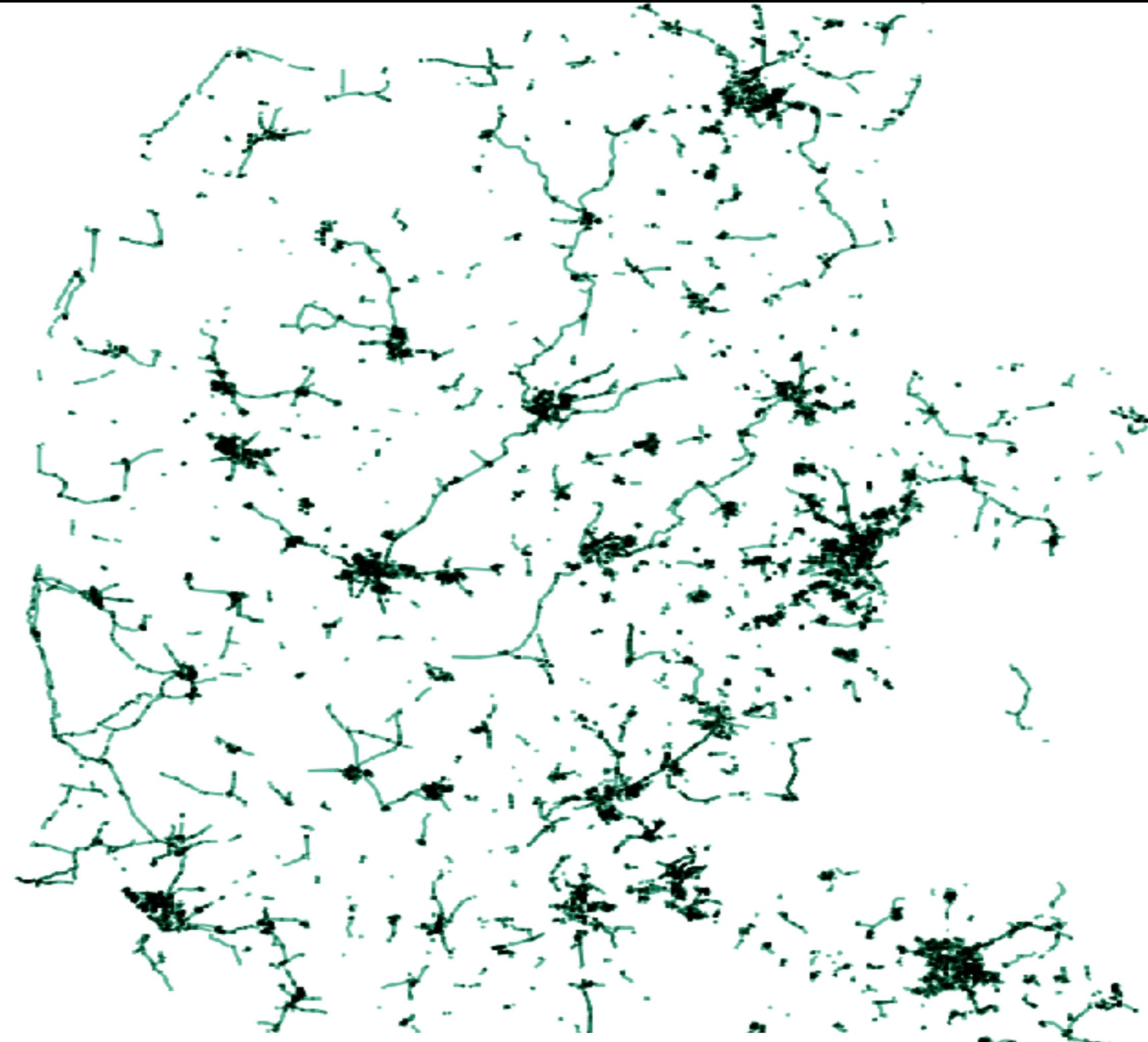


# Netværksanalyse af den danske cykelinfrastruktur



Michael Szell  
with  
Ane Rahbek Vierø



NEtwoRks, Data, and Society (NERDS) [nerds.itu.dk](http://nerds.itu.dk)

IT UNIVERSITY OF COPENHAGEN

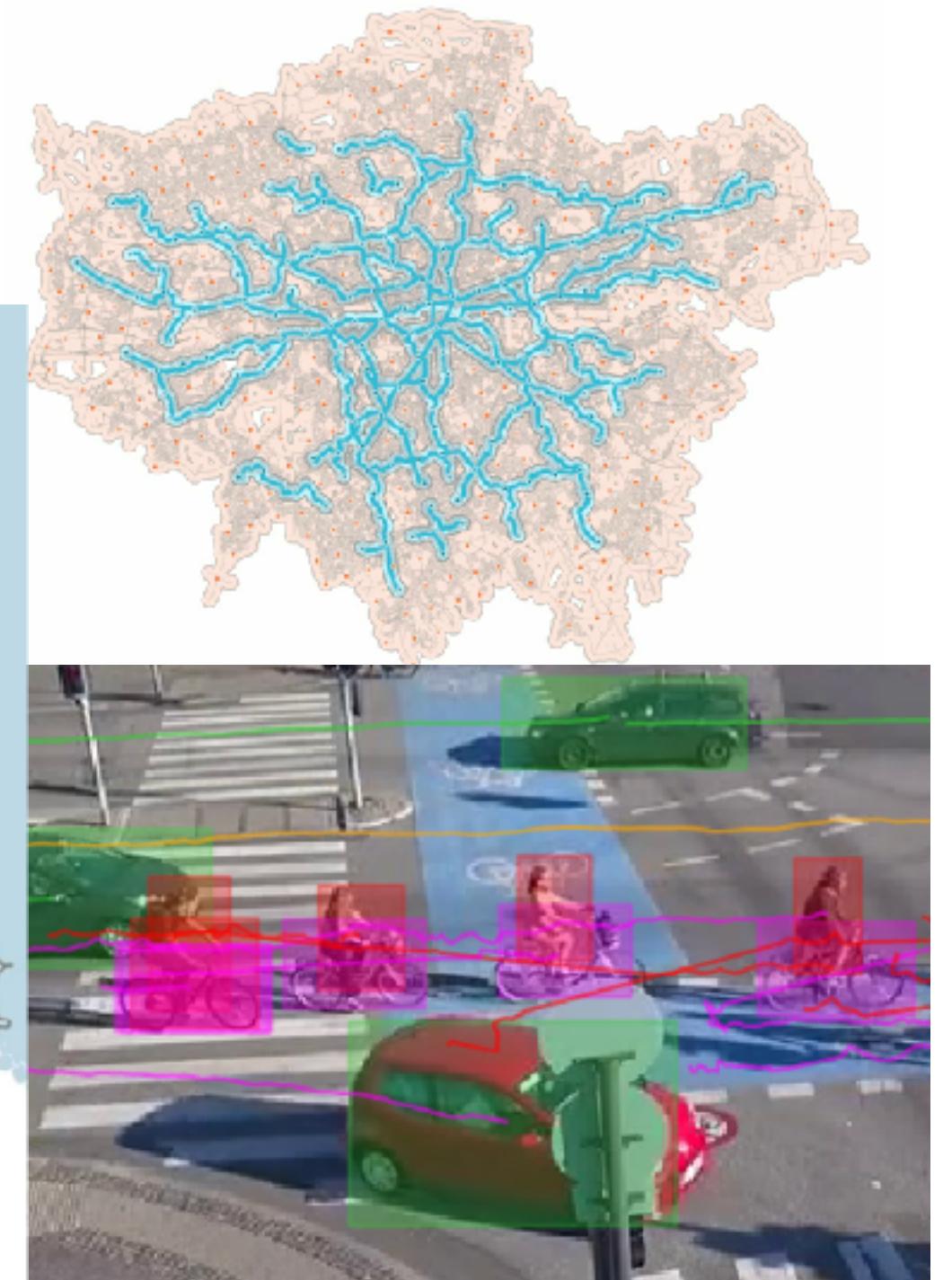
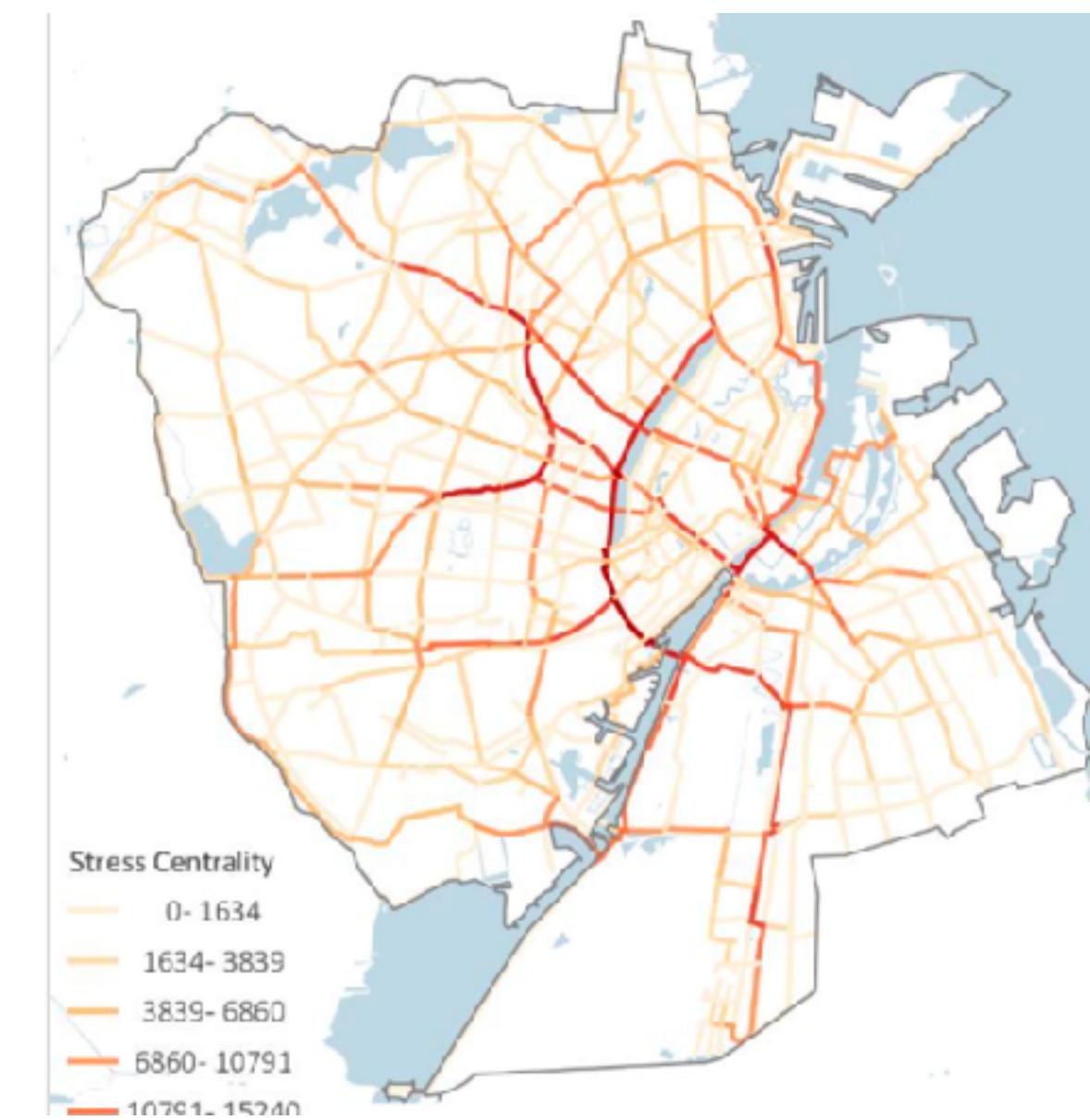
# We are NERDS

