Semantic Enrichment of Mobile Phone Data Records Using Linked Open Data

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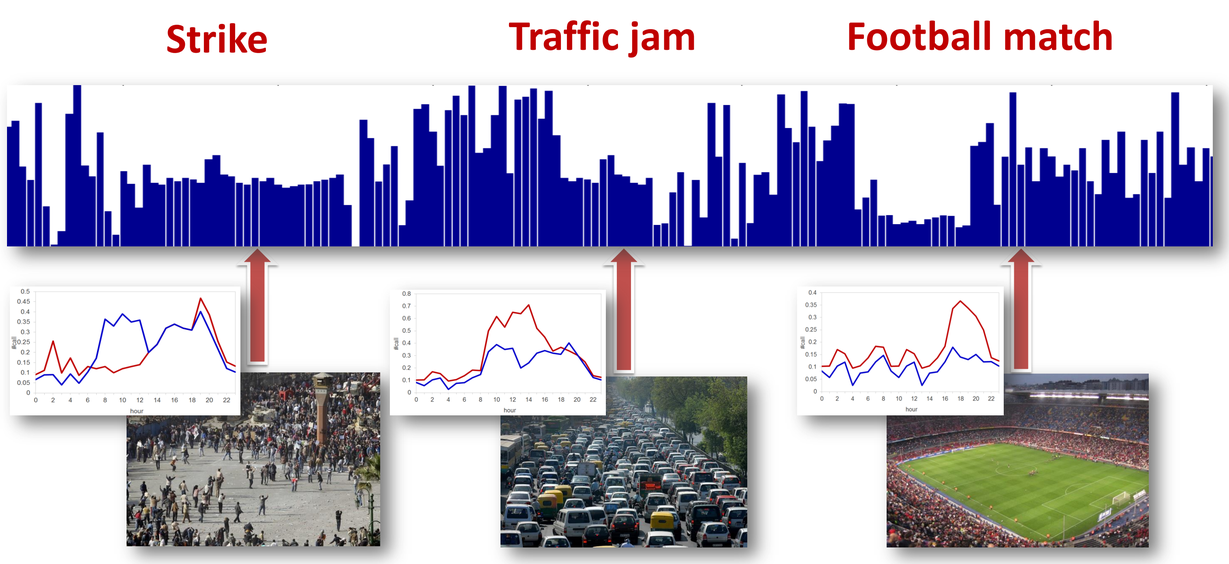
The problem

Recognizing personal & social behaviors from mobile phone data (CDR) using geo/time referenced relevant knowledge [1]

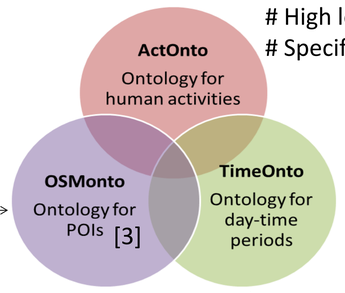
Challenges:
- ✓ Large amounts of CDR
- ✓ Privacy (largely anonymous data)
- ✓ Noisy and incomplete data
- ✓ Heterogeneous data (CDR and Linked Open Data (LOD))

A qualitative description of human **activities/events** interpreted in CDR



Methodology

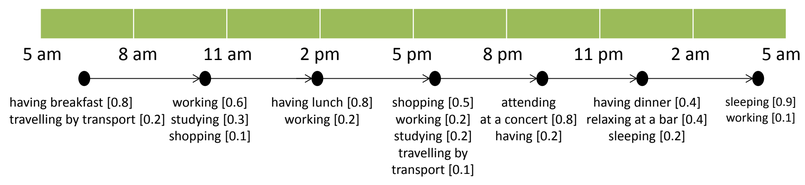
:Instance of Point of Interest (POI)



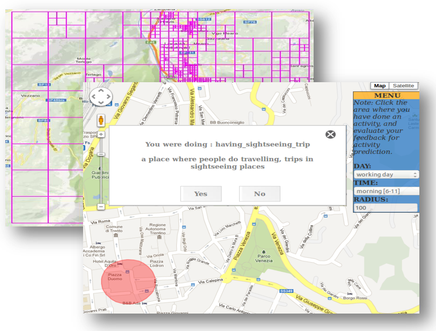
High level activities: 10
Specific activities: 220

:Instance of activity/event

Possible actions ranked



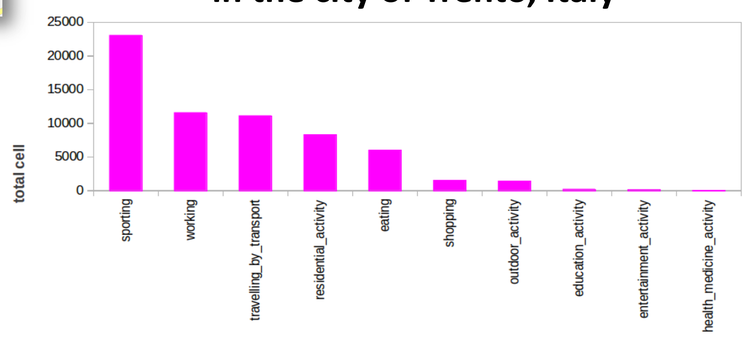
BHRModel application



Trento's area of about 157.9 km^2 with 333,809 POIs (cleaned to 159,314) is partitioned in 27,632 cells, with an average of 7.1 POI/cell.

