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School of Computing Science

Essence: Pervasive & Distributed Computing

A Predictive Vehicle Ride Sharing Recommendation System for Smart Cities Commuting

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WORLD CHANGING GLASGOW

Vehicle Riding Sharing System

- Smart Cities
- Smart Mobility
- Vehicle Ride Sharing
- Future Location Prediction Service
- Personalized Recommendation Service

Smart Cities

- Cities 2.0
- Industry 4.0
- Internet of Things
- Artificial Intelligence
- Robotics

Smart Mobility

- Unmanned Aerial Vehicles
- Autonomous Vehicles
- Connected and Autonomous Vehicles
- Intelligent Transport Systems
- Smart Parking

Vehicle Ride Sharing

- Vehicle Pooling
- Ride Sharing
- Ride Hailing
- Commute System
- Uber
- Taxi Beat

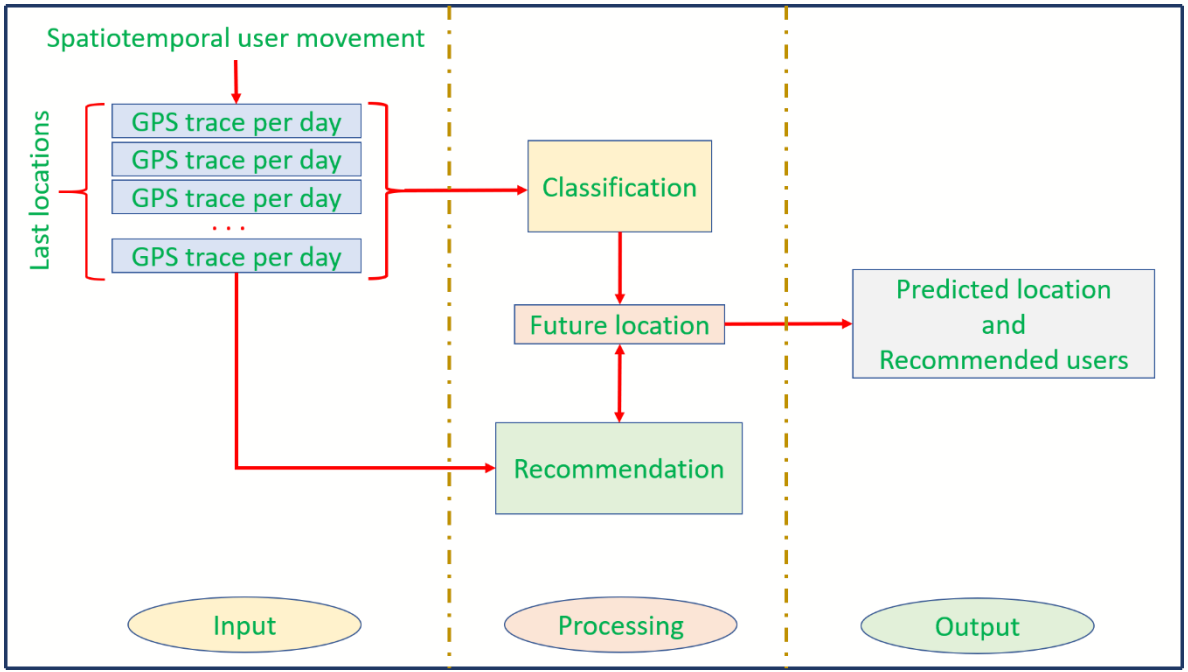
Future Location Prediction Service

- Where am I?
- What time is it?
- Where the system infers I will go to in the near and/or far future?
- Does the system support detours?
- Am I satisfied from the system's location prediction service?

Personalized Recommendation Service

- Do I want to go alone?
- Do I need company?
- How many persons will accompany me?
- Does the companion have the same spatiotemporal mobility behavior with me?

Systems Architecture



Prediction & Recommendation Model

#	Prediction and Recommendation Algorithm
1	**Input:** KB // knowledge base, i // examined instance, d //day of the week, m //historic window size, l // prediction window size,
2	μ //spatial historic similarity threshold, ϑ //spatial prediction similarity threshold, k //recommendation list size
3	**Output:** N //returned recommendation list
4	**Begin**
5	$N \leftarrow Null$ //returned recommendation list is empty, $k \leftarrow read()$ //initialize recommendation list size
6	$i \leftarrow read()$ //read the examined instance from user mobile app, $j \leftarrow read(KB)$ //read the first instance of the KB
7	**While** $(j \neq KB(EoF))$ **Do** //traverse KB
8	**If** $((d(i) = d(j))\ AND\ (i(m) - j(m) \leq \vartheta)\ AND\ (i(l) - (j(l) \leq \vartheta))$ **Then** //if current and predicted locations of i, j are similar w.r.t. ϑ similarity for certain day
9	**For** $(n \in [0,\ m-1])$ **Do** //traverse from first to last historic location of the trajectory
10	**If** $(i(n) - j(n) \leq \mu)$ **Then** //step by step historic comparison
11	$\varphi \leftarrow \varphi + 1$ //historic similarity flag increases
12	**End If**
13	**End For**
14	**If** $(\varphi = n)$ **Then** //if historic similarity condition w.r.t. μ holds proceed to recommendation list step
15	**If** $(size(N) \leq k)$ **Then** //if size of N is less than or equal to k
16	$N \leftarrow N + j$ //recommendation list is expanded
17	**Else**
18	$sort(N)$ //sort recommendations in ascending order of similarity
19	$return(N)$ //return recommendation list and exit
20	**End If**
21	**End If**
22	**End If**
23	**End While**
24	**End**