NEtwoRks, Data, and Society [nerds.itu.dk](http://nerds.itu.dk)

14 members, founded 2019

Network/Data science expertise from MIT, Harvard, ...

~6 of us do cycling research



# The plan

# Netværksanalyse af den danske cykelinfrastruktur

## Overview

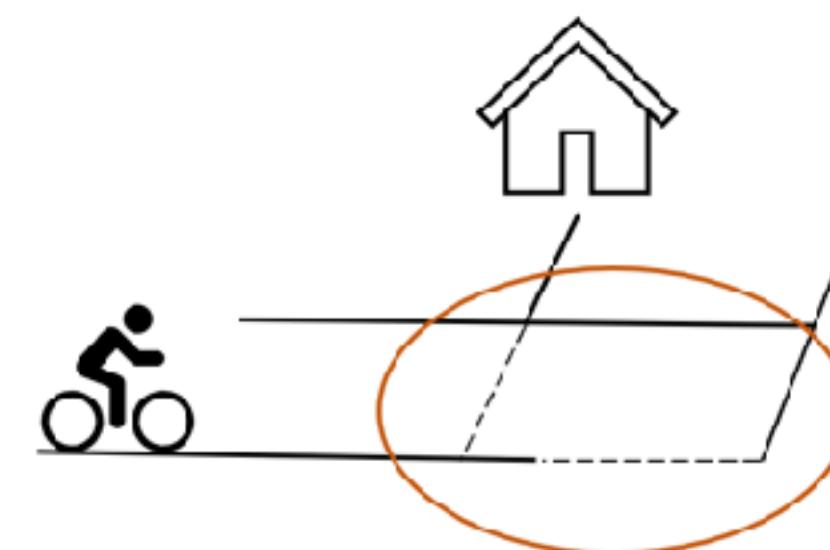
- Funded by Cykelpuljen 2021
- 3 year research project (PhD) since 2022
- Analyzing cycling infrastructure in all of Denmark & across municipal boundaries



# Netværksanalyse af den danske cykelinfrastruktur

## Objectives

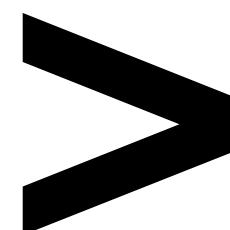
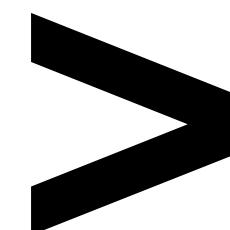
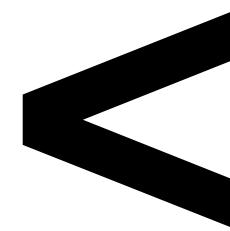
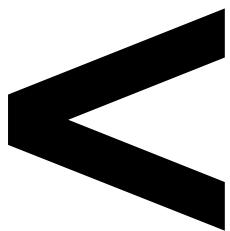
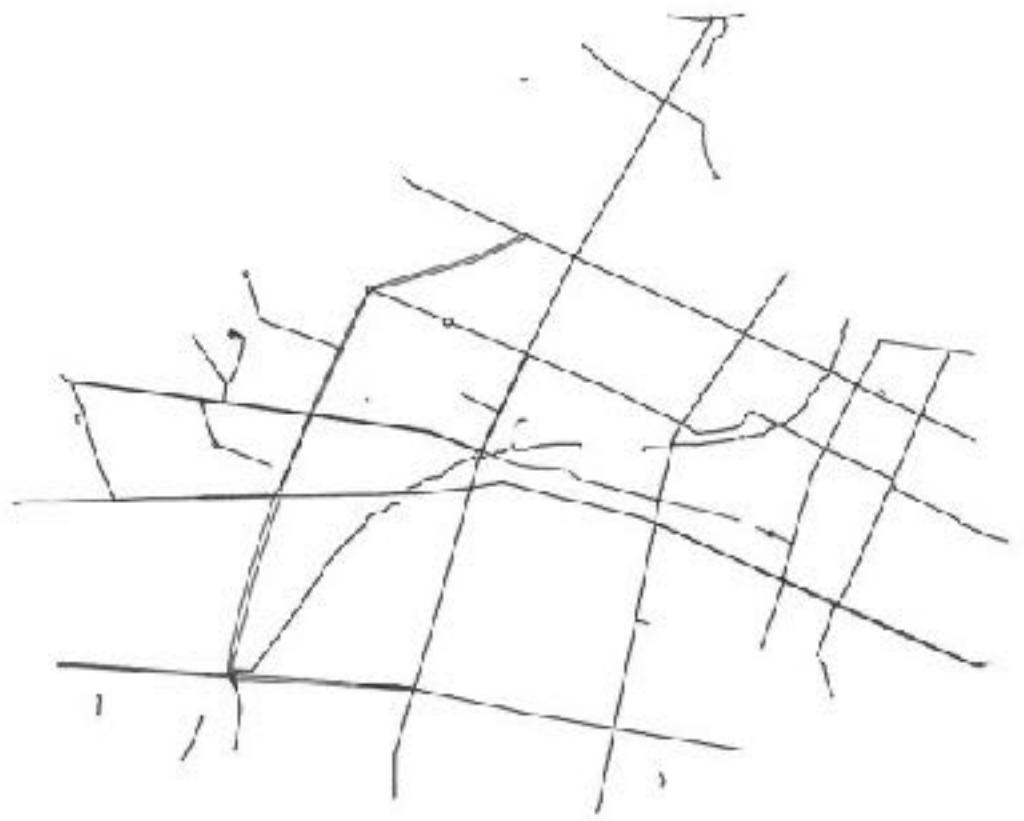
- Quantification of quality of Danish cycling network
- Mapping of cycling accessibility (15 minute city)
- Method for identifying & prioritizing needs for improvements/new infrastructure