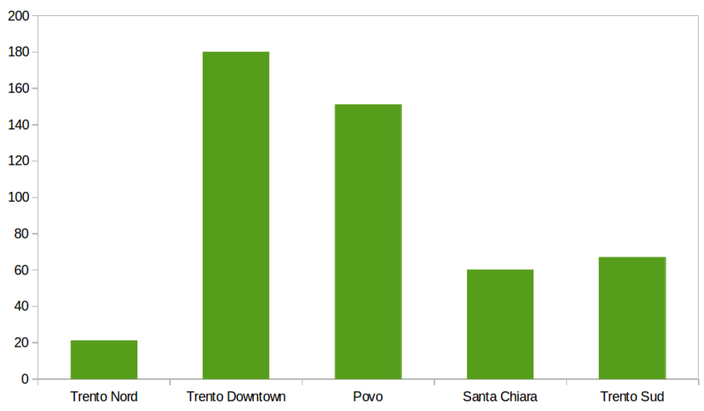
We created a web application that predicts possible human activities/events happened in a territory (selected the city of Trento, Italy for the experiment). A geographical area of the territory is divided into a grid [2].

Histogram of activities in the city of Trento, Italy



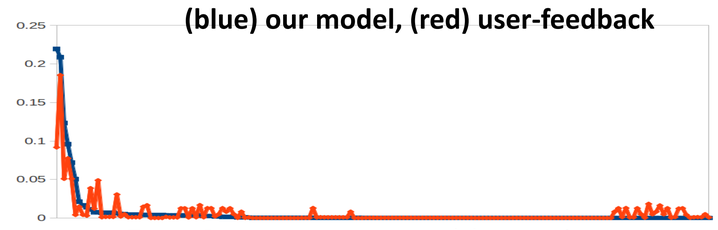
Experiment & Evaluation

Histogram of feedback in the city of Trento, Italy

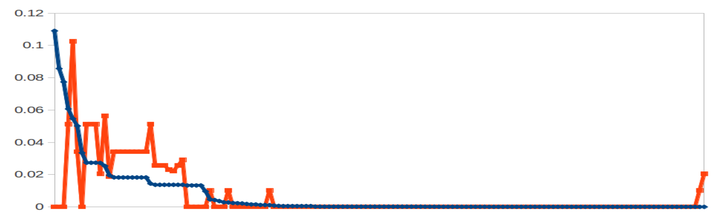


Territory: the city of Trento, Italy
Total feedback: 481
Participants: 32 people
Duration: a week
Clusters by the feedback location: 5 clusters
Overall accuracy (specific activities) : **70.89**%
Overall accuracy (high level activities): **80.23**%
Overall accuracy (among top-5) : **61.95**%

Divergence of probability of activities from (blue) our model, (red) user-feedback



Trento Downtown area on weekday mornings



Trento Povo area on weekday afternoons

Conclusions & Future work

✓Ability to predict possible human activities/events that happen in a given region at a given time in which CDR occur.
✓Ability to provide a qualitative description of human activities/events given in terms of semantically rich concepts that refer to an ontology of human actions and events and environmental descriptions.

Future work:
✓Enrich the model making use of the other geo/time-referenced knowledge available on the web, such as info on weather forecast, social events, news events and other statistical information about a region and so on.
✓Improve the classification task of behaviors and the identification and prediction from the CDR with the help of machine learning methods.

References

[1]. Z.Dashdorj and L.Serafini. Semantic interpretation of mobile phone records exploiting background knowledge. In Intl.Conf. ISWC 2013, Doctoral Consortium, 2013.
[2]. S.Phithakkitnukoon, T.Horanont, G.Di Lorenzo, R.Shibasaki, and C.Ratti. Activity-aware map: identifying human daily activity pattern using mobile phone data. I n the Proc. of the 1st Intl. Conf. Human Behavior Understanding, pages 14–25, 2010.
[3]. M. Codescu, G. Horsinka, O. Kutz, T. Mossakowski, and R. Rau. Osmonto - an ontology of openstreetmap tags. In State of the map Europe (SOTM-EU), 2011