# Software Engineering 2 (e20)
## More details (on existing systems)

Ekkart Kindler

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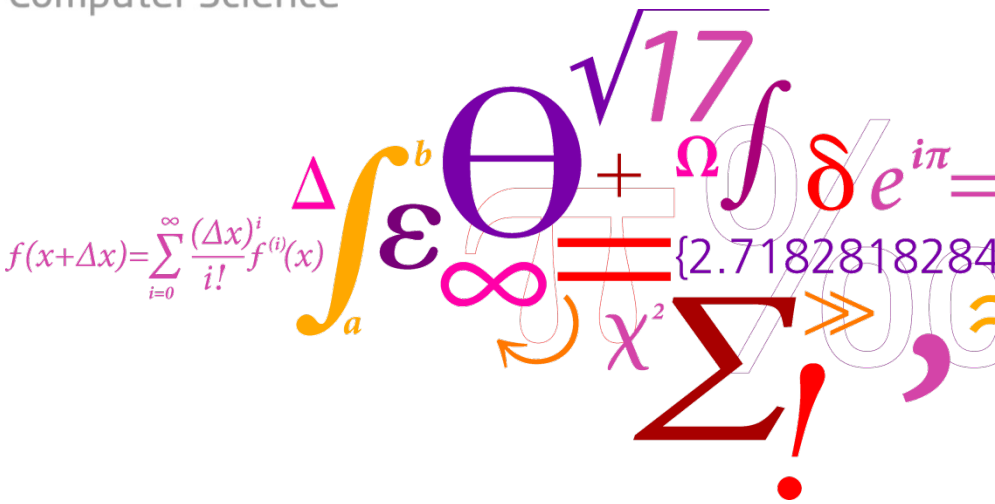

# Outline

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Department of Applied Mathematics and Computer Science
Ekkart Kindler

- Idea
- Some screen shots
- Concepts (domain analysis)
- “Domain model”

# LiRA: Main Idea

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Can we find a more efficient and faster way to **monitor**, maintain and manage the roads?

Modern cars are equipped with many sensors and can also provide further data including energy consumption.

*Can car sensors data be used to measure road conditions?*

# Project idea

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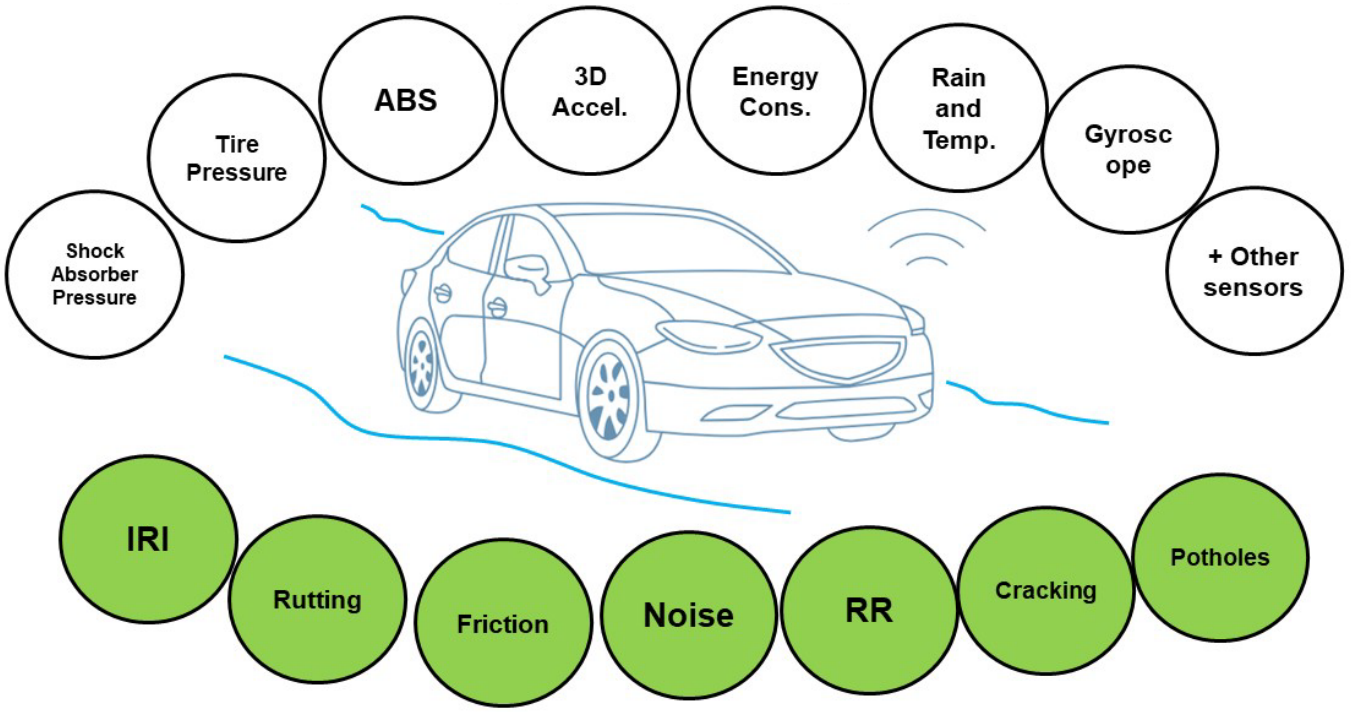
## Car sensors (approx. 150 sensors)




## Road measures

# Machine Learning

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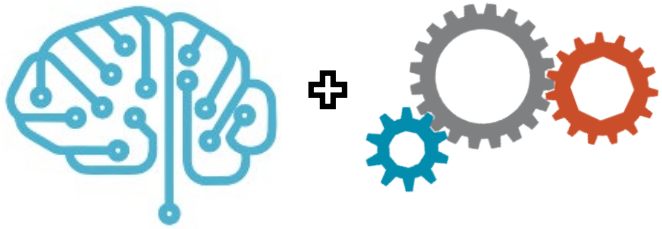
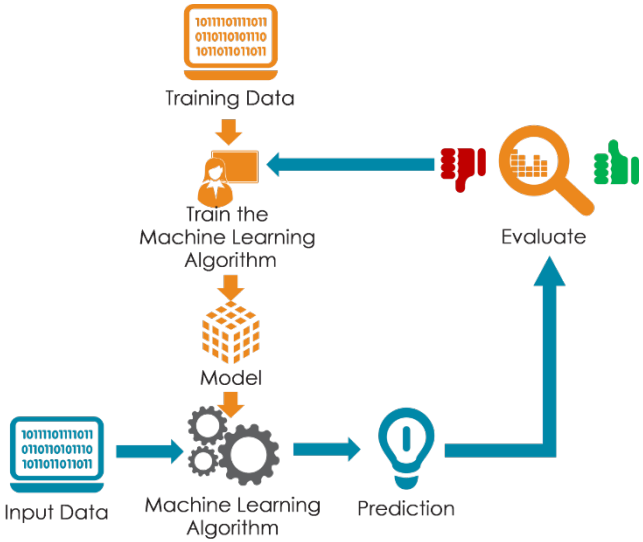


- Training (supported by physical models)
- Validation & Testing (Municipality of Copenhagen)