Capasso da Silva, King & Lamar, Accessibility: “the ease of reaching destinations” (2019)

# Netværksanalyse af den danske cykelinfrastruktur

Consider accessibility for different needs

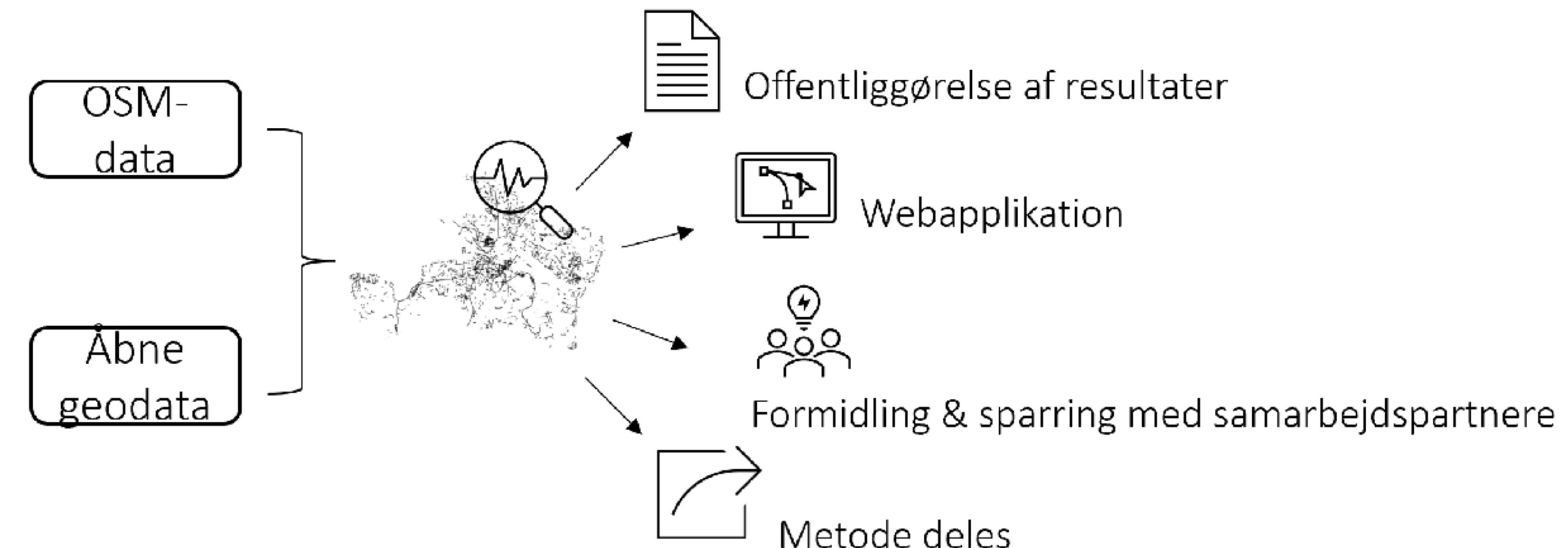


# Netværksanalyse af den danske cykelinfrastruktur

## Expected outcomes

### Methods for...

- Calculating metrics for network quality
- Evaluating cycling accessibility - who can bike where?
- Prioritizing missing links



# Data types

- Road and cycling network geometries
- Lane attributes: width, speed, surface, light,...
- Intersection attributes
- Traffic volume
- Location of services, amenities
- Surroundings?
- ...

# Data sources

- OpenStreetMap
- GeoDanmark & GeoFA
- Municipalities / Opendata.dk
- Vejdirektoratet
- ...



