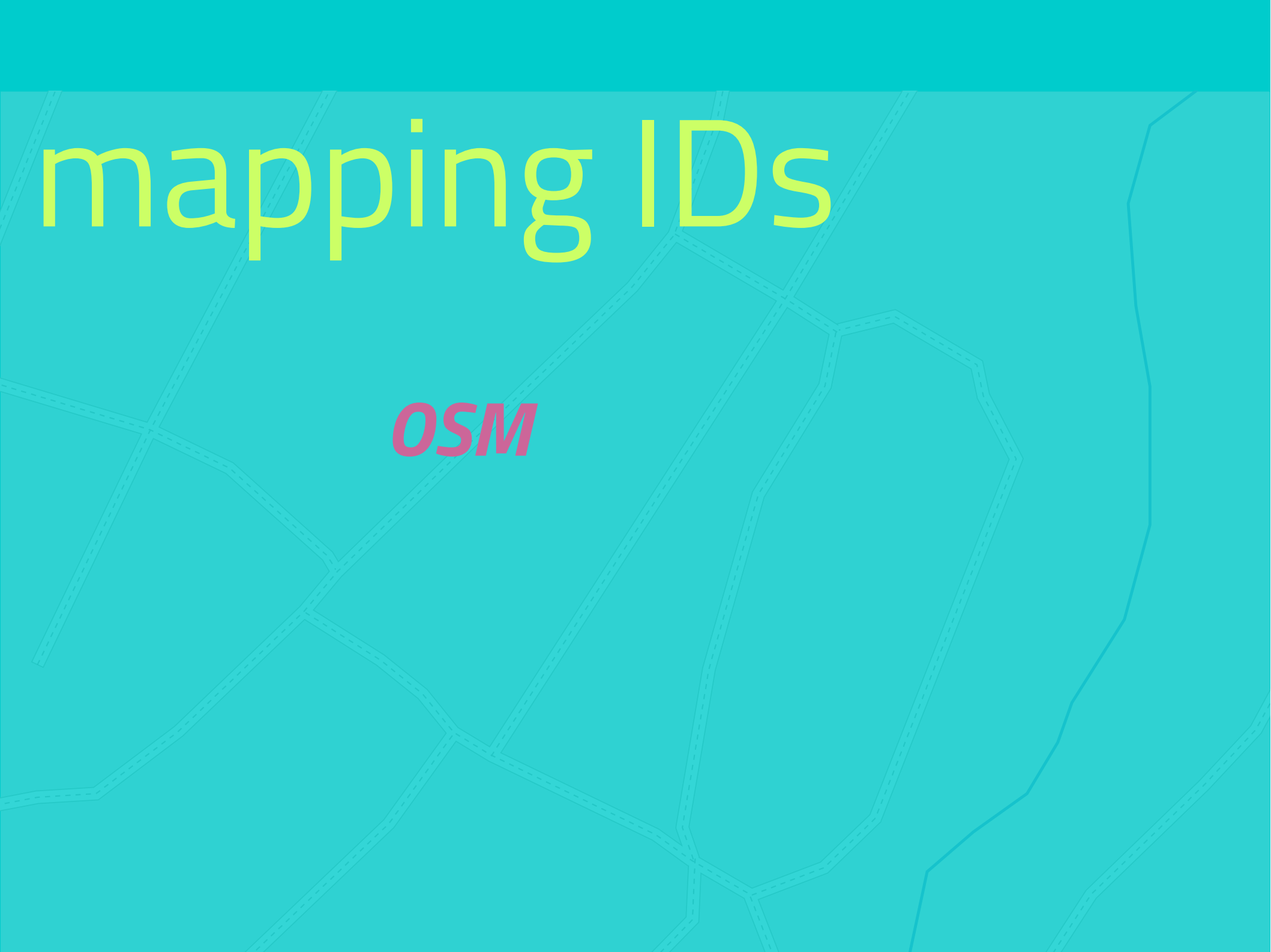
configurable

json

file
for

settings

database, vehicle properties,
road speeds, surfaces,
restrictions and costs, ...



mapping IDs

OSM

mapping IDs

An abstract network diagram is overlaid on a teal background. It consists of several thin green lines that intersect at various points, marked by small green dots. The lines form a complex web of connections, with some lines being straight and others slightly curved. The dots are positioned at the intersections and along the lines, suggesting nodes or data points within a network.