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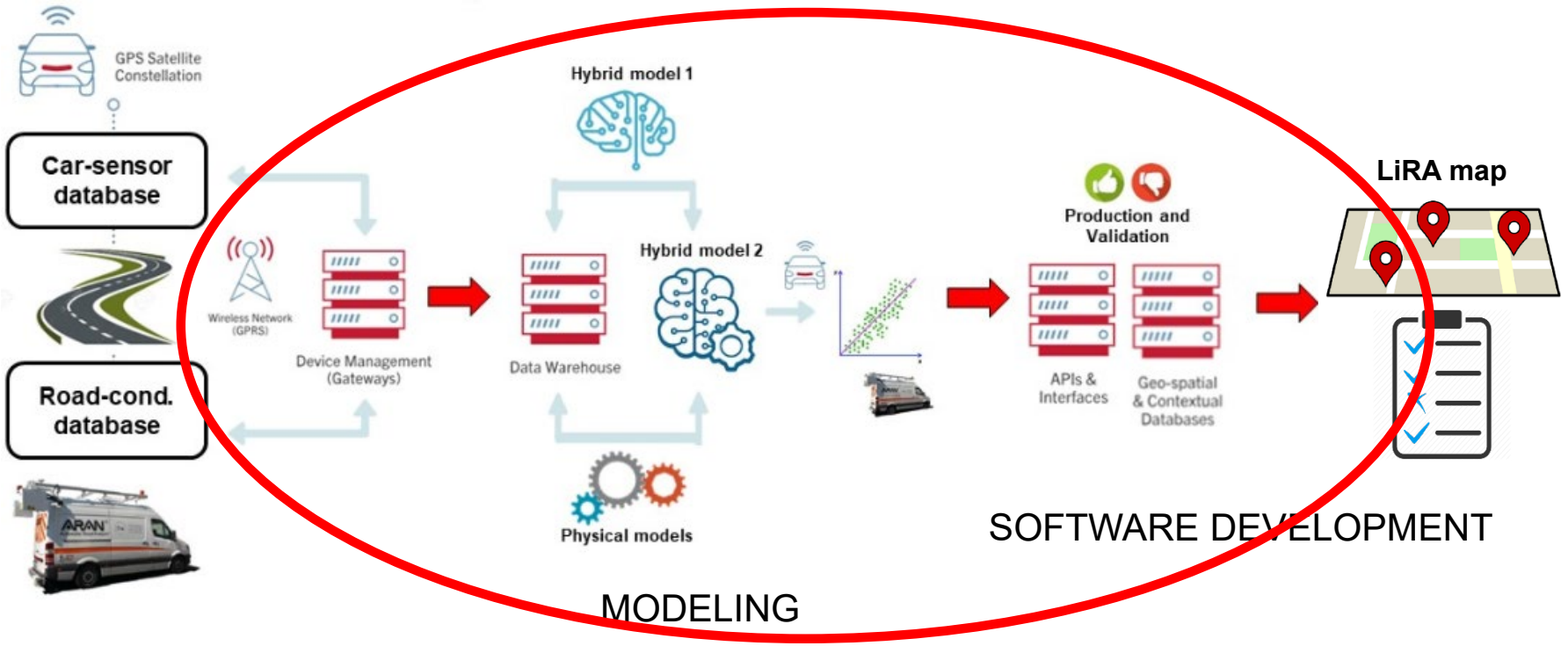
# Overview



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# LiRA Map

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Source: Jonathan Drud Bendsen: LiRA Map: A Cloud-based Geo-information System for Road Maintenance. BSc project 2020.

# LiRA Map

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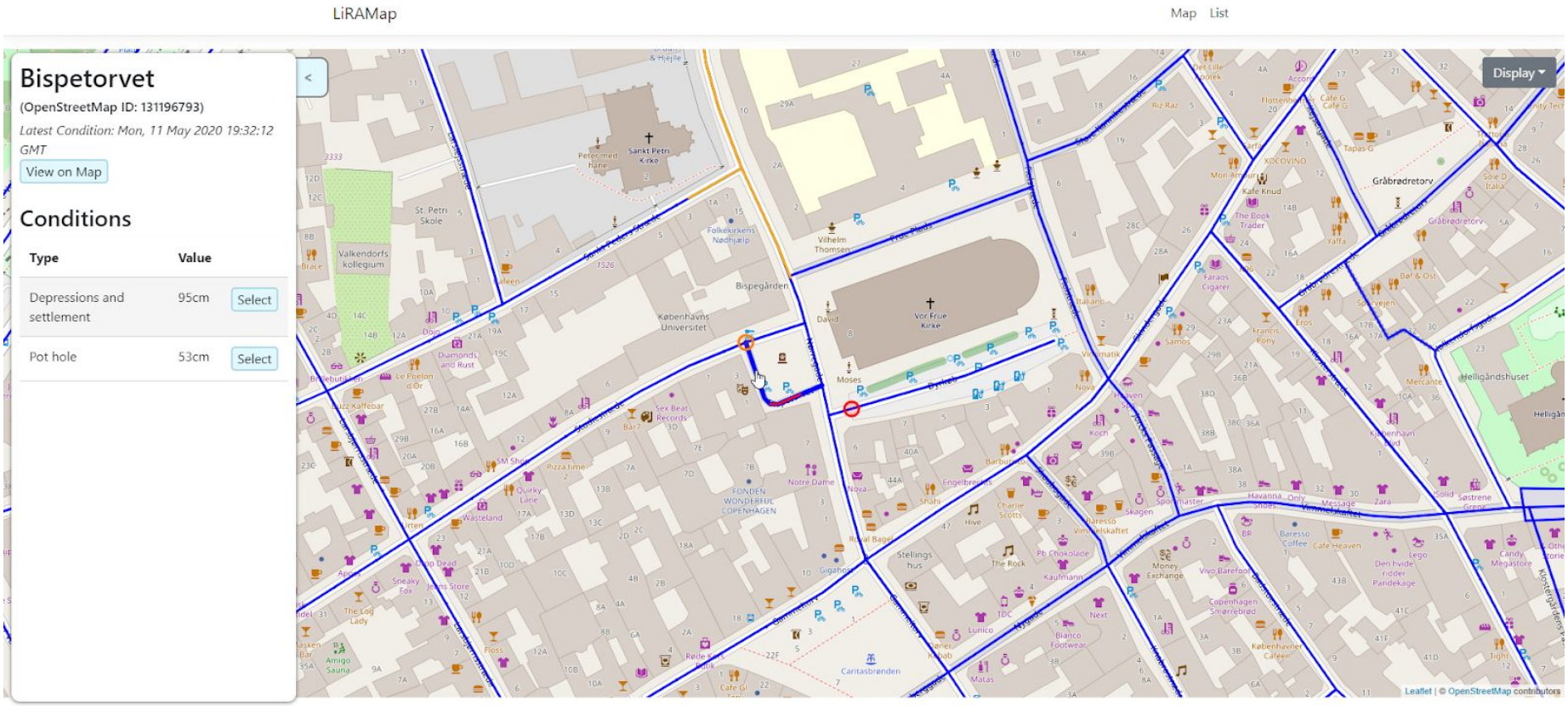


Source: Jonathan Drud Bendsen: LiRA Map: A Cloud-based Geo-information System for Road Maintenance. BSc project 2020.