**Geo Danmark**  
– det fælles datagrundlag

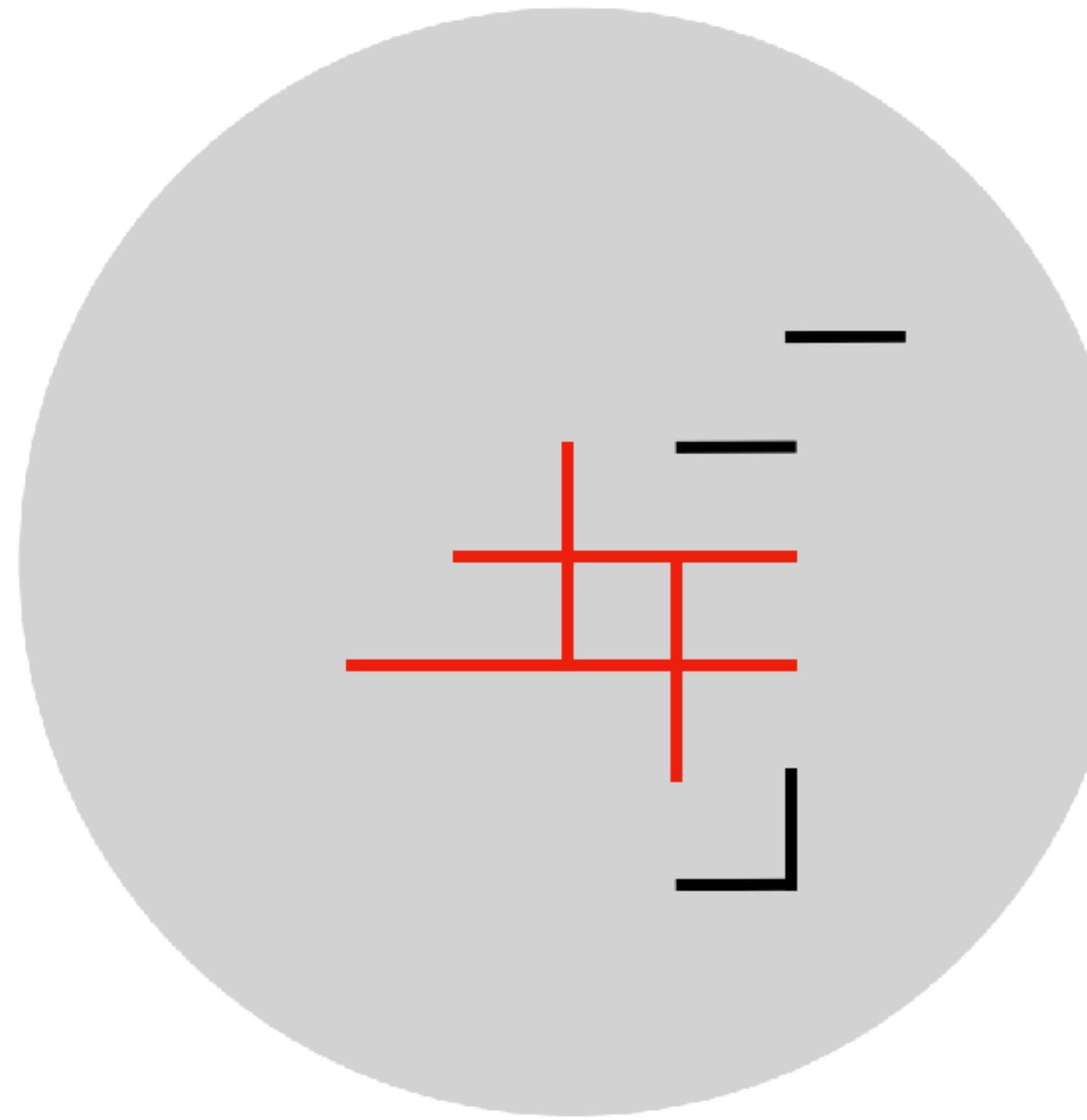
**OPEN DATA DK**

 **Vejdirektoratet**

# The know-how

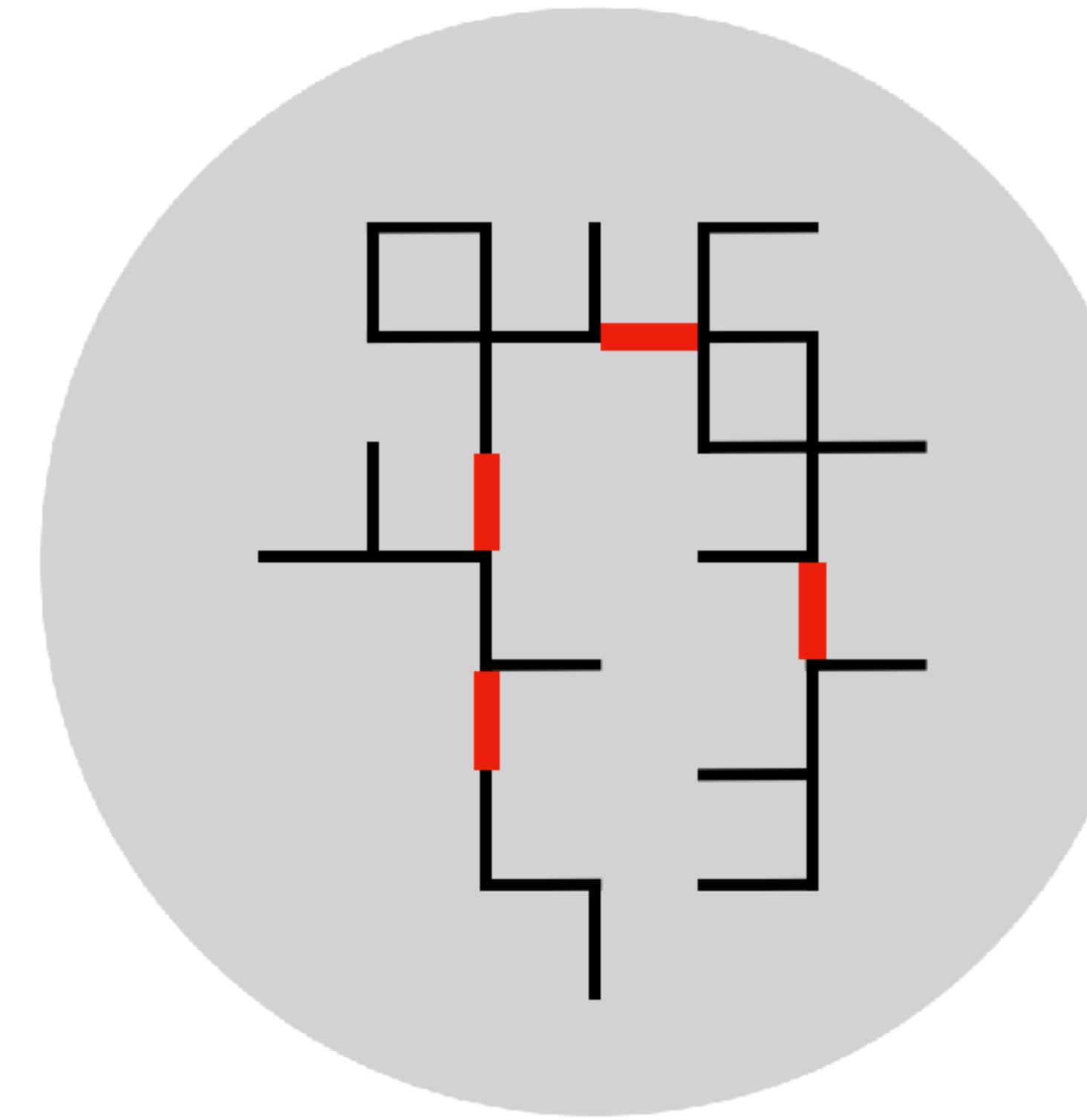
# We build on our experience from 3 finished projects

