I-CiTies 2019

Pisa, 18 September 2019

Vehicle mobility data analysis and Individual Mobility Networks for crash prediction

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Sistematica

Work funded by:

Track & Know

Big Data for Mobility Tracking Knowledge Extraction in Urban Areas

EU H2020 G.A. 780754

Crash risk prediction

- **Context:** insurance companies
  - Base their business on evaluating the expected costs (for the company) of a client
  - Cost is a function of client's risk of suffering an accident/loss
  - Specific to car insurance: cost ~ crash risk in the next term

- **Problem definition**: given the recent mobility history of a user predict whether he/she will have a crash in the next future
  - E.g. predict crashes in the next month based on data of the last 4

State of the Art

Mainly based on

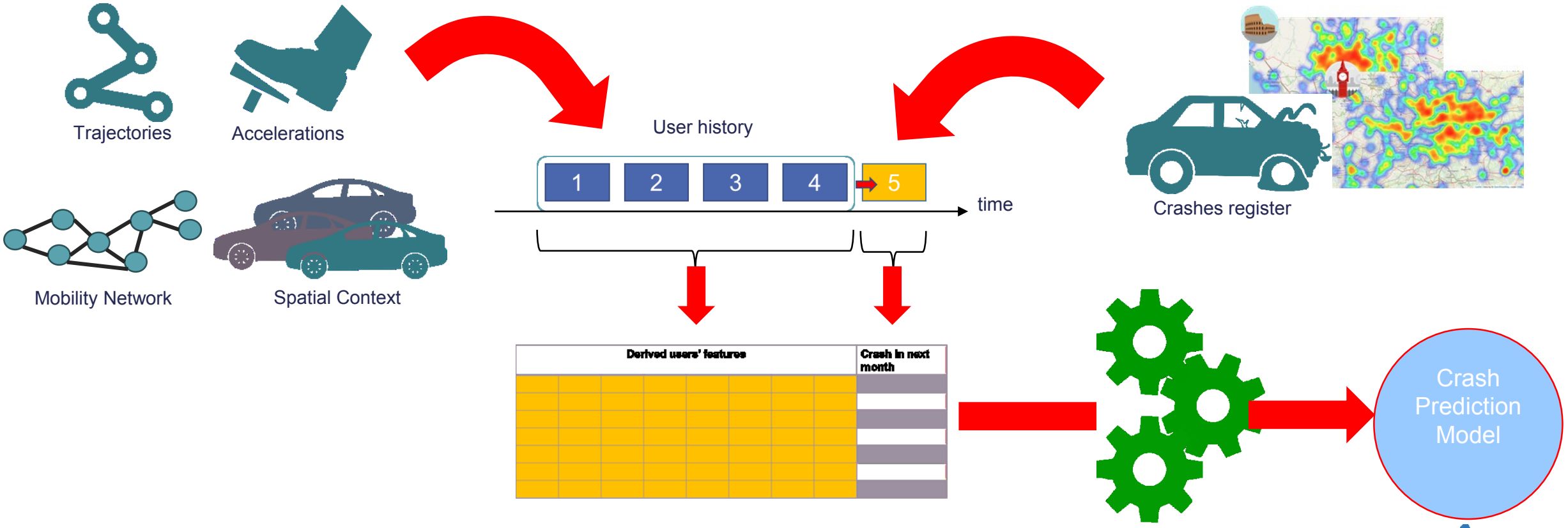
- Real Time Crash Prediction
- Contextual conditions (weather, traffic intensity)

Our approach:

- Individual, medium-term prediction (e.g. 1 month)
- Based on several features extracted from the history of the individual

