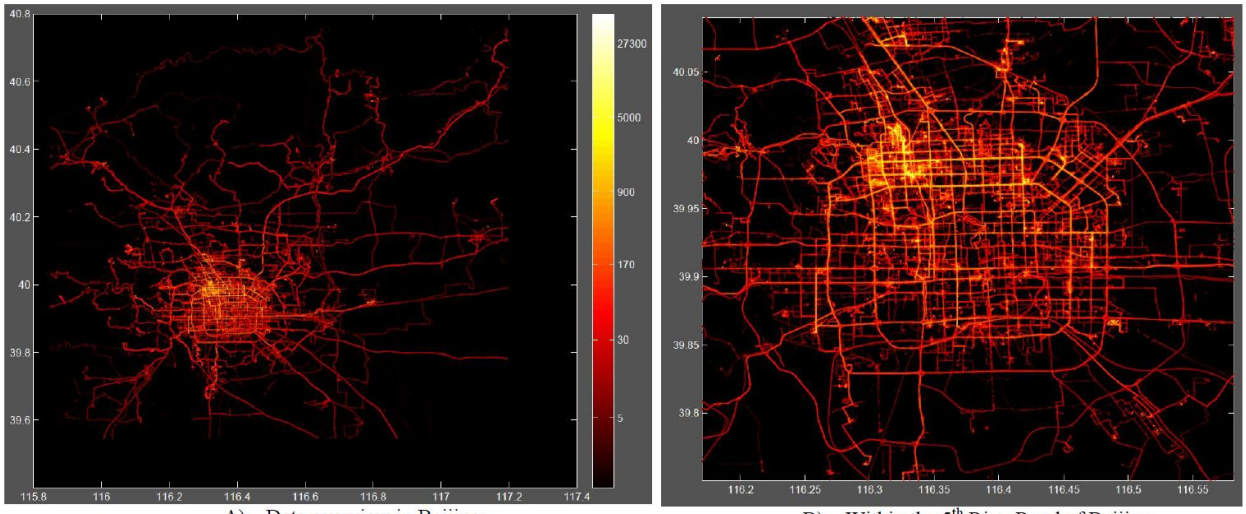
1.0 Project Description

Process and collect GPS trajectory dataset.

This GPS trajectory dataset was collected in (Microsoft Research Asia) Geolife project by 182 users in a period of over five years (from April 2007 to August 2012). A GPS trajectory of this dataset is represented by a sequence of time-stamped points, each of which contains the information of latitude, longitude and altitude. This dataset contains 17,621 trajectories with a total distance of 1,292,951kilometers and a total duration of 50,176 hours. These trajectories were recorded by different GPS loggers and GPS-phones, and have a variety of sampling rates. 91.5 percent of the trajectories are logged in a dense representation, e.g. every 1~5 seconds or every 5~10 meters per point.

This dataset recorded a broad range of users' outdoor movements, including not only life routines like go home and go to work but also some entertainments and sports activities, such as shopping, sightseeing, dining, hiking, and cycling. This trajectory dataset can be used in many research fields, such as mobility pattern mining, user activity recognition, location-based social networks, location privacy, and location recommendation.

Although this dataset is widely distributed in over 30 cities of China and even in some cities located in the USA and Europe, the majority of the data was created in Beijing, China. Figure 1 plots the distribution (heat map) of this dataset in Beijing. The figures standing on the right side of the heat bar denote the number of points generated in a location.



A) Data overview in Beijing

B) Within the 5th Ring Road of Beijing

Figure 1 Distribution of the dataset in Beijing city

The distributions of distance and duration of the trajectories are presented in Figure 2 and Figure 3.

In the data collection program, a portion of users have carried a GPS logger for years, while some of the others only have a trajectory dataset of a few weeks. This distribution is presented in Figure 4, and the distribution of the number of trajectories collected by each user is shown in Figure 5.

