

Exploring Urban Human Activity Patterns Using Large-scale Location Sharing Service Data

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In recent years, the introduction of location-based services in online social networks have provided unprecedented amount of public-generated data on human movement. This data provide us a new dimension of information related to human activity categories with greater details.

In this study, we analyze the spatio-temporal patterns of human activities from the location-based information shared in an online social media (i.e. Twitter). Previous human mobility studies used only distance-based measures to characterize human mobility patterns using data collected from mobile phones [1], bank notes movements [2], and subway smart-card transactions [3] etc. However these studies fail to provide any information about the purposes behind these human movements. However, neglecting the activity purposes can be potentially problematic, as different purposes may impact people's decisions on when and where to go to perform the activity. Therefore by considering the spatio-temporal dimensions and activity categories (i.e. purposes) into the analysis, we are able to discover more realistic and detailed descriptions of human dynamics.

Data

The data used in this study is the checkins from location sharing service (LSS), like Foursquare, Gowalla, etc. The data were collected from February 25, 2010 to January 20, 2011 which about a year's period [4]. The original data contains 22 million checkins across 220,000 users. We further reprocess the data to obtain location category information from Foursquare for each record, and breakdown the data into city level to investigate urban human activity patterns. The location category information in this data provides very detailed and accurate representation of the activity that a human is participating, therefore it can allow us to investigate urban human activity patterns in a much finer detail.

Methodology

In this study, activity patterns are investigated in both individual level as well as city level. Studying individual activity patterns can reveal the hidden patterns about how people make travel decisions. Important factors like activity location, activity type, and activity timing constitute the major dimensions of human activity participation behavior. To study the individual level activity patterns, we compute a characteristic length of movement for each user and analyze its distribution with respect to each activity category and time period. These distributions reveal the spatio-temporal activity patterns when human perform different types of activities. We also analyze the frequency of visits at different locations and rank the visited locations based on the corresponding frequency, which reveals the spatial regularity of individual movements.

On the other hand, by looking at the activity pattern on aggregate city level, we can understand how activity patterns are distributed spatially in the city. Investigating these patterns can information on important characteristics such as the proportions of activity-specific trips attracted to different places and the temporal variations of visitation pattern for different activity categories. We construct a virtual grid reference by dividing the city map into square cells of 200 by 200 meters. We count the number of purpose-specific visits within each cell and get the proportion of each activity category. We also compute the radius of gyration of each purpose-specific visits of each cell. These will generate an activity distribution map which shows the popular places within a city and the functionality of each part of the urban area. Using these approaches, we can visualize different human activities in a city and thus capture the pulse of urban human dynamics.

References

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