The approach

- Machine Learning approach: directly learn from past crashes



Individual Trajectory Features

Trips count

Lengths

Durations

Time of day

Avg speed

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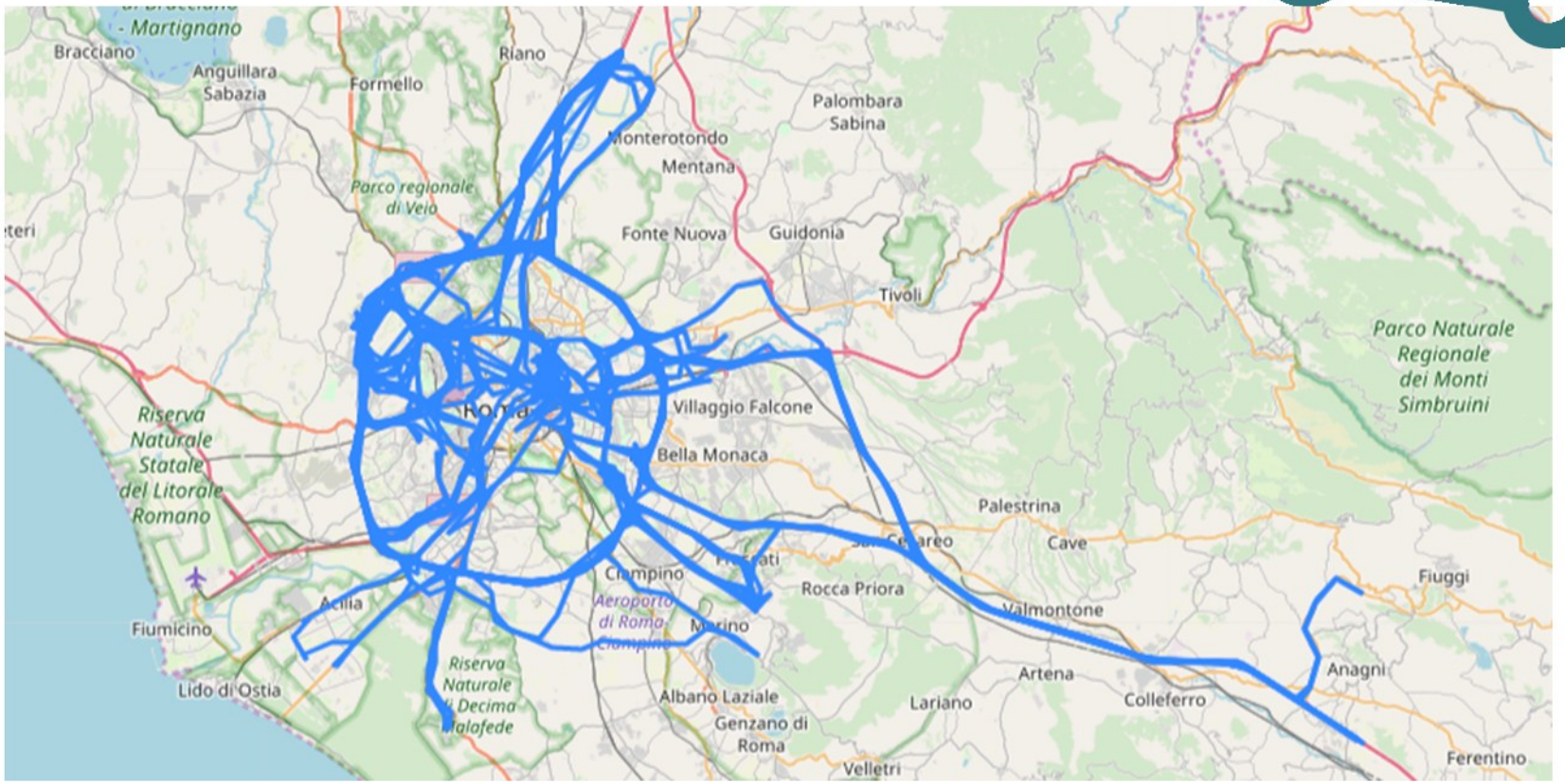