Most cities  
Not developed



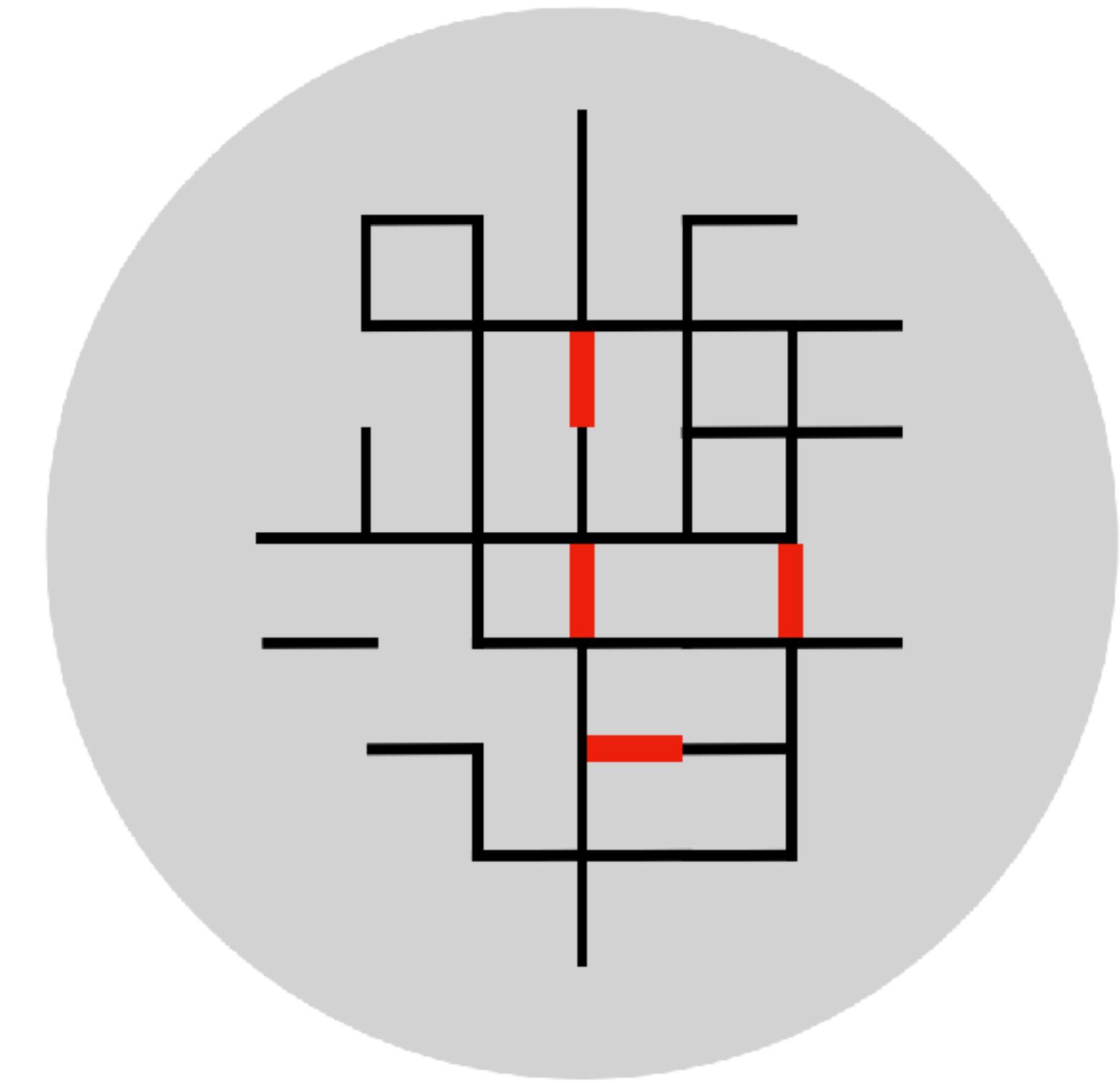
**Grow from scratch**  
GrowBike.Net

Some cities  
Developed but  
disconnected



**Connect components**  
LinkBike.Net

Few cities  
Developed and  
mostly connected



**Find missing links**  
FixBike.Net

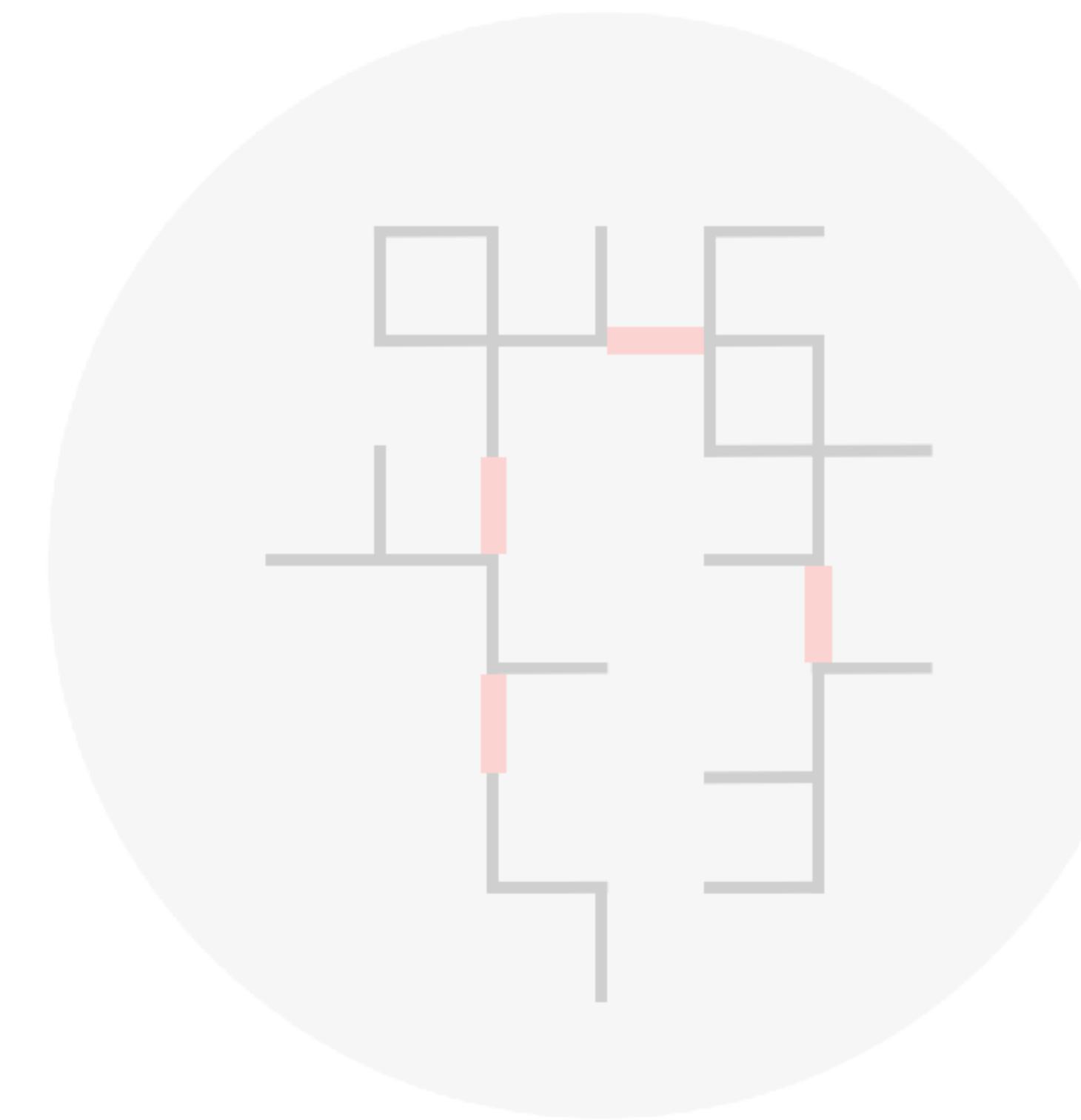
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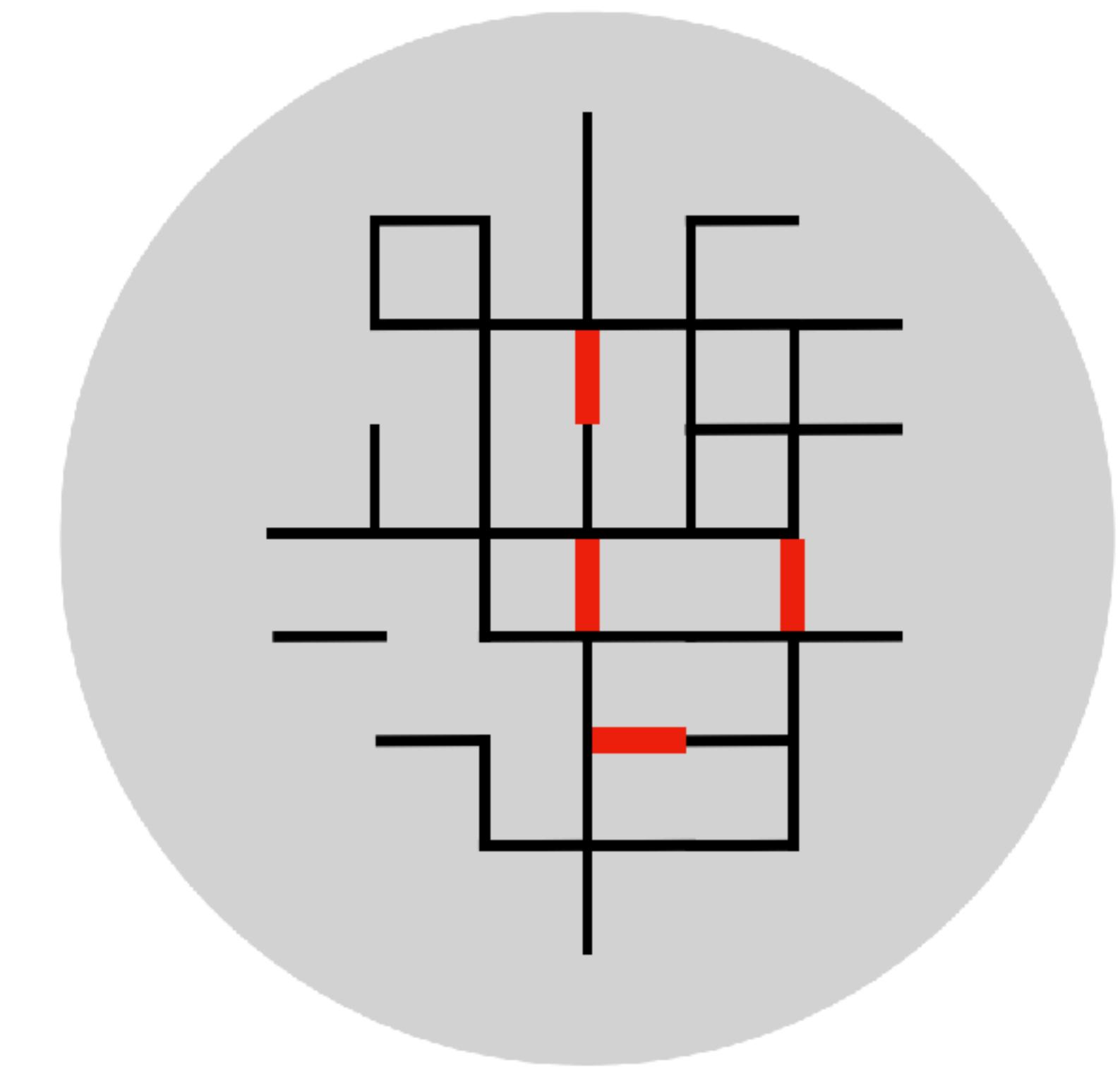
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**Find missing links**  
FixBike.Net

**ORIGINAL ARTICLE**

# **Automated Detection of Missing Links in Bicycle Networks**

**Anastassia Vybornova<sup>1</sup> | Tiago Cunha<sup>1</sup> |  
Astrid Gühnemann<sup>2</sup> | Michael Szell<sup>1,3,4</sup>**