# LiRA Map

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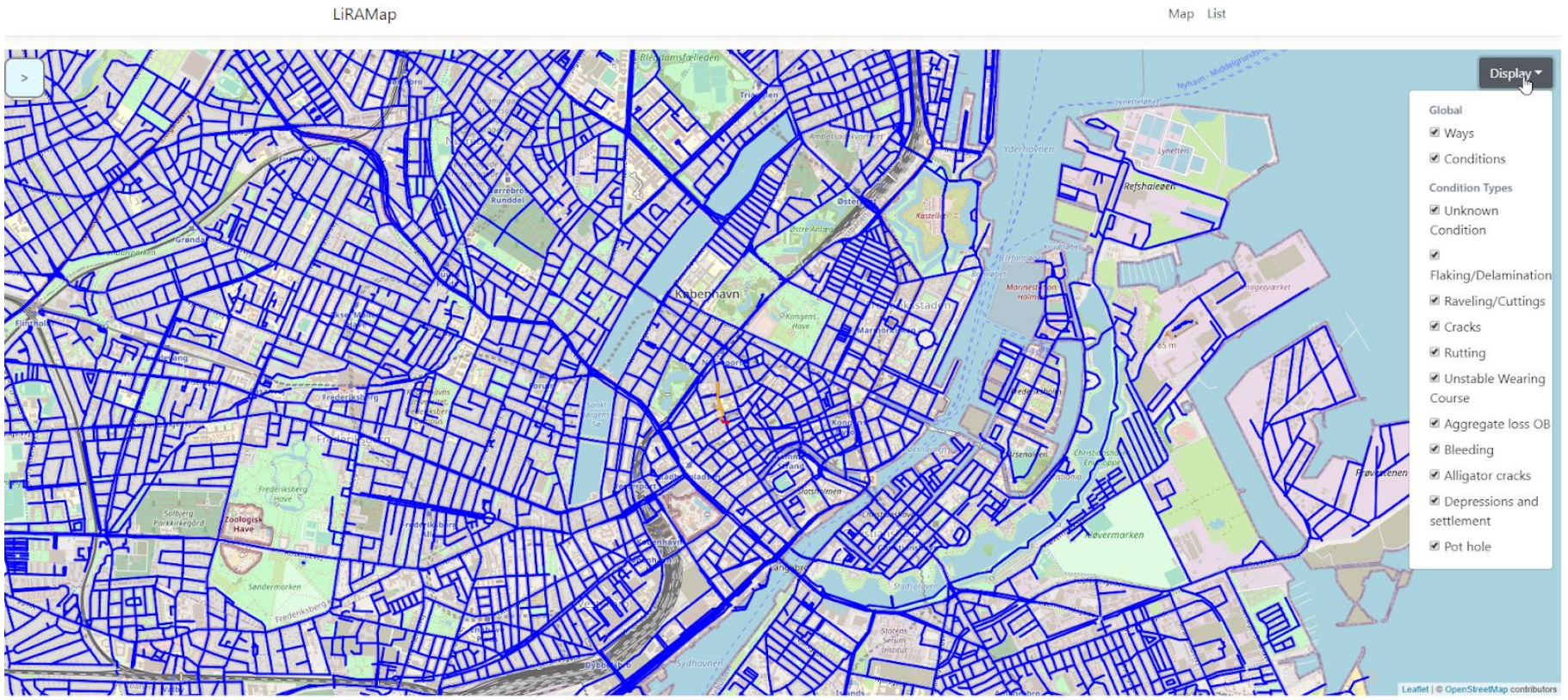


Source: Jonathan Drud Bendsen: LiRA Map: A Cloud-based Geo-information System for Road Maintenance. BSc project 2020.

# Outline



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# Concepts

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- Road conditions
  - Point condition (e.g. pothole)
  - Stretch condition (e.g. rolling resistance between to points); actually even a bit more tricky in practice (see Jonathan's thesis)
  - Condition refers to a point or a stretch, has a type and one or more values (type defines unit and what the condition means)
- Road concepts from OSM (but own terminology)
  - → see next slides

# Open Street Map (OSM)

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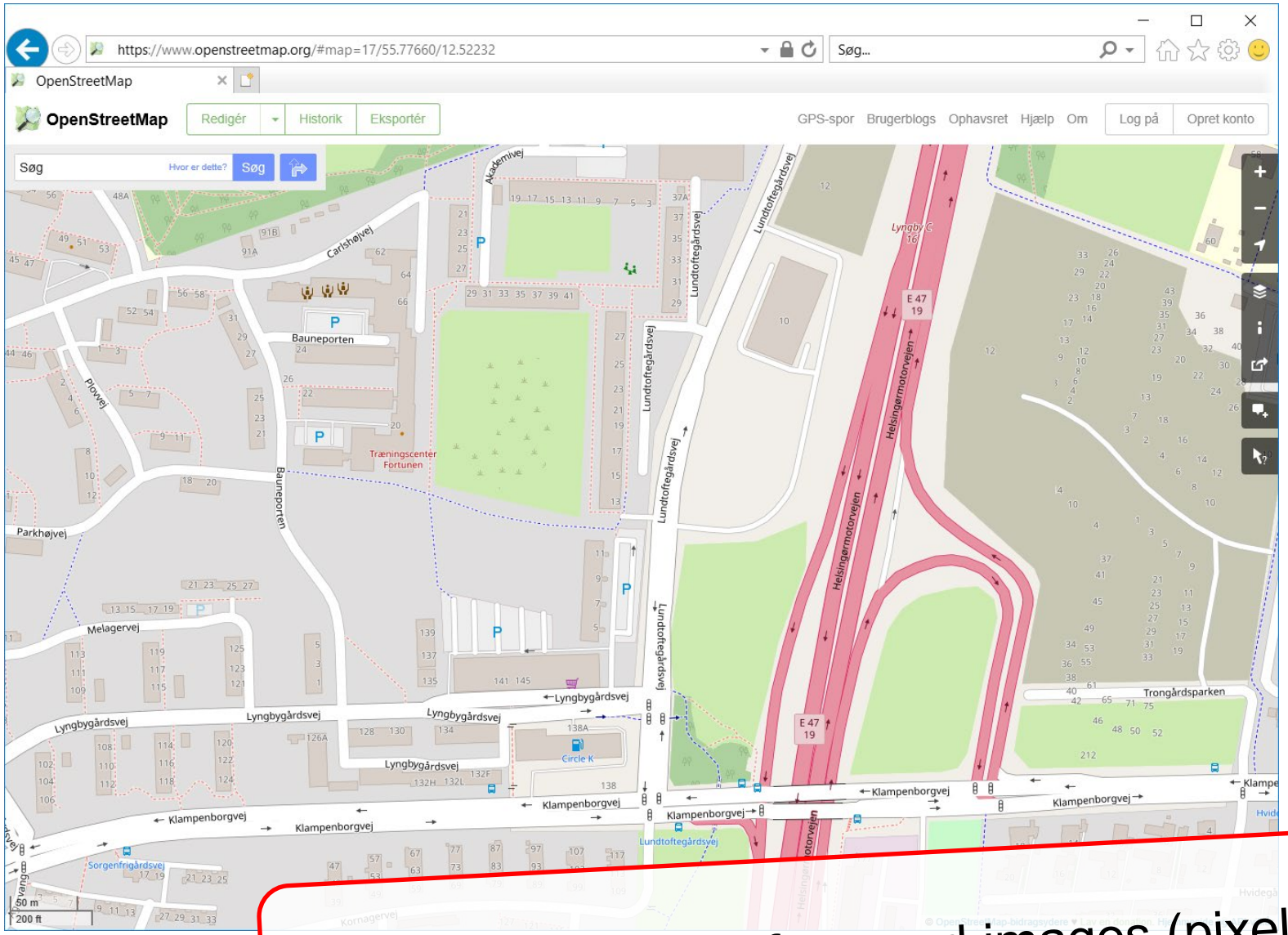


Basically, just geo-referenced images (pixels)!