Events Features

Accelerations

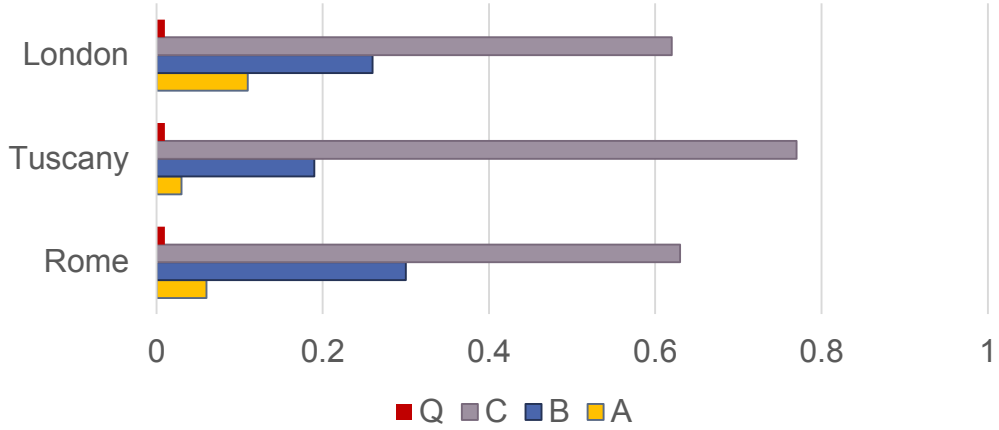
Breaks

Cornering

Zig-zag

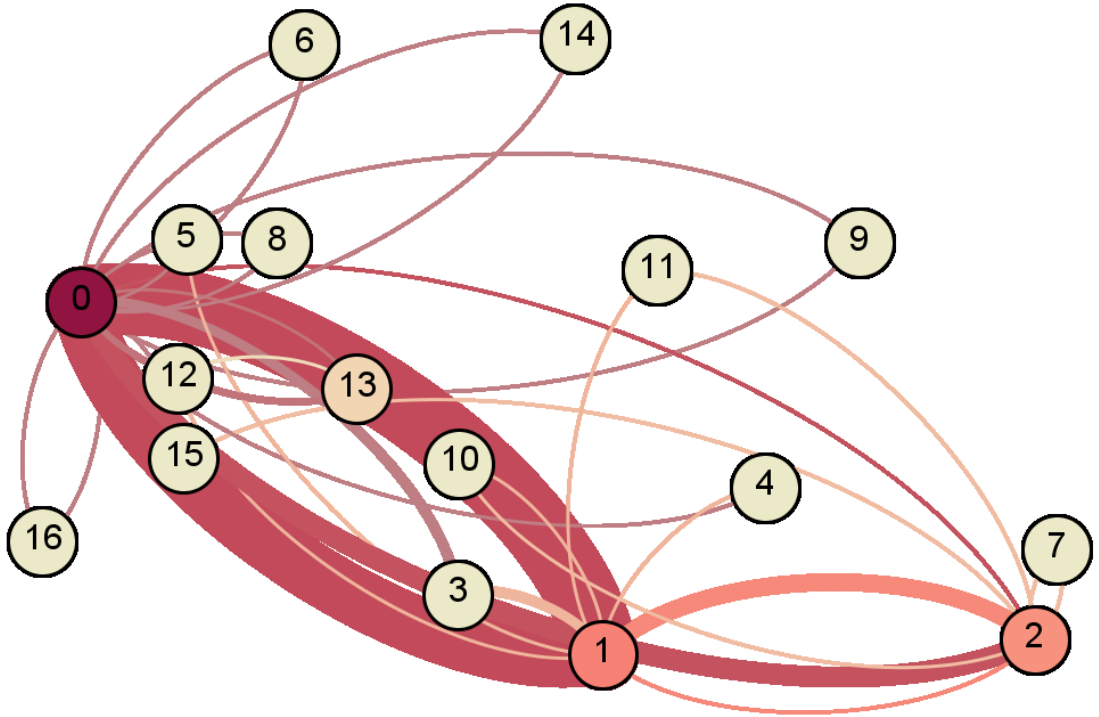
Mini-stops

- Short engine switch-offs



Individual Mobility Network

Graph abstraction of the overall mobility of the individual based on locations (nodes) and movements (edges).