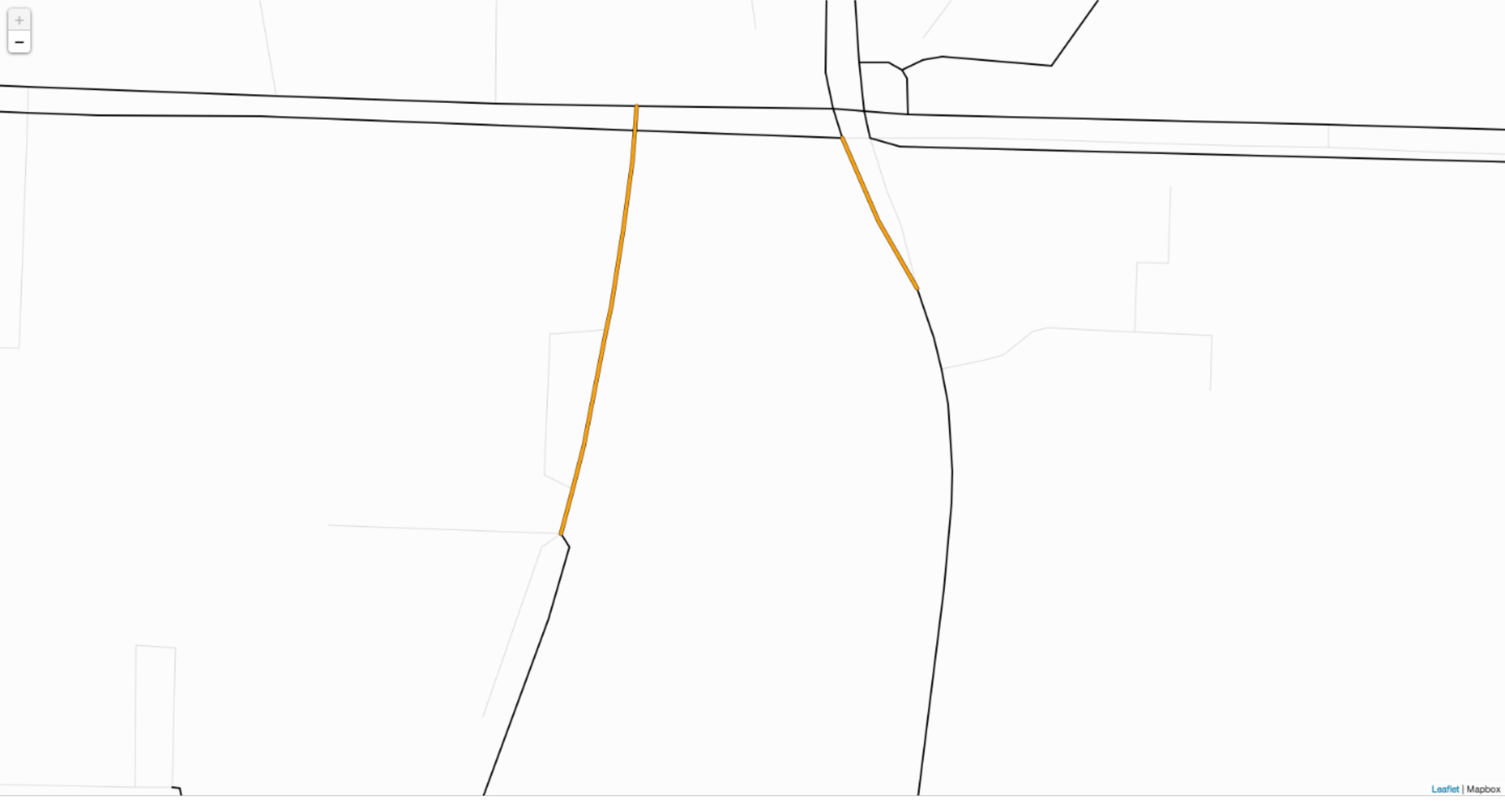
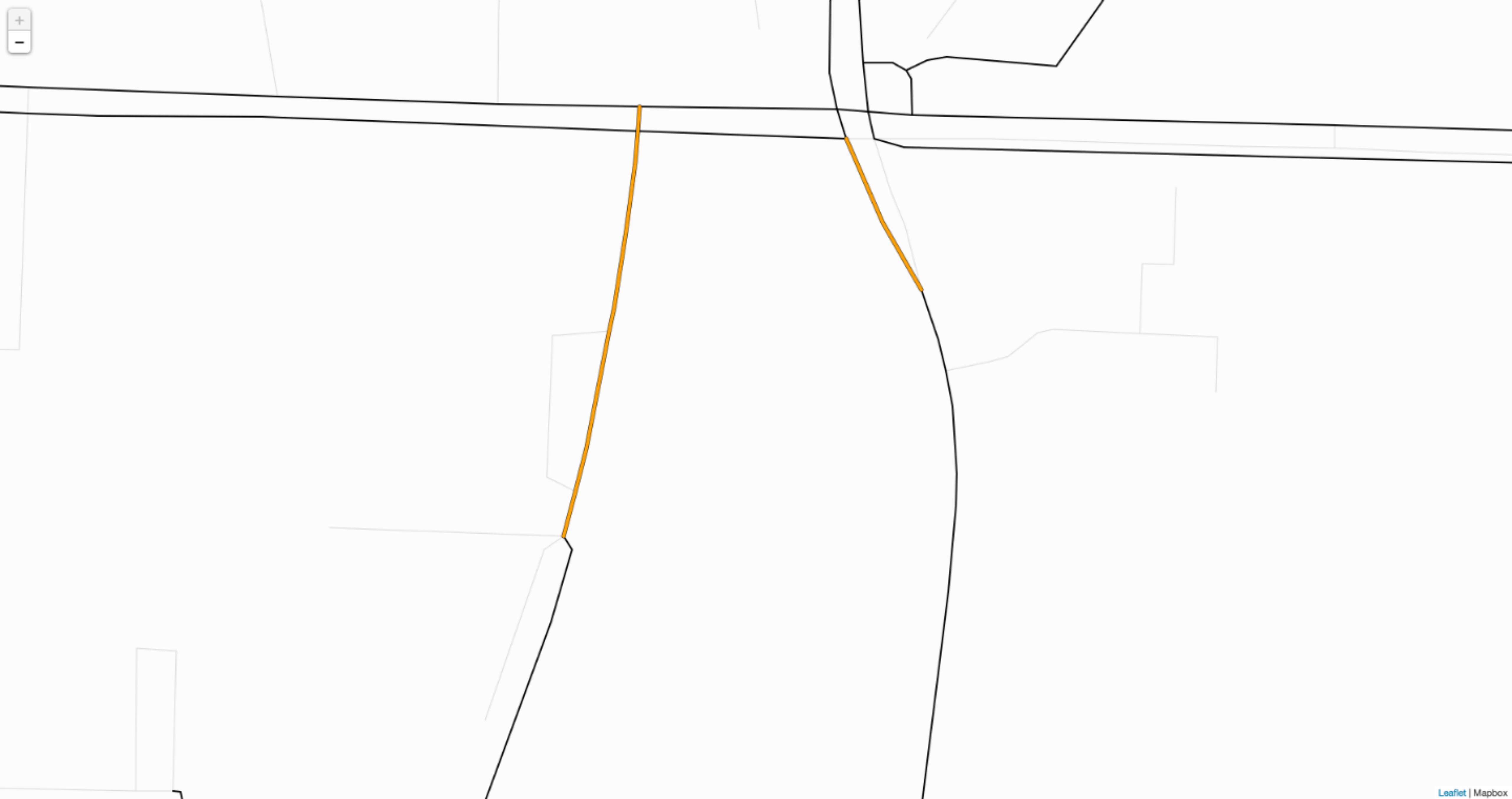


A photograph of a street scene illustrating a protected cycle lane. A blue diagonal band labeled "PROTECTED" indicates the path for cyclists. A red arrow labeled "GAP" points to a gap in the blue line, where a car is parked. The street has white markings and other vehicles are visible in the background.