# OSM: Map Data

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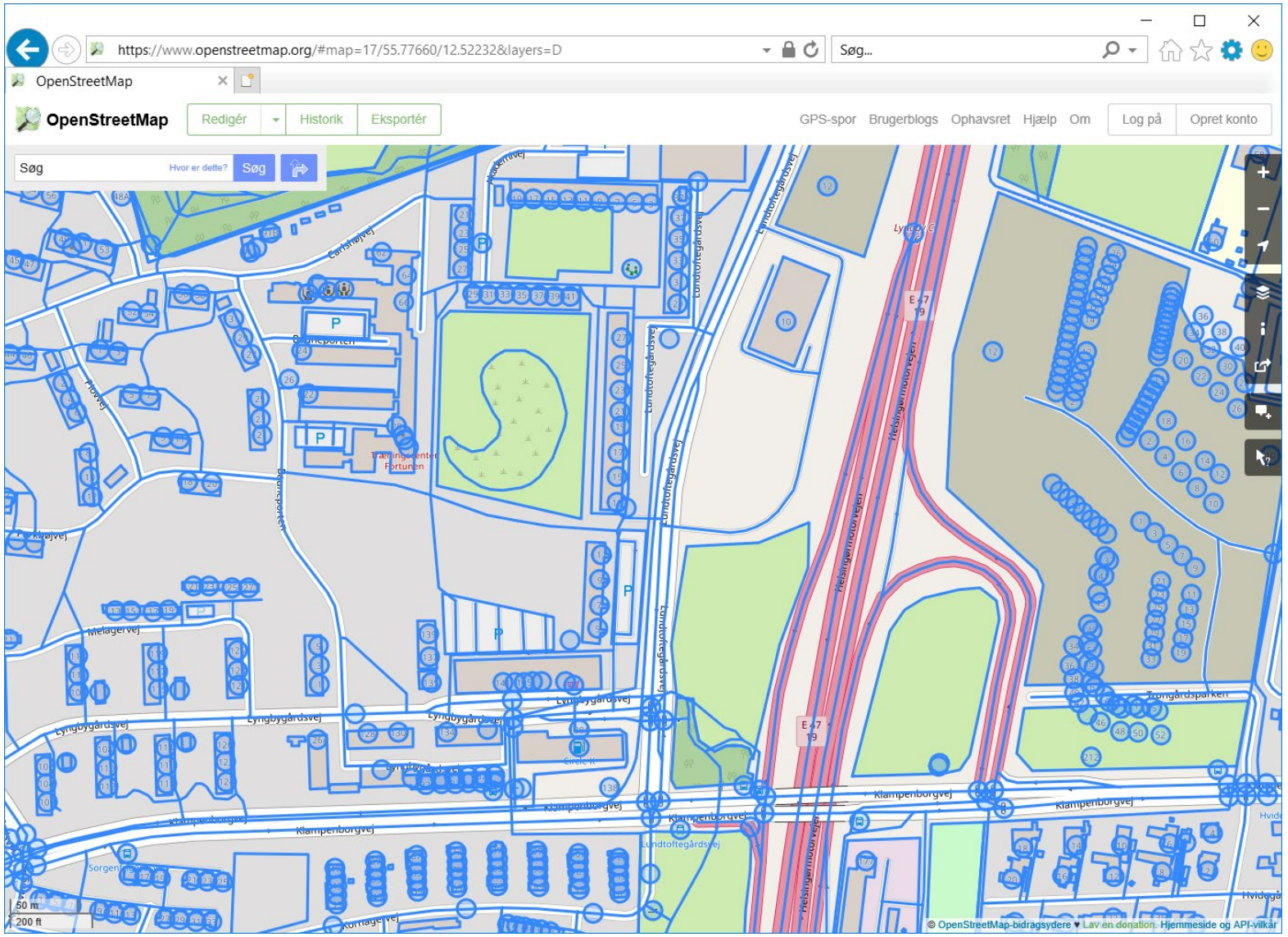

# OSM: Way with Tags

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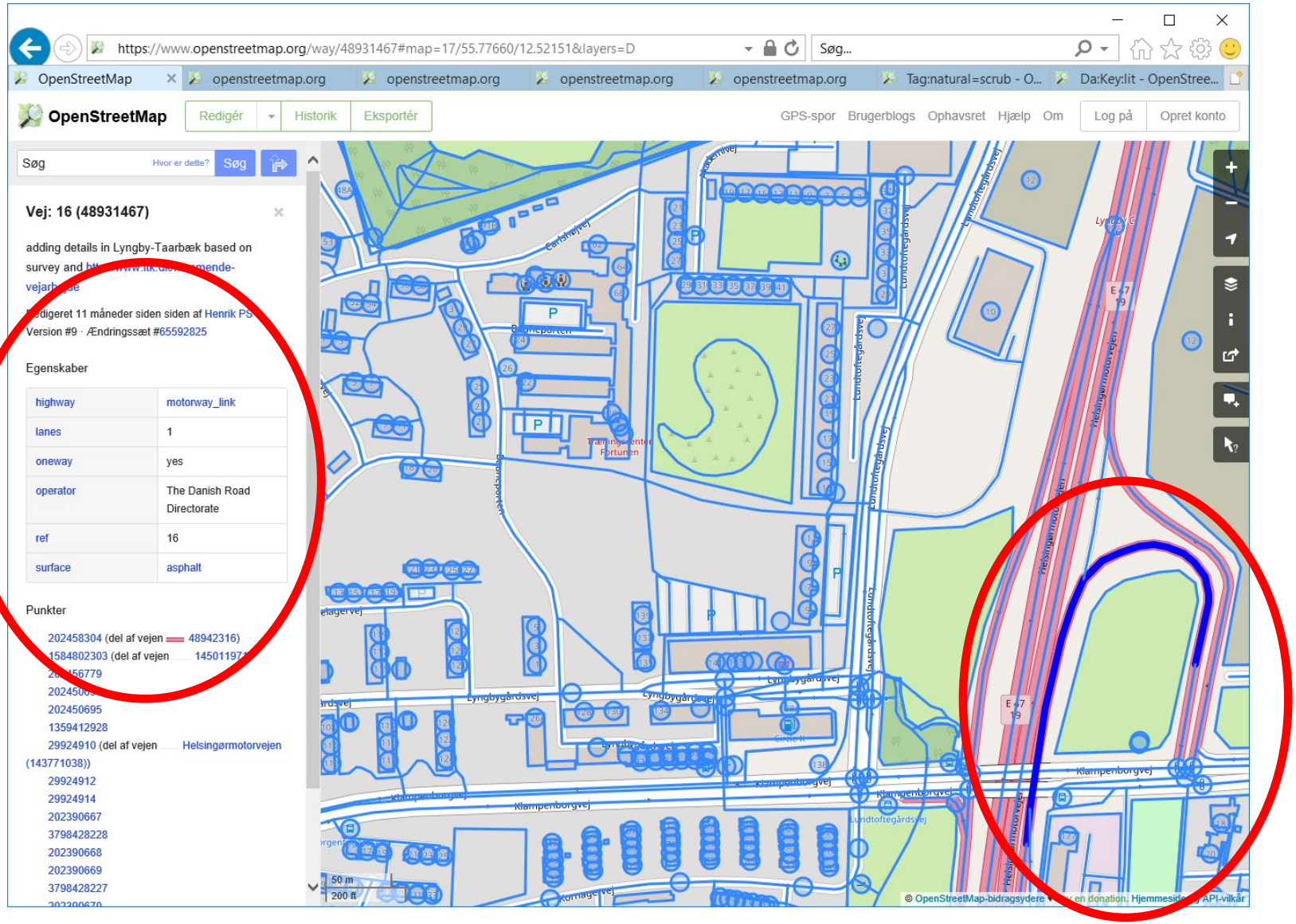