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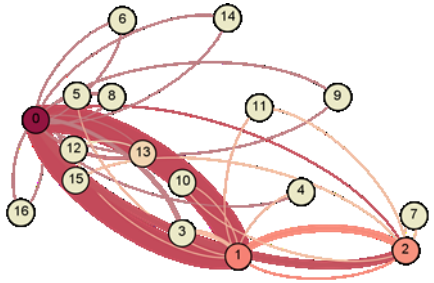
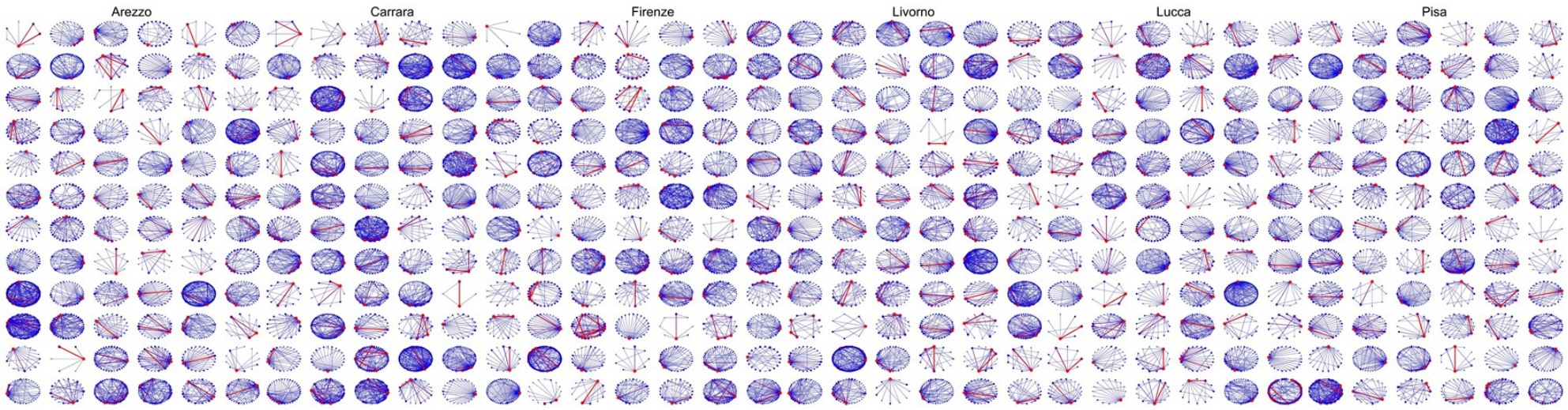
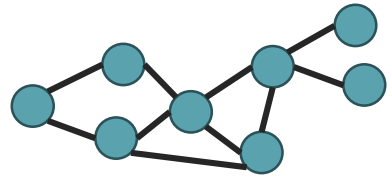