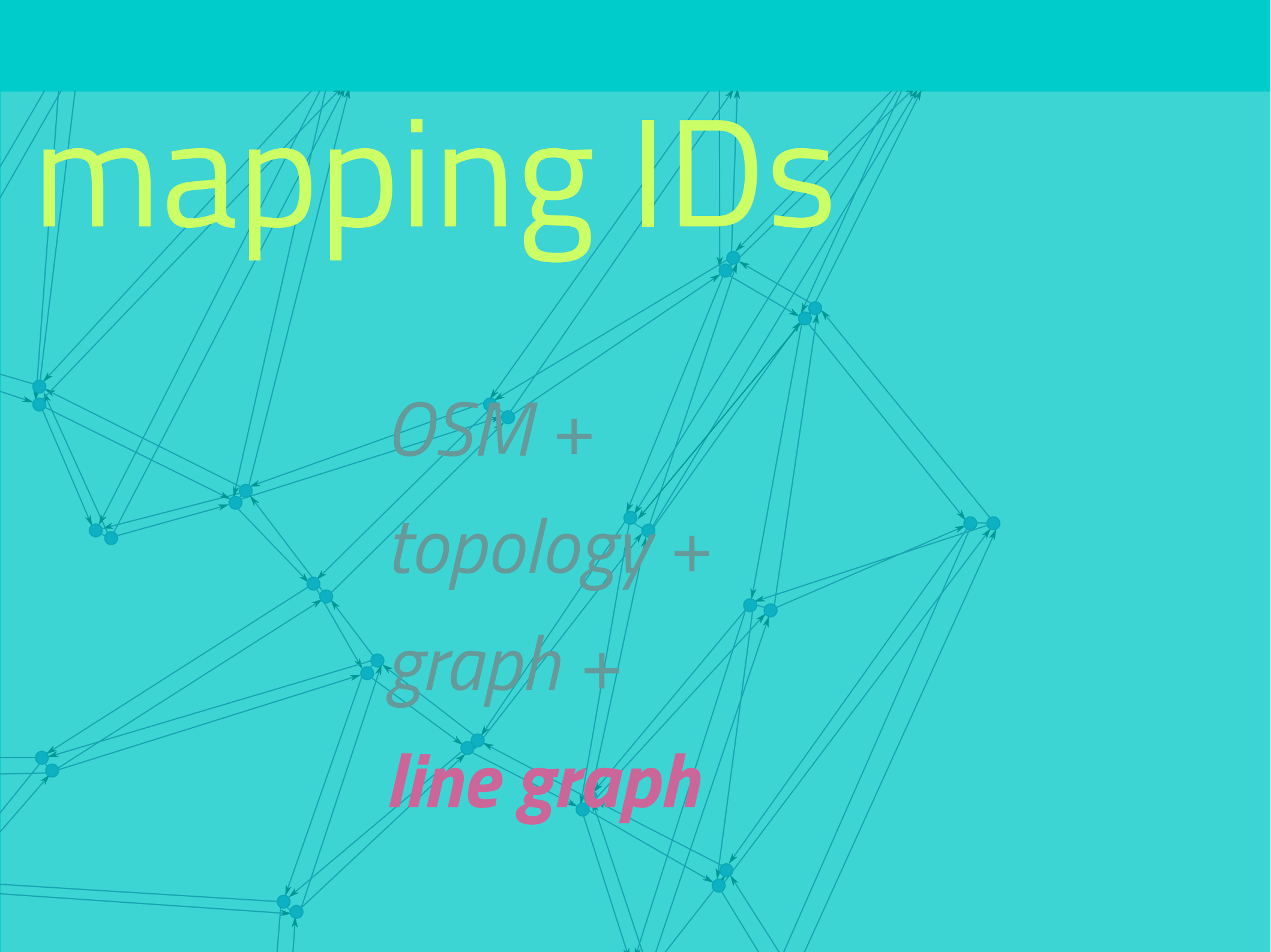
OSM +

topology

mapping IDs

*OSM +
topology +
graph*

A network graph is overlaid on a teal background. The graph consists of approximately 12 green circular nodes connected by thin blue lines representing edges. Some edges are straight, while others are curved. The nodes are distributed across the frame, with a higher concentration in the center and bottom-right areas. The overall aesthetic is clean and technical.



mapping IDs

OSM +

topology +

graph +

line graph

restrictions

Values:

yes

restrictions

Values:

yes,

no

restrictions

Values:

yes, no,

permissive

restrictions

Values:

yes, no, permissive,

designated

restrictions

Values:

yes, no, permissive, designated,

private

restrictions

Values:

yes, no, permissive, designated, private,

discouraged

restrictions

Values:

yes, no, permissive, designated, private, discouraged,

delivery

restrictions

Values:

yes, no, permissive, designated, private, discouraged, delivery,

customers...

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all,

foot

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot,

vehicle

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle,

bicycle

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle,

motor_vehicle

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle,

motorcycle

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle,

motorcar

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar,

goods

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar, goods,

hgv

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar, goods, hgv ...

by use:

psv

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar, goods, hgv ...

by use:

psv,

car_sharing

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar, goods, hgv ...

by use:

psv, car_sharing,

emergency

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar, goods, hgv ...

by use:

psv, car_sharing, emergency,

hazmat

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar, goods, hgv ...

by use:

psv, car_sharing, emergency, hazmat,

disabled

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar, goods, hgv ...

by use:

psv, car_sharing, emergency, hazmat, disabled ...

restrictions

values:

yes, no, permissive, designated, private, discouraged, delivery, customers ...

routing:

one-way (explicit / implicit), lanes ...

transportation mode:

all, foot, vehicle, bicycle, motor_vehicle, motorcycle, motorcar, goods, hgv ...

by use:

psv, car_sharing, emergency, hazmat, disabled ...