# Core Concepts

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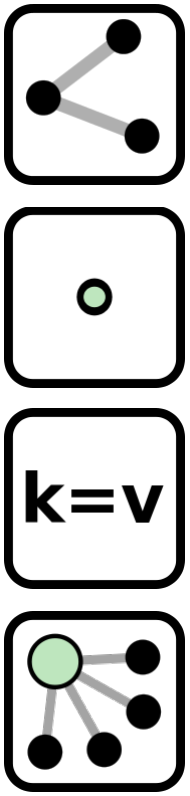
- Way / Section
- Node / Point
- Tags / Attributes
- Relations



# Car data

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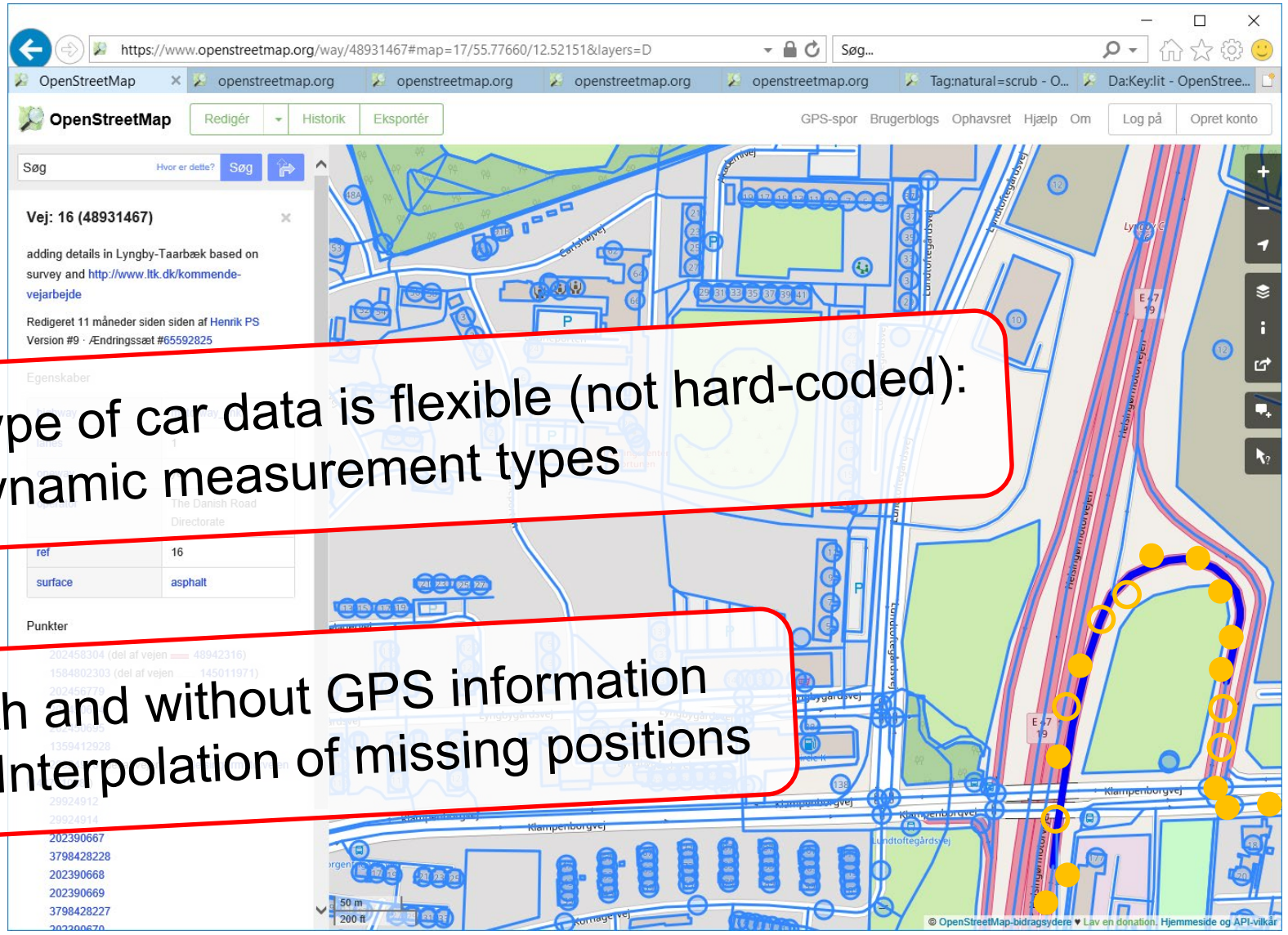

# Car data

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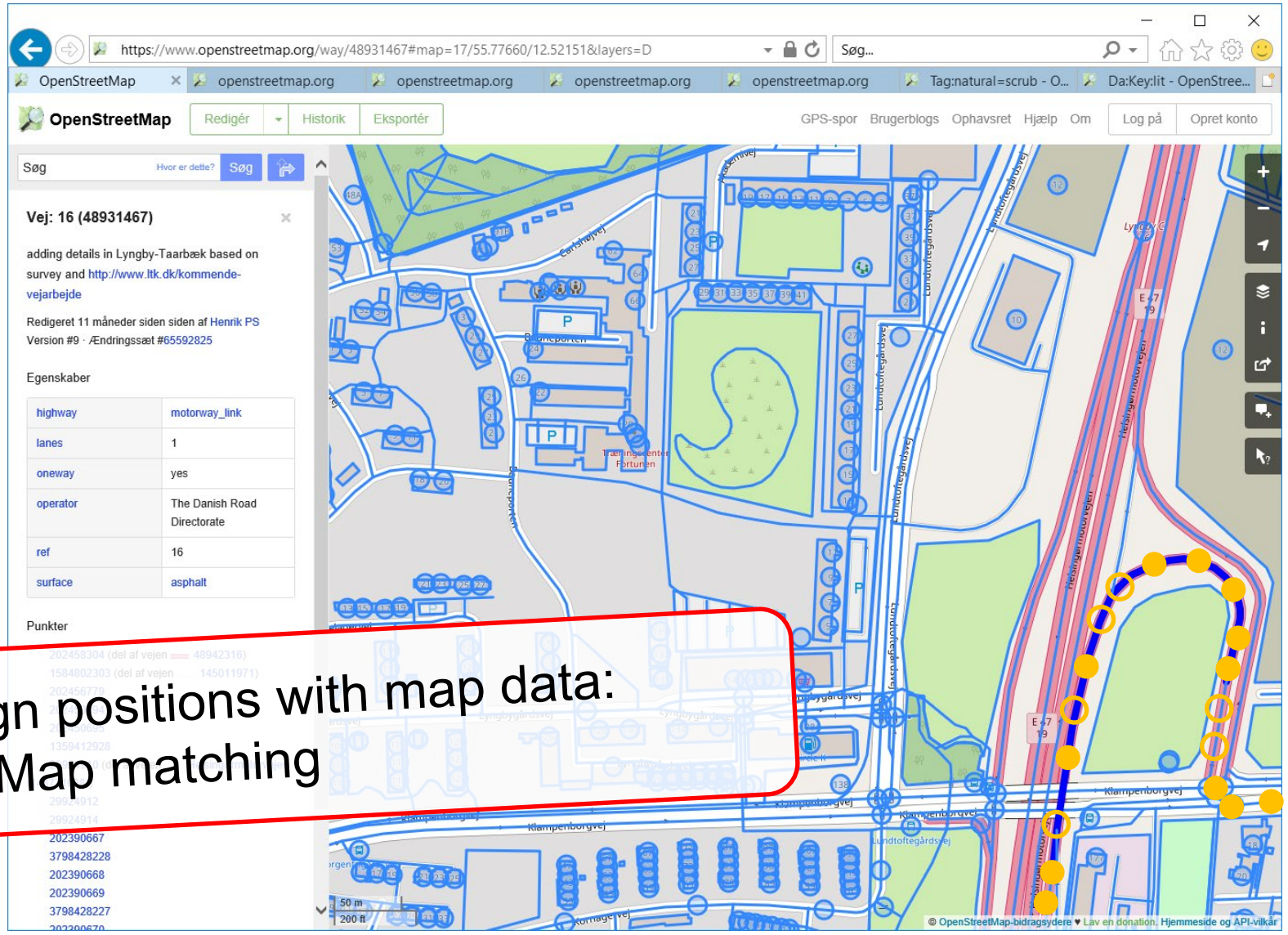