Evaluation Method & Metrics

- 10-Fold Cross Validation Evaluation Method
- Prediction Accuracy Evaluation Metric
- Recommendation MAP@N Evaluation Metric

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Experiments – Data Visualization

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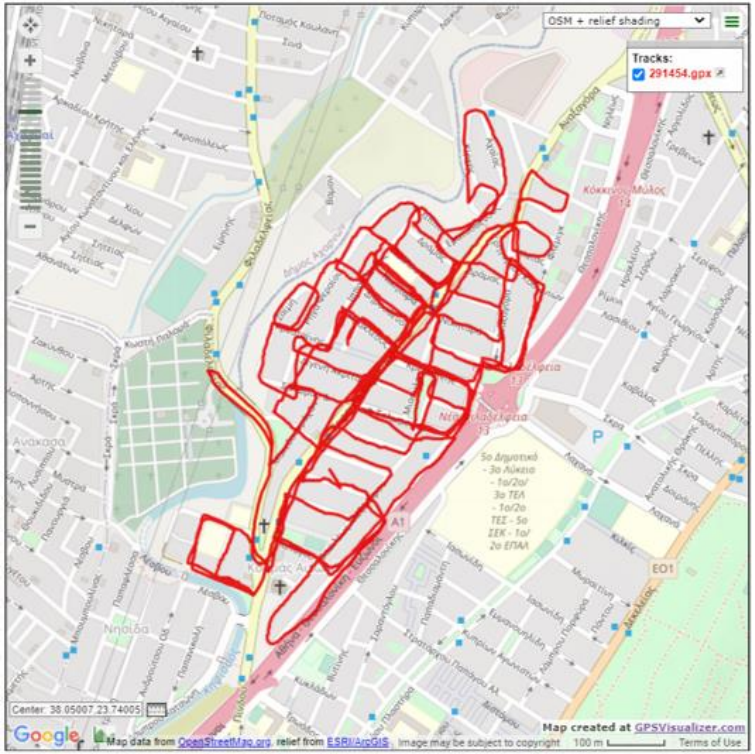

Experiments – Data Structure

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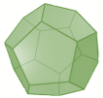
Dataset Experimental Parameters



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Parameter	Value
GPS traces length	8 decimal digits
Sensitivity	10 meters
Minimum latitude	38.04582595
Minimum longitude	23.73619793
Maximum latitude	38.05432318
Maximum longitude	23.74390125
Coverage area	0.64 square kilometers

Model Experimental Parameters

Parameter	Value
l	1 GPS predicted location
ϑ	0.00000001 (10 meters)
μ	0.000001 (100 meters)
$\|U\|$	100 users totally
$\|KB\|$	2958 instances

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Results – Historic Window Size

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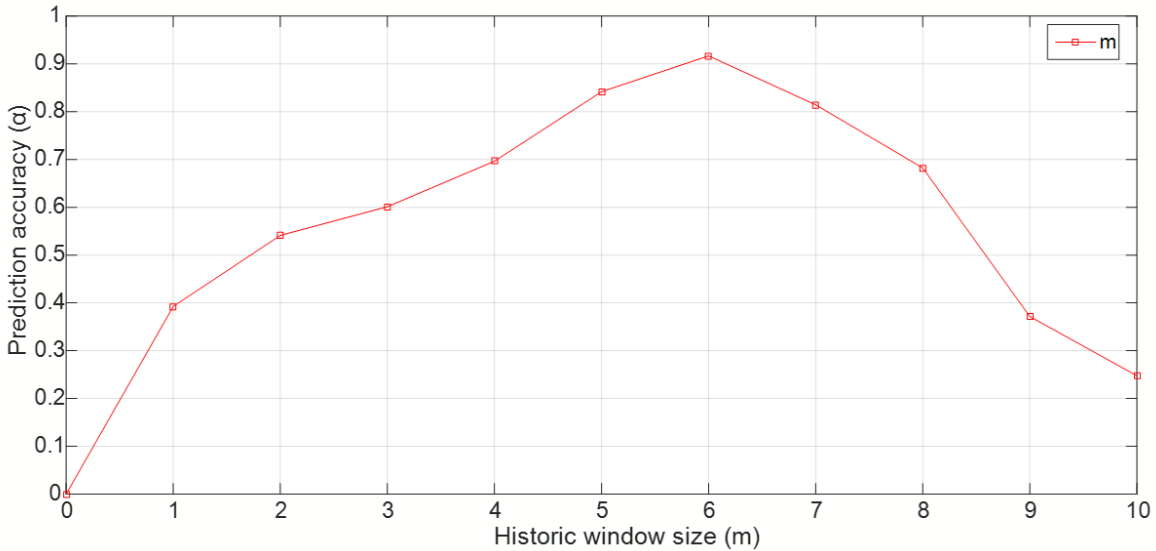

