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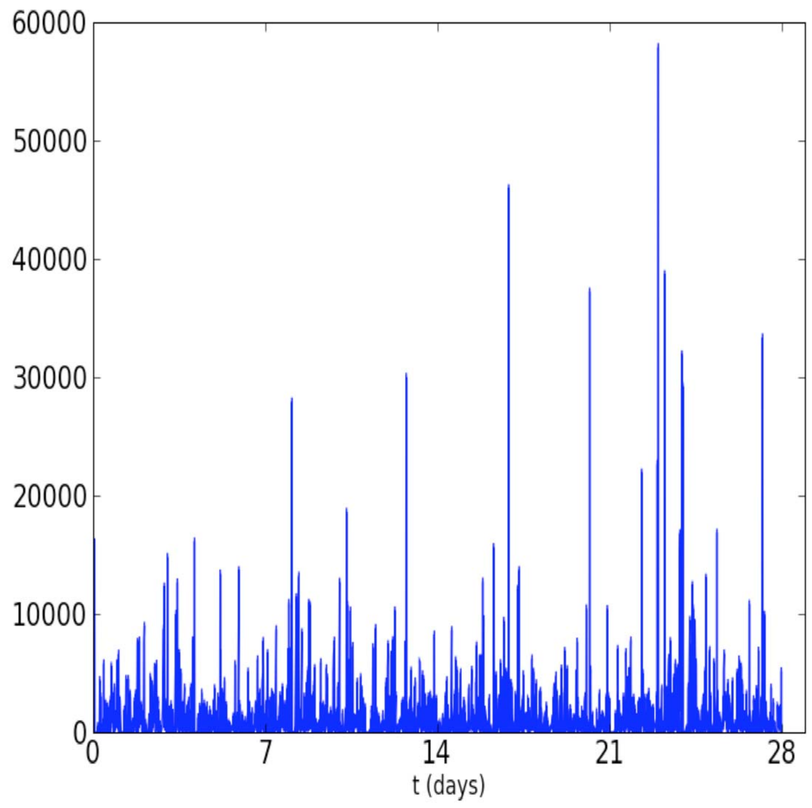
Spatial and Temporal Analysis of Collective and Individual Human Mobility

Problem

Mobile devices are now widely available and they are becoming increasingly ubiquitous. However, mobile applications are far from being fully context-aware and do not automatically react to human activities. **Time** and **space** are the two immanent categories that embed human actions and movements, thus ubiquitous devices should be able to predict human movements and activities in order to anticipate user needs. Furthermore, distributed networked systems generally assume random mobility patterns for users, but this is far from the truth.

Applications

- Devices able to sense geographical, social and behavioral context
- Location-aware services, social facilitators, targeted advertising
- Insight about collective behavior
- Security control and monitoring
- Urban planning and public services analysis



Challenges

• Spatial and temporal characteristics of human movements are complex but intertwined

• Human actions are so unpredictable..or not?

• Individual behavior can significantly deviate from collective behavior

• Privacy issues related to data collection and analysis

Main ideas

• **Daily** and **weekly patterns** in human activities can be identified and exploited

• Personal routines are quite **predictable**

• Significant portion of daily human activities happens in few **significant places**

• People in the same locations may share interests or **common behavior**

• Collective analysis of people movements gives insight on human use of **geographical space**

Initial results

An initial result is the identification of **some degree of determinism** in patterns of visits of humans to specific **significant places**.

Through the **nonlinear analysis of the time series** extracted from the arrival and residence times of users in relevant places we are able to predict the locations where they will be in the short-term future.

The evaluation over different datasets confirms a **prediction accuracy which ranges between 65% and 90%** even after a number of hours, while linear predictors or Markov-based predictors perform considerably worse for predictions extending in the future.

• *S. Scellato, M. Musolesi, C. Mascolo, V. Latora, A. Campbell -* ***"Predicting Mobile User Location through Nonlinear Time Series Analysis"*** *- Submitted for publication*
• *S. Scellato, M. Musolesi, C. Mascolo, V. Latora -* ***"On Nonstationarity and Predictability of Human Networks"*** *- Submitted for publication*