Align positions with map data:
→ Map matching

# Road state data

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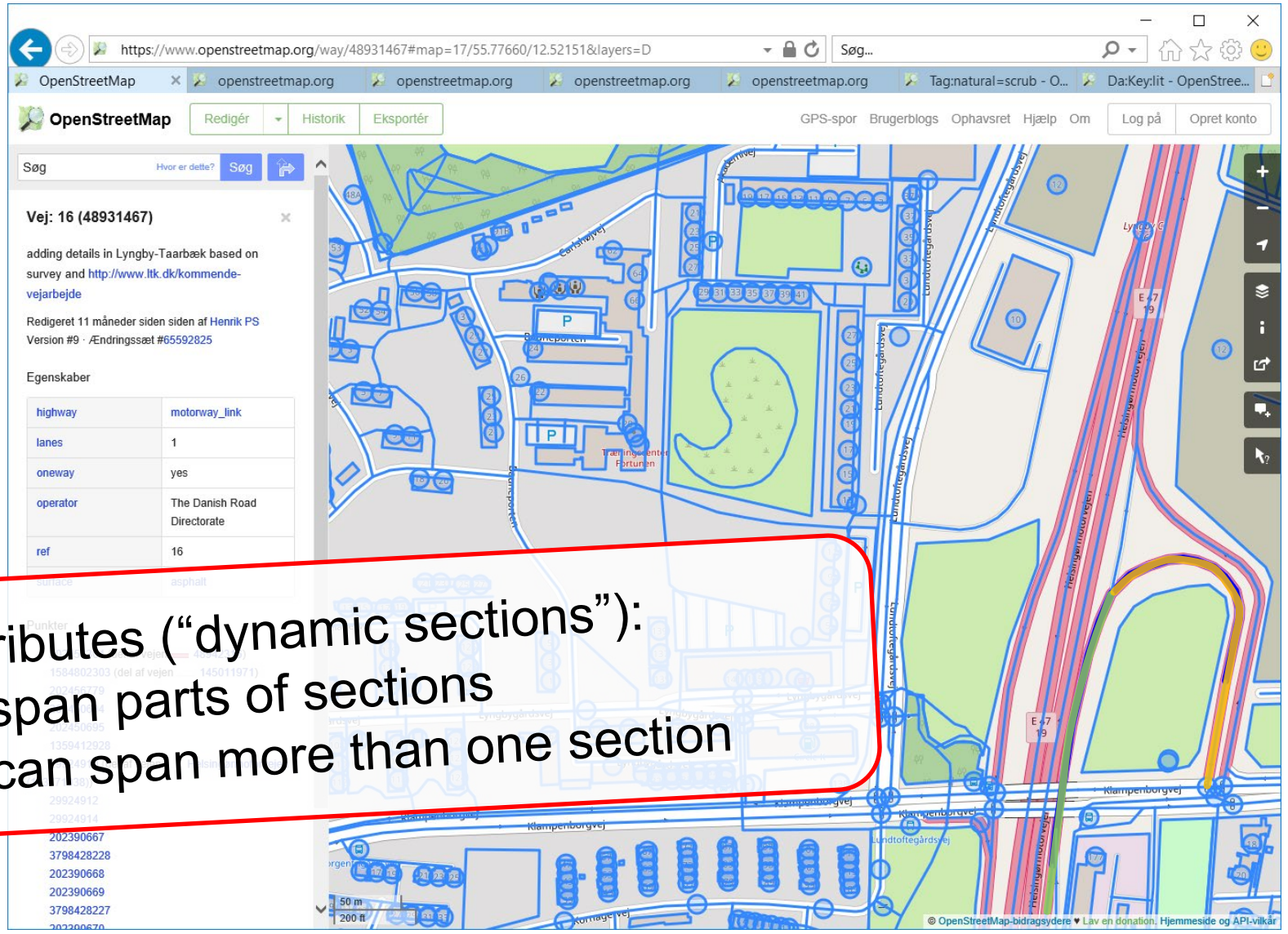


Attributes (“dynamic sections”):

- span parts of sections
- can span more than one section

# Data Collection: Steps

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- Collect data raw data from cars (per trip)
- Clean data (done by AutoPi on care already)
- Calculate position for data without positions (Interpolation)
- Map positions to sections:
  there are different services available for that, e.g. http://project-osrm.org/docs/v5.10.0/api/#general-options

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# Simplified Data Model

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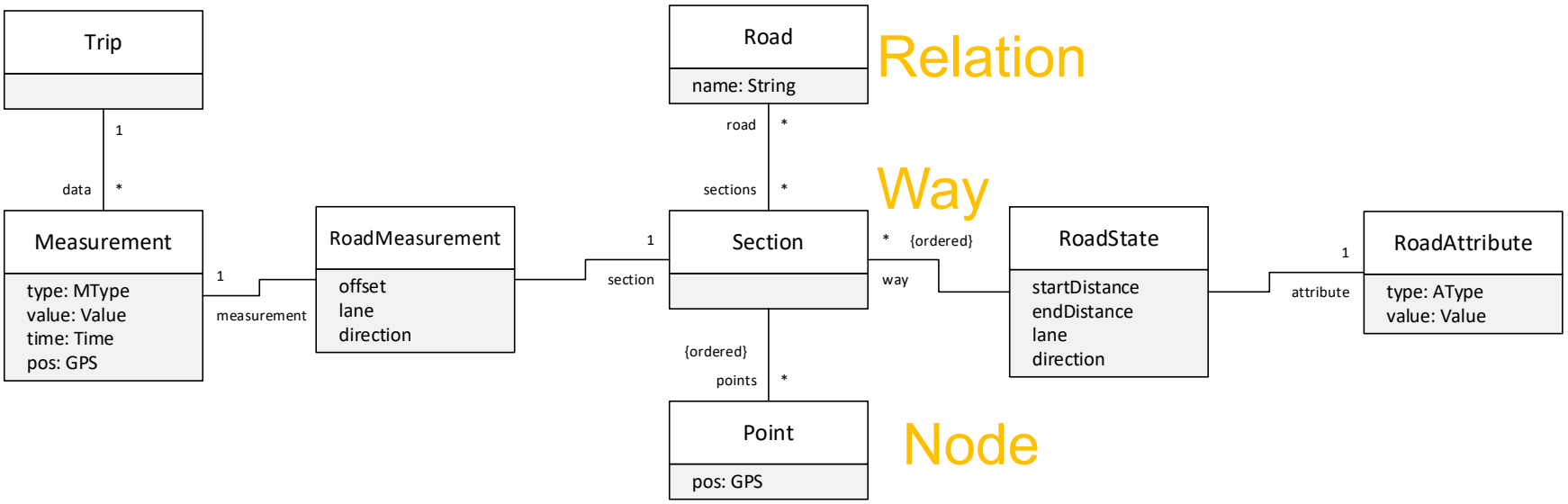
Car Data (from GM)