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Results – Optimal System Convergence

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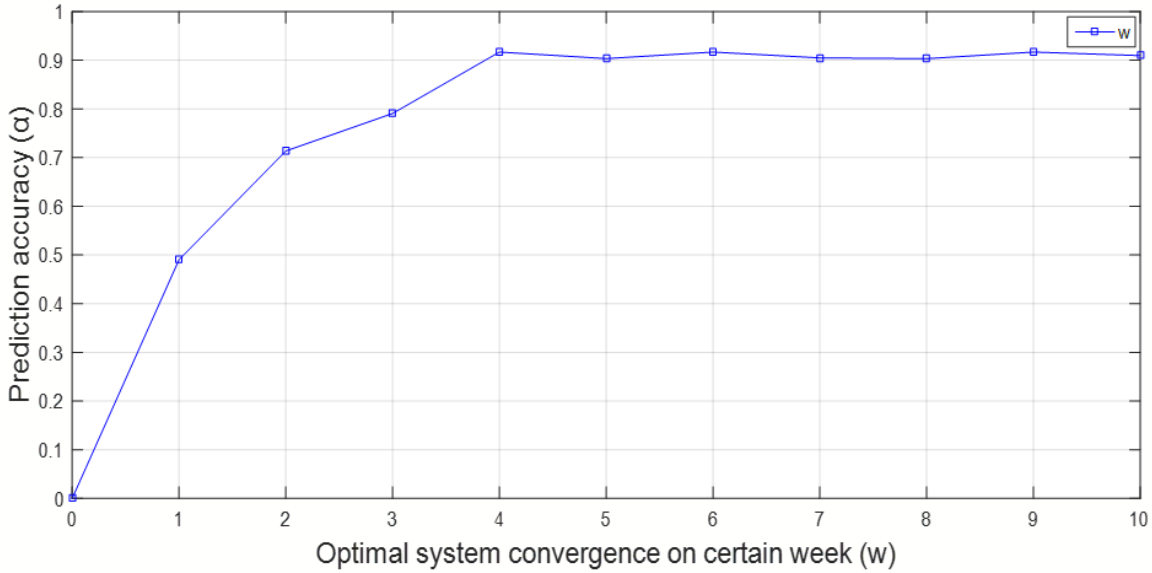

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Results – Recommended Users

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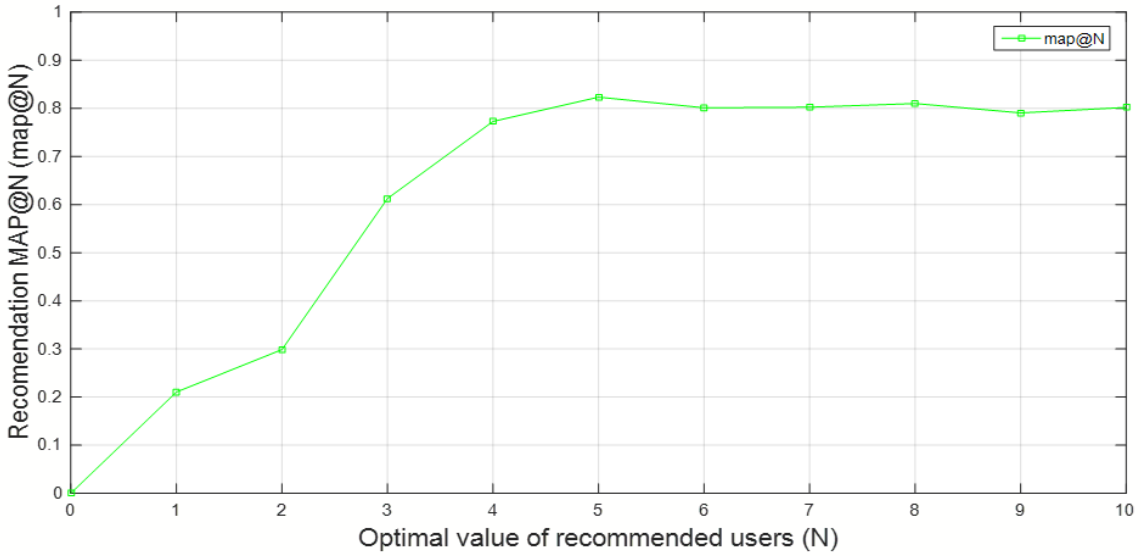

Future Directions

- Time of Arrival Estimation to Destination Service
- Citizen – Centric Qualitative Data Sources
- Social Networks Mobility Context

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Funding Received

Themisi : Research & Innovation European Project

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Business Alliance

Movebis : Germany

Cloudcrew.io : Greece

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Test in the Wild

Smart City of Viborg : Denmark

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Th@nk you for your Attendance!
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