GAP

PROTECTED





# How to go from map to gap?



# How to go from map to gap? IPDC

- 1) Identify gaps
- 2) Prioritize gaps
- 3) Decluster gaps
- 4) Classify gaps



# 1) Identify: We need a formal definition of “gap”

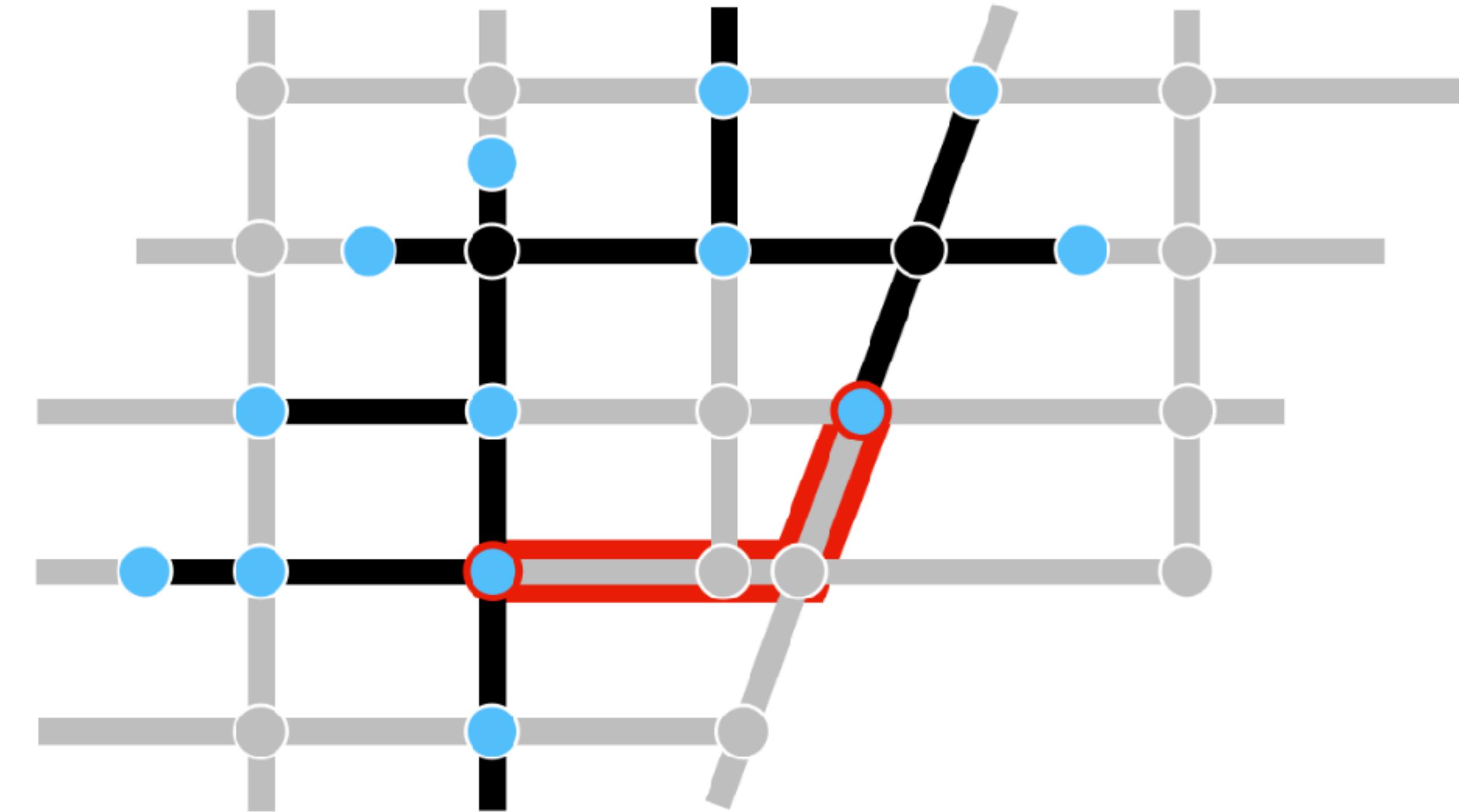
## Multiplex network

### Links

- 1) unprotected
- 2) protected

### Nodes

- 1) unprotected
- 2) protected
- 3) contact



A **gap** is a shortest path  
between two **contact nodes**  
that consists only of **unprotected links**

## 2) Prioritize

We could find millions of gaps...

We need a metric to prioritize them.



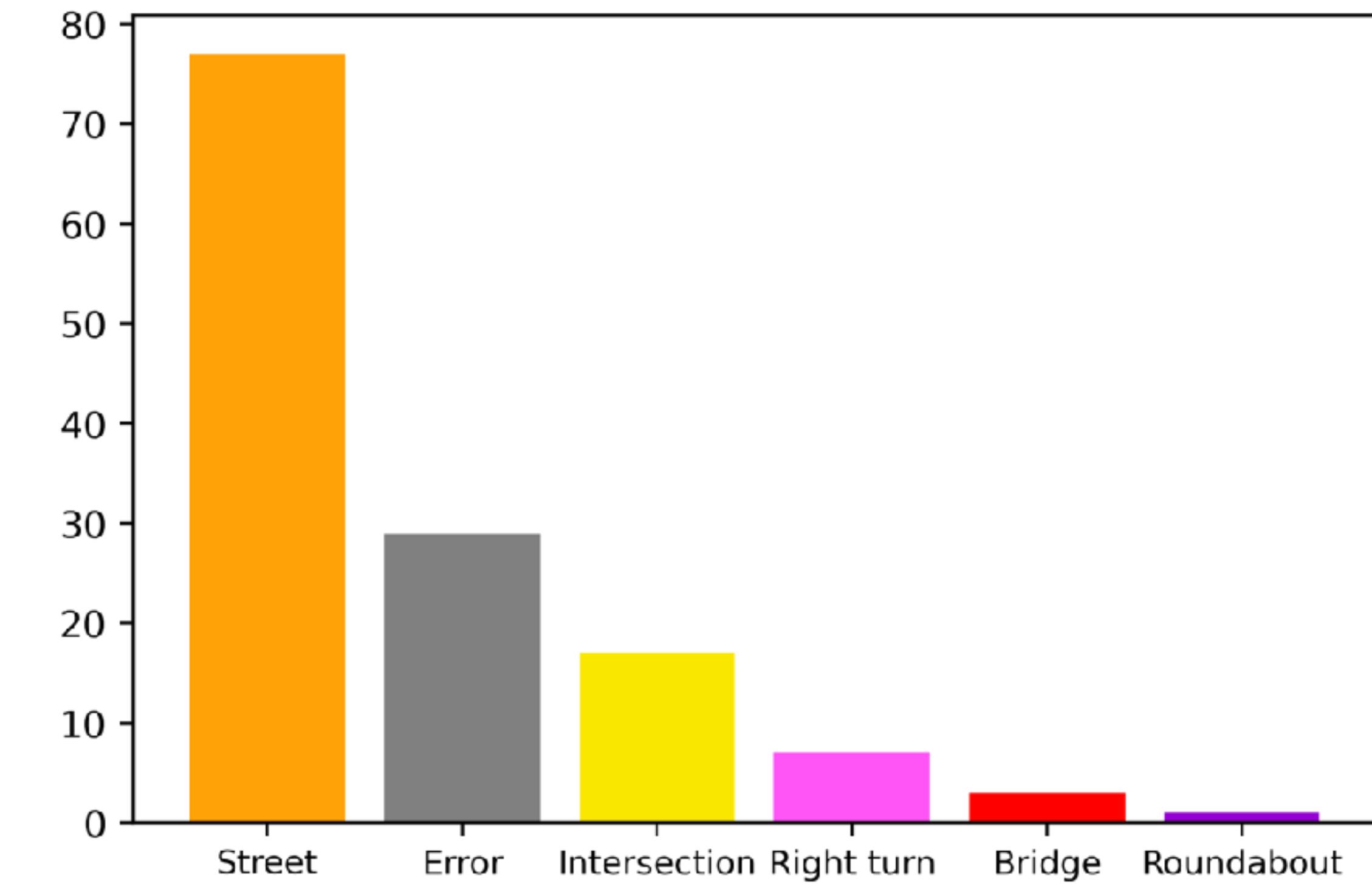
## 2) Prioritize



“If this gap was closed, how many meters cycled in mixed traffic would be avoided per investment unit?”