Static road data (OSM, Sweco, …)

Dynamic road data …



# Design

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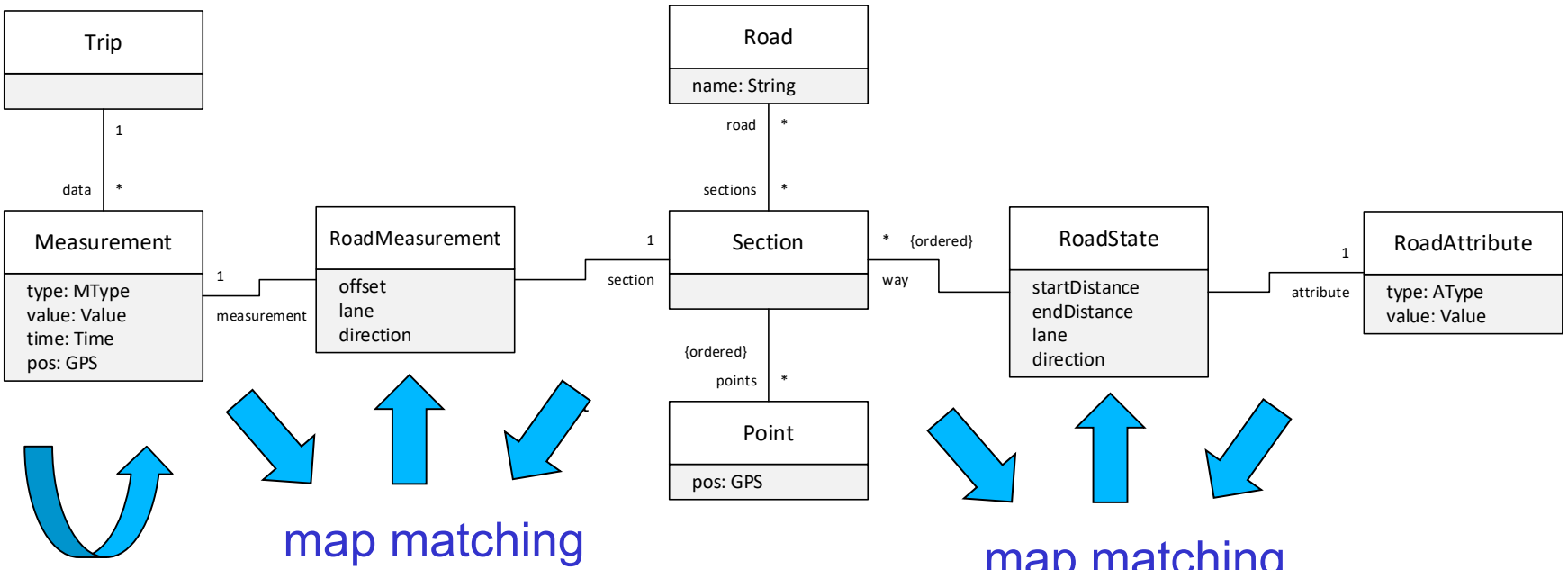
data collection (GM)

Initial data (VD)




- data cleaning
- GPS interpolation

# Design

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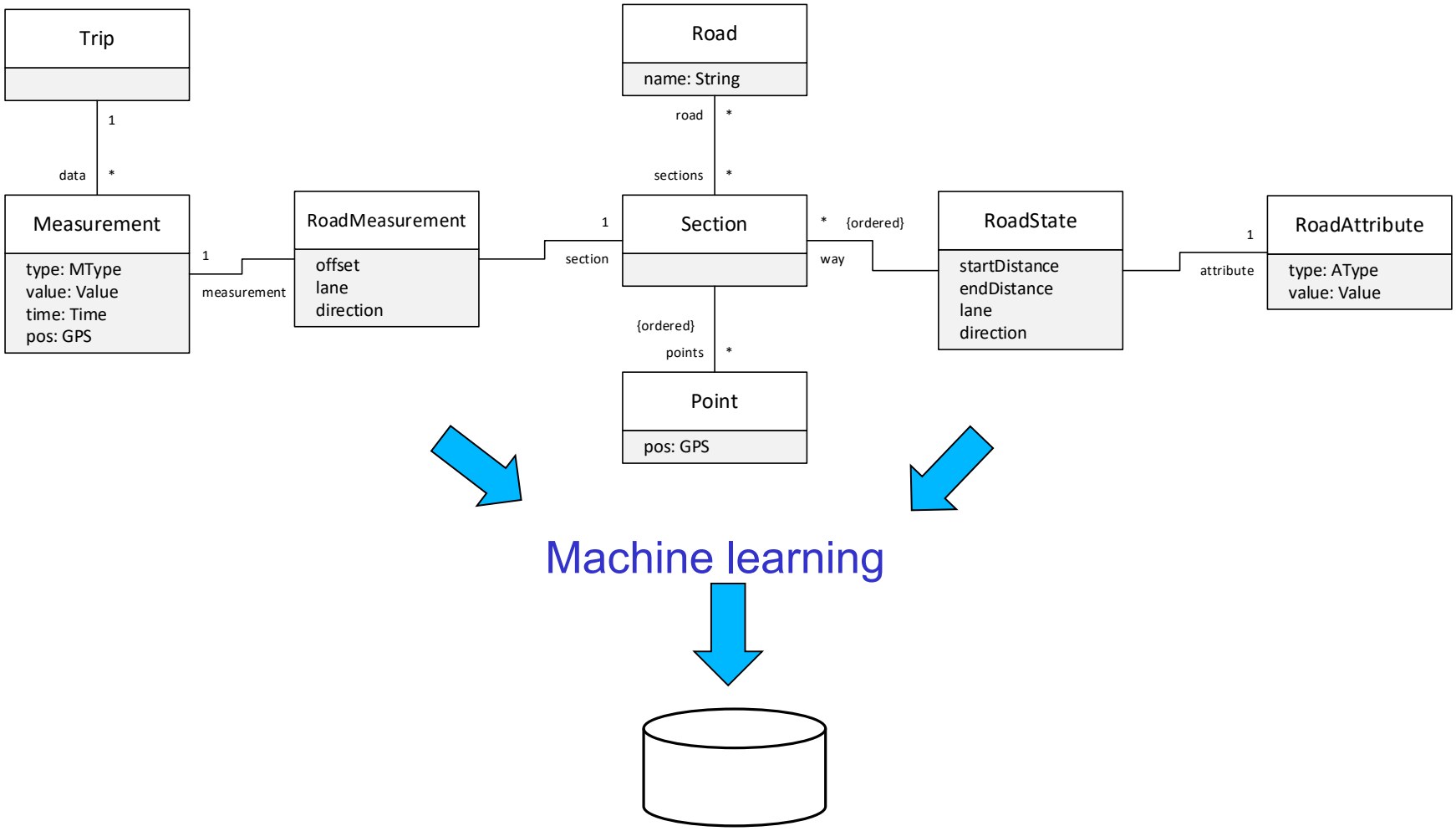