IMN Features: network measures



Nodes

Edges

Node frequency

Edge frequency

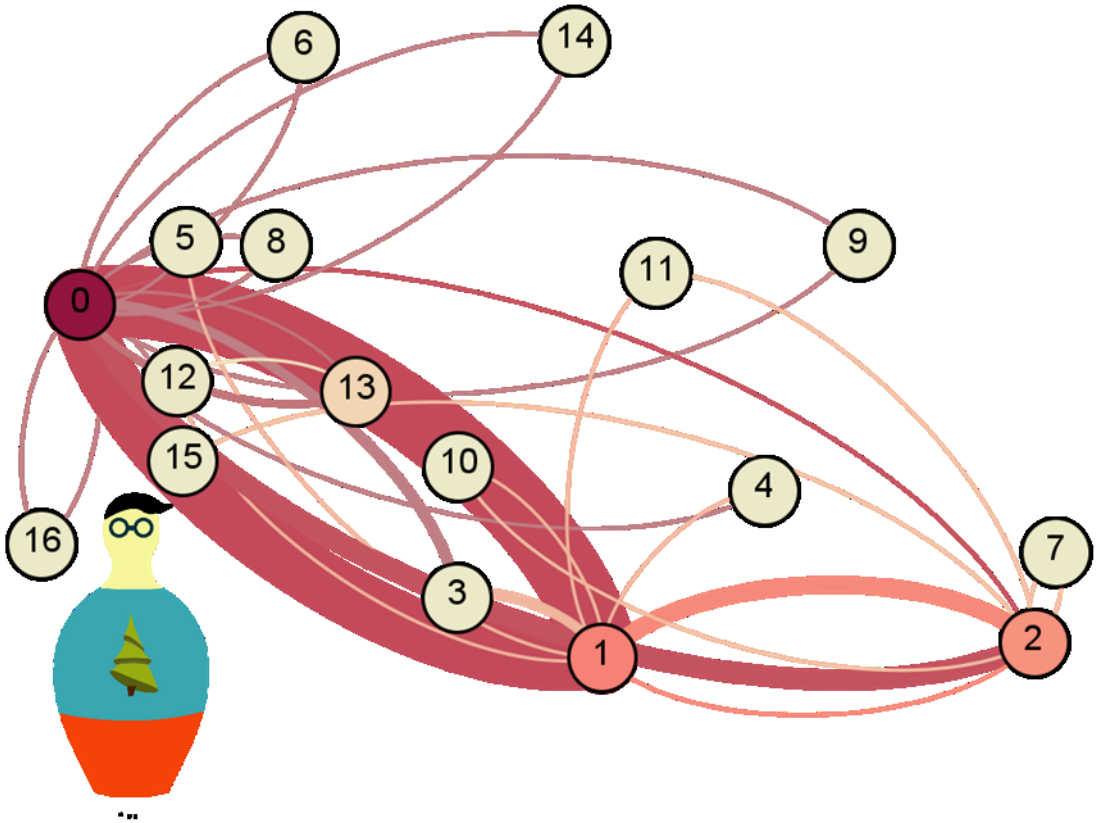
Indegree

Outdegree

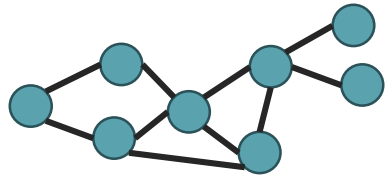
Clustering Coefficient

Entropy

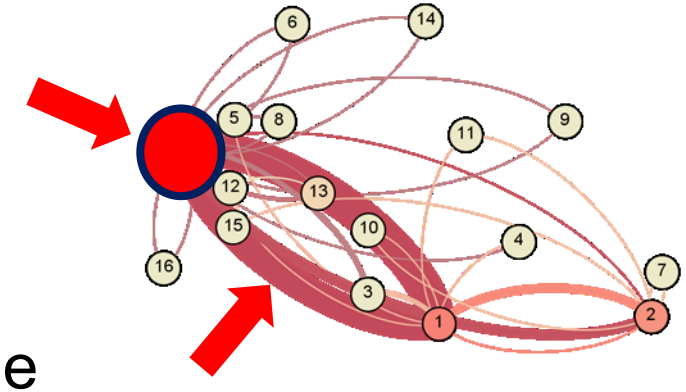
…



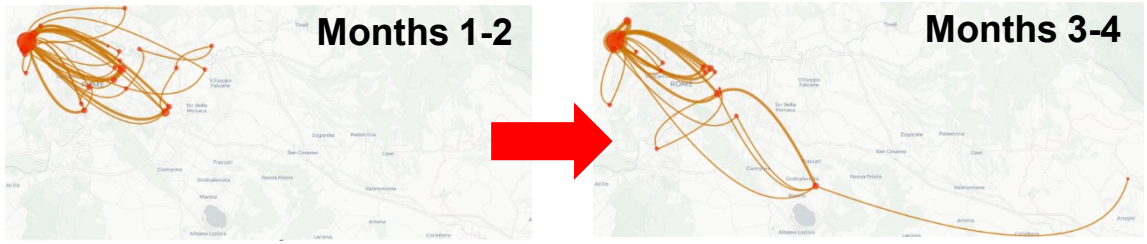
IMN Features: ON GOING WORK



- Compute features focused on parts of IMN
  - on frequent locations (in-flow)
  - along frequent movements