dimensions:

max height, weight, width ...

conditional restrictions



conditional restrictions



Photo (cropped): Achadwick. ©CC-SA 2.0

http://wiki.openstreetmap.org/wiki/File:UK_motor_restriction_sign_with_exceptions.jpg

motor_vehicle=no

motor_vehicle:conditional=yes @ (18:30-07:30)

psv=yes

conditional restrictions

```
maxspeed=none  
maxspeed:conditional=  
    120 @ (06:00-20:00);  
    100 @ (22:00-06:00)
```

turning restrictions

Relation:

turning restrictions

Relation:

from

turning restrictions

Relation:

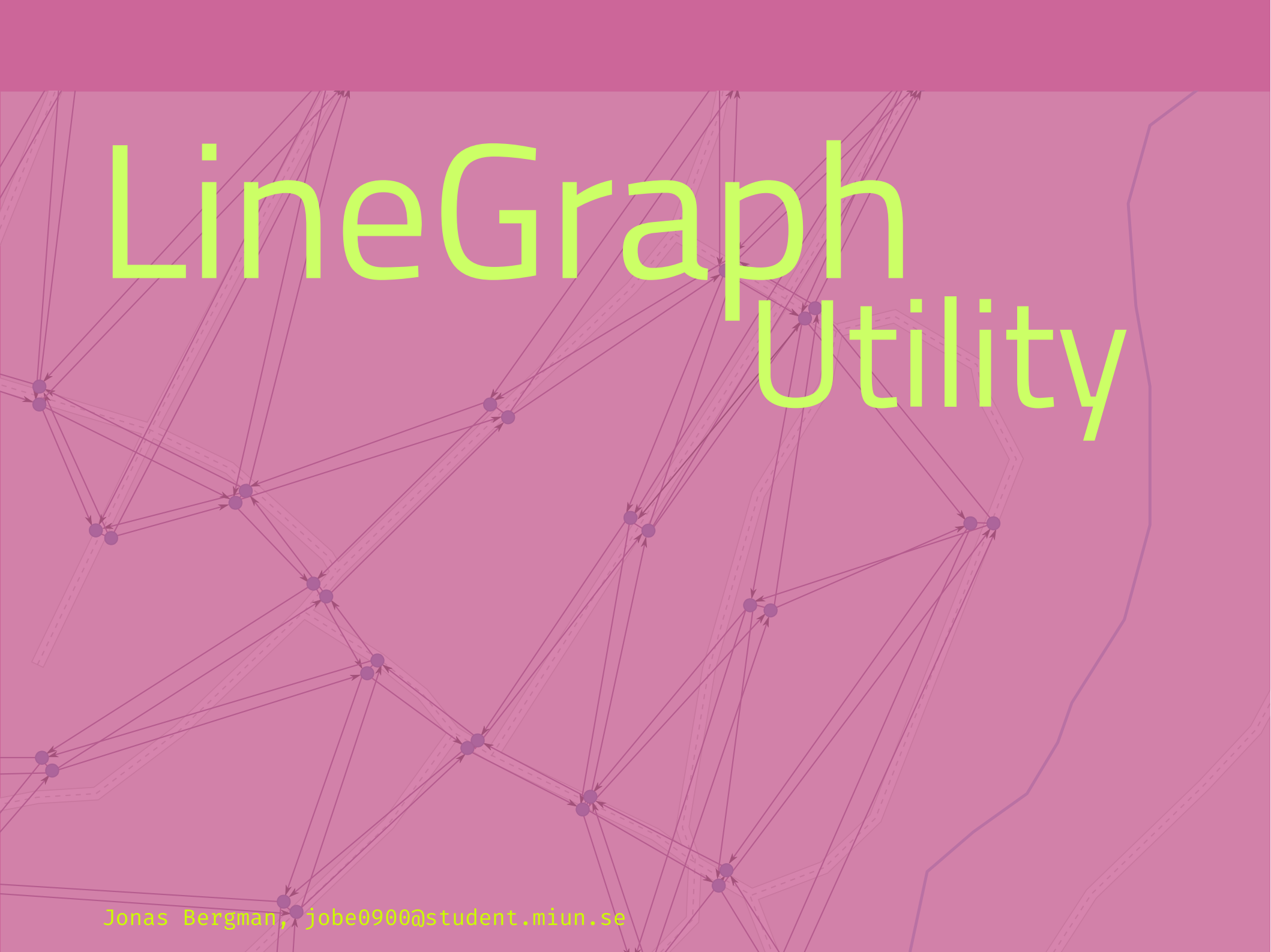
from \rightarrow *via*

turning restrictions

Relation:

from \rightarrow via \rightarrow *to*

LineGraph Utility

The background of the slide features a light purple map of a road network. Overlaid on this map is a complex graph structure. The graph consists of numerous small, dark purple circular nodes. These nodes are interconnected by a dense web of thin, dark purple lines representing edges. Some of these edges are directed, as indicated by small arrowheads. The graph appears to be a utility or network graph, possibly representing a road network or a data flow system. The overall aesthetic is technical and modern, with a monochromatic purple color scheme.