# Design

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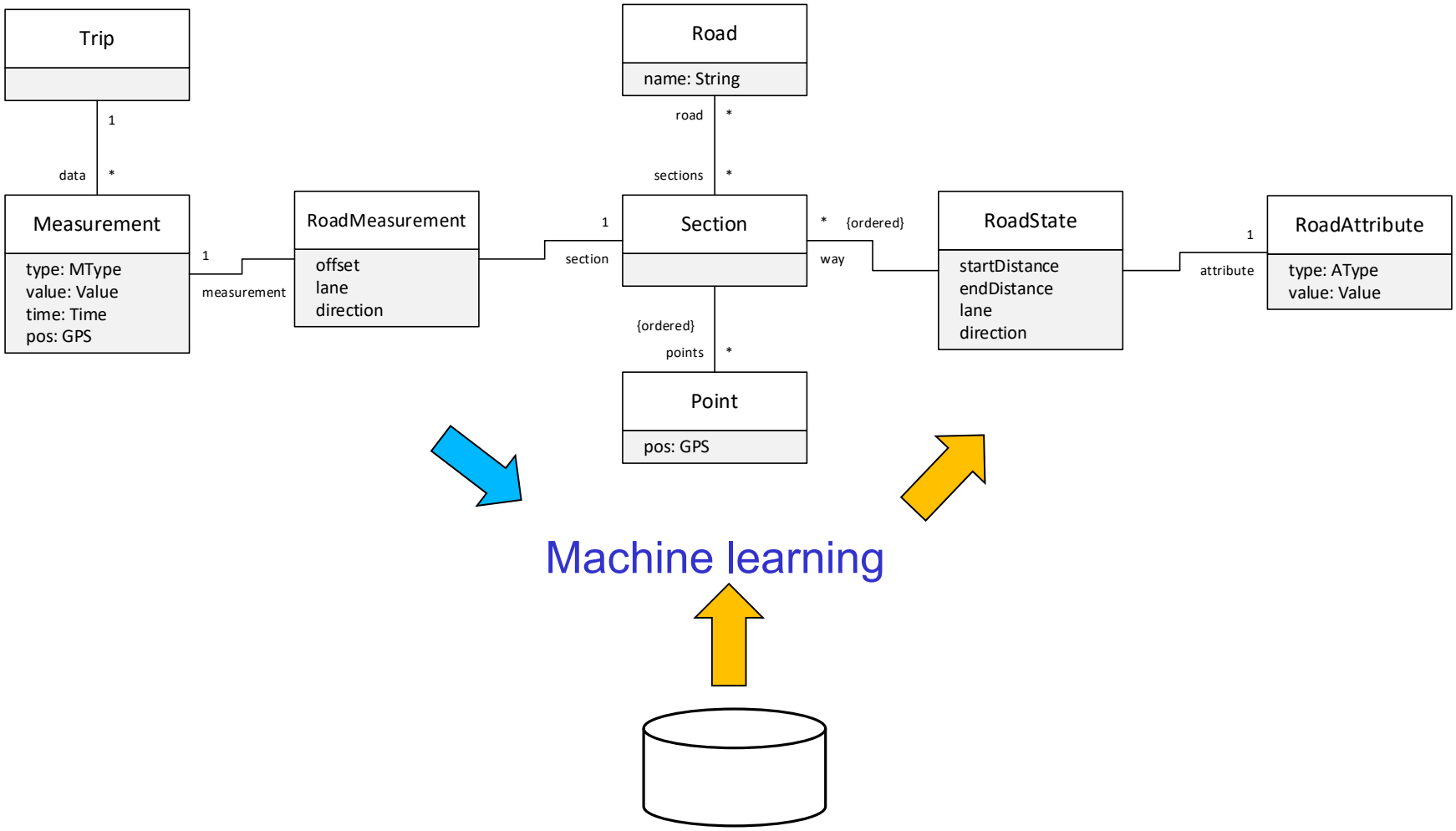

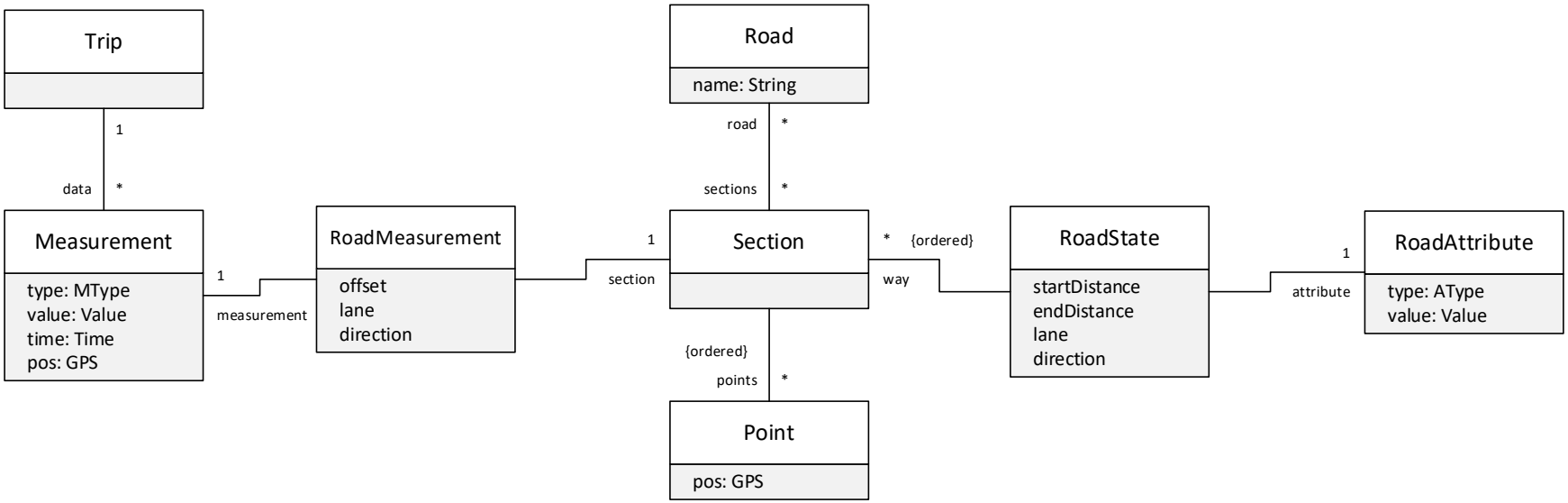


## Data Collection

## Machine Learning

## LiRA Map

Note that this is just the rough idea!
Many aspects and details still missing!