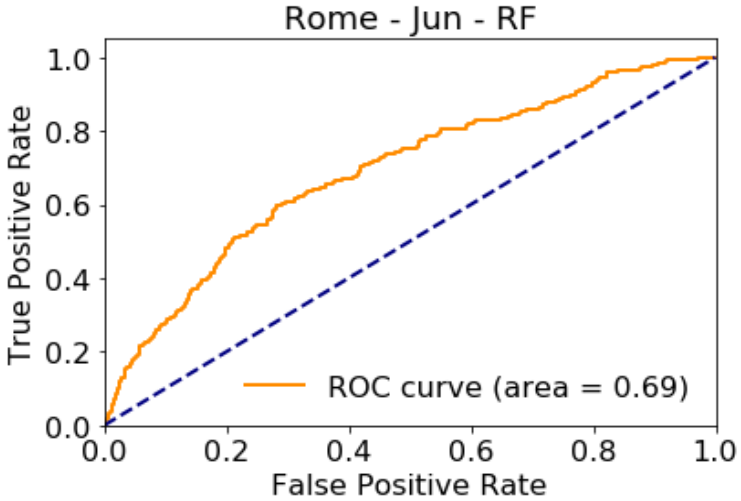
- Measure how much the IMN changes in time
  - Might reflect changes in habits or mobility needs



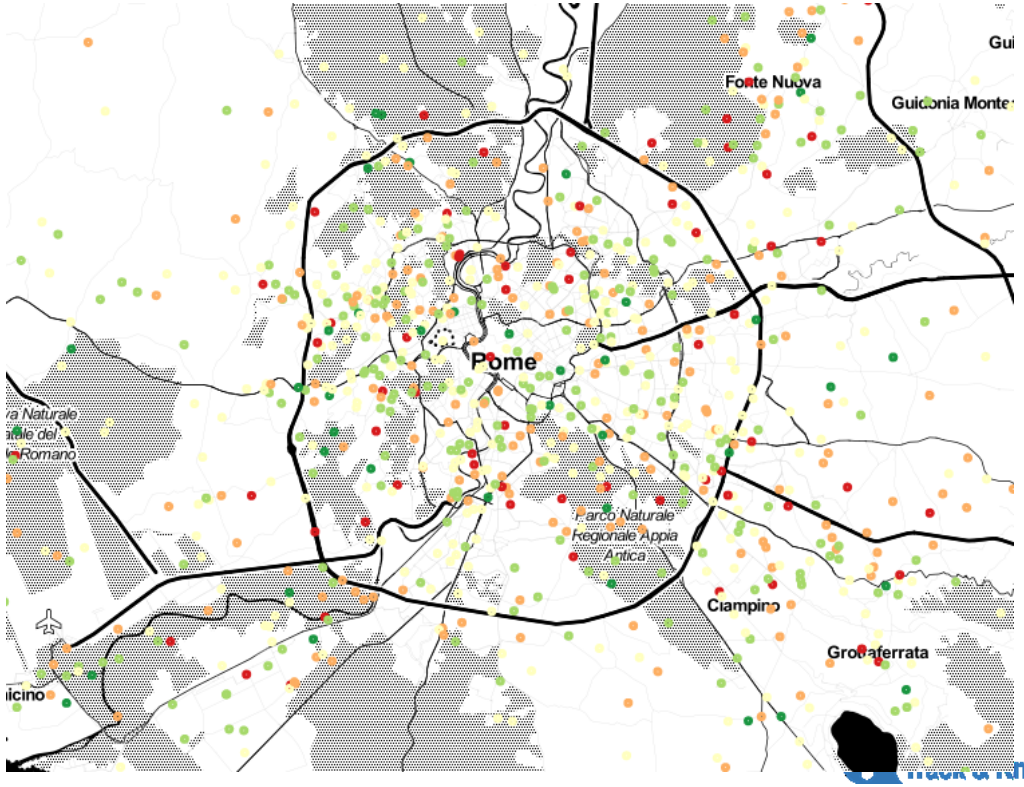
- Characterize what kind of areas I cross/stay in
  - Measure through mobility information on the areas aggregated over all the vehicles (e.g. traffic density)

Preliminary performance tests

- Various tree-based classification algorithms tested
- Promising yet to improve results
  - Moderately good precision (up to 48%)
  - Low recall (up to 6%)
  - Low F1-score (up to 0.098)
  - Moderately good AUC(ROC)



Spatial distribution of prediction (period = June)



Next steps on crash prediction

- Features & model refinements to improve performances, especially recall
  - Work on developing richer IMNs
  - Integrate information from other sources (e.g. weather and POI enrichment)
- Test model geographical transferability at various scales
  - Problem: how to adapt a model built in area A in order to work well in area B?
- From predictions to prescriptive rules
  - Explainable AI !

THANK YOU!

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