#### 4) Classify: Our top 105 gaps

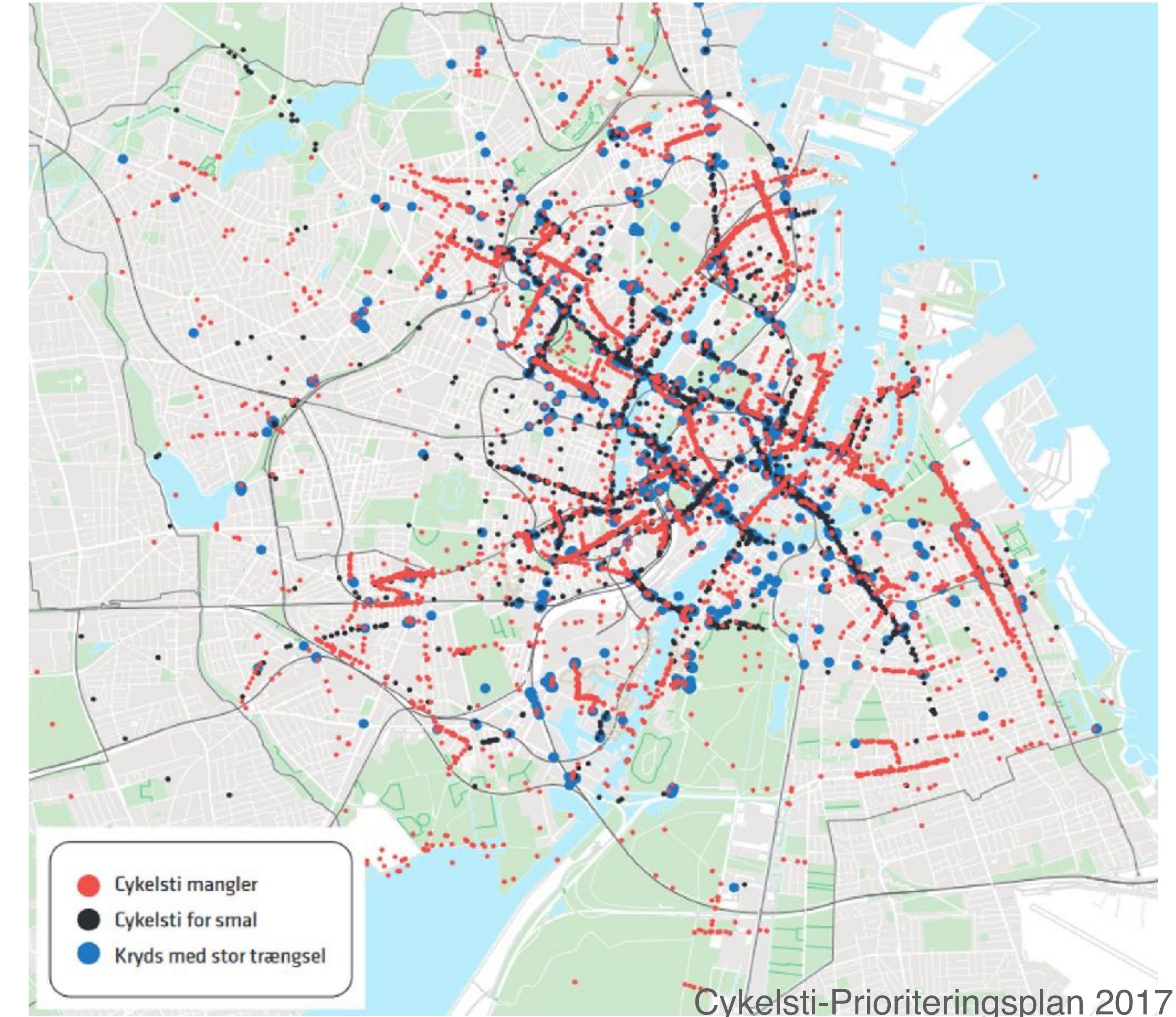


# The most important gaps are bridges



Knippelsbro

# Evaluation: Comparison with Cykelsti-Prioriteringsplan



# Evaluation: Comparison with Cykelsti-Prioriteringsplan



# Evaluation: We find many overlaps

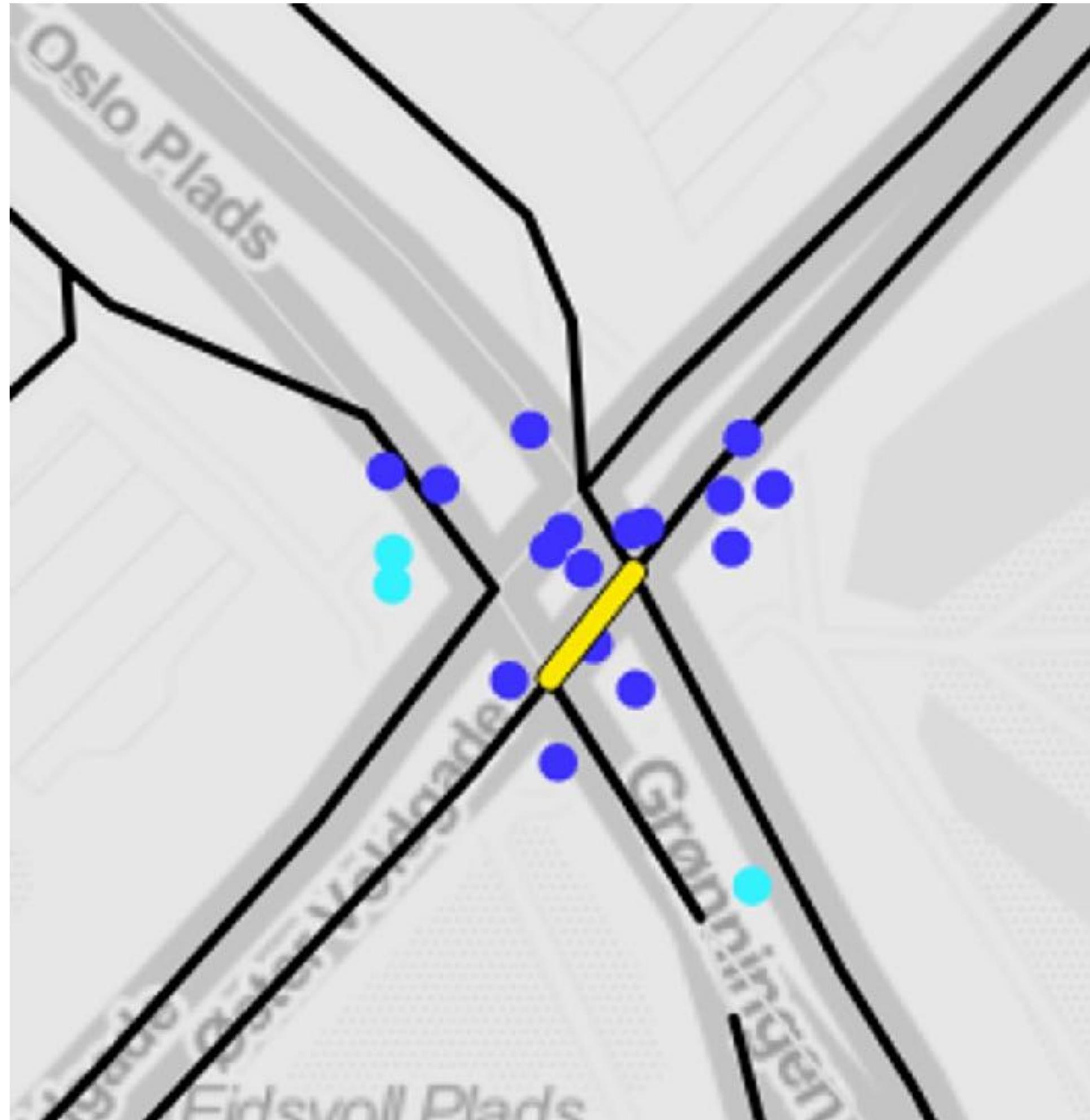


Nørregade



Rantzausgade

# Evaluation: We find many overlaps



Østerport



Sølvtorvet

# Netværksanalyse af den danske cykelinfrastruktur

We will use our existing know-how of

- urban bicycle network analysis
- identifying & prioritizing missing links

and extend it

- to the whole Danish network
- with accessibility metrics

for improved data-driven methods to increase the quality of the Danish bicycle infrastructure