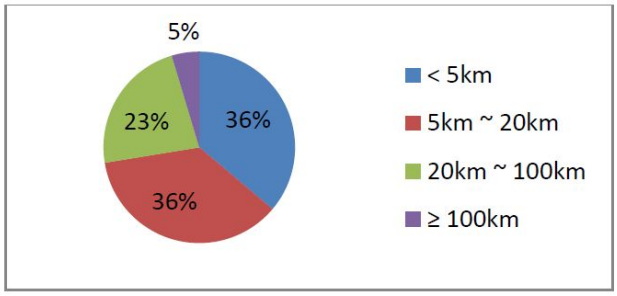


Figure 2 Distribution of trajectories by distance

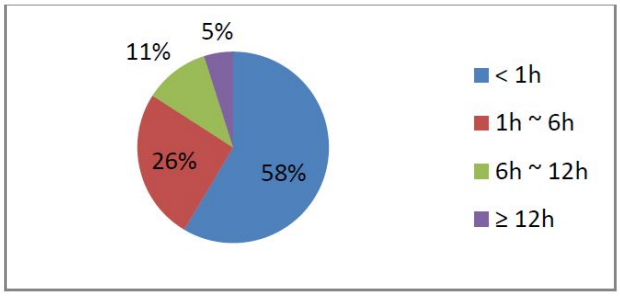


Figure 3 Distribution of trajectories by effective duration

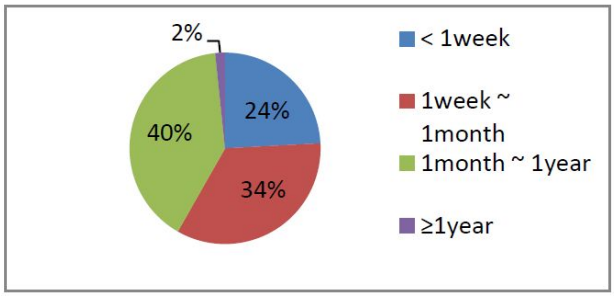


Figure 4 Distribution of users by data collection period

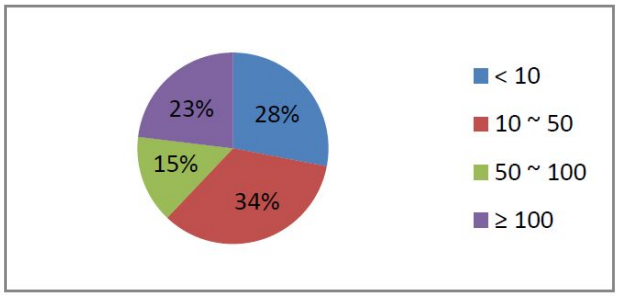


Figure 5 Distribution of users by trajectories

2. What's new?

2.1. Transportation mode labels

73 users have labeled their trajectories with transportation mode, such as driving, taking a bus, riding a bike and walking. There is a label file storing the transportation mode labels in each user's folder. See section 4.2 for the format of labels.

The total distance and duration of transportation modes are listed in Figure 6. Though this only covers a part of the dataset used in the following papers, the scale of this released dataset can still support transportation mode learning.

Transportation mode	Distance (km)	Duration (hour)
Walk	10,123	5,460
Bike	6,495	2,410
Bus	20,281	1,507
Car & taxi	32,866	2,384
Train	36,253	745
Airplane	24,789	40
Other	9,493	404
Total	14,0304	12,953

Figure 6 Total distance and duration of transportation modes

2.2. Changes on the scale of dataset

Changes on the scale of dataset between version 1.2 and version 1.3 are listed in Figure 7. Effective days refer to the total number of days where there's a record in the dataset.

	Version 1.2	Version 1.3	Change
Time span of the collection	04/2007 – 10/2011	04/2007 – 8/2012	+10 months
Number of users	178	182	+4
Number of trajectories	17,621	18,670	+1,049
Number of points	23,667,828	24,876,978	+1,209,150
Total distance	1,251,654km	1,292,951km	+41,297 km
Total duration	48,203hour	50,176hour	+1,973 hour
Effective days	10,413	11,129	+716

Figure 7 Changes on the scale of dataset

3. Paper Citation

Please cite the following papers when using this GPS dataset.

[1] Yu Zheng, Lizhu Zhang, Xing Xie, Wei-Ying Ma. Mining interesting locations and travel sequences from GPS trajectories. In Proceedings of International conference on World Wild Web (WWW 2009), Madrid Spain. ACM Press: 791-800.

[2] Yu Zheng, Quannan Li, Yukun Chen, Xing Xie, Wei-Ying Ma. Understanding Mobility Based on GPS Data. In Proceedings of ACM conference on Ubiquitous Computing (UbiComp 2008), Seoul, Korea. ACM Press: 312-321.

[3] Yu Zheng, Xing Xie, Wei-Ying Ma, GeoLife: A Collaborative Social Networking Service among User, location and trajectory. Invited paper, in IEEE Data Engineering Bulletin. 33, 2, 2010, pp. 32-40.

2.0 Data Files

2.1. Trajectory file

Every single folder of this dataset stores a user's GPS log files, which were converted to PLT format. Each PLT file contains a single trajectory and is named by its starting time. To avoid potential confusion of time zone, we use GMT in the date/time property of each point, which is different from our previous release.

PLT format:
Line 1…6 are useless in this dataset, and can be ignored. Points are described in following lines, one for each line.
Field 1: Latitude in decimal degrees.
Field 2: Longitude in decimal degrees.
Field 3: All set to 0 for this dataset.
Field 4: Altitude in feet (-777 if not valid).
Field 5: Date - number of days (with fractional part) that have passed since 12/30/1899.
Field 6: Date as a string.
Field 7: Time as a string.
Note that field 5 and field 6&7 represent the same date/time in this dataset. You may use either of them.
Example:
39.906631,116.385564,0,492,40097.5864583333,2009-10-11,14:04:30
39.906554,116.385625,0,492,40097.5865162037,2009-10-11,14:04:35

2.2. Transportation mode labels

Possible transportation modes are: walk, bike, bus, car, subway, train, airplane, boat, run and motorcycle. Again, we have converted the date/time of all labels to GMT, even though most of them were created in China.
Example:
Start Time End Time Transportation Mode
2008/04/02 11:24:21 2008/04/02 11:50:45 bus
2008/04/03 01:07:03 2008/04/03 11:31:55 train
2008/04/03 11:32:24 2008/04/03 11:46:14 walk
2008/04/03 11:47:14 2008/04/03 11:55:07 car
First, you can regard the label of both taxi and car as driving although we set them with different labels for future usage. Second, a user could label the transportation mode of a light rail as train while others may use subway as the label. Actually, no trajectory can be recorded in an underground subway system since a GPS logger cannot receive any signal there. In Beijing, the light rails and subway systems are seamlessly connected, e.g., line 13 (a light rail) is connected with line 10 and line 2, which are subway systems. Sometimes, a line (like line 5) is comprised

of partial subways and partial light rails. So, users may have a variety of understanding in their transportation modes. You can differentiate the real train trajectories (connecting two cities) from the light rail trajectory (generating in a city) according to their distances. Or, just treat them the same.

3.0 Data Ingestion and Initial Validation

- [x] 3.0.1 Data comes as a stream real time in several data sources simultaneously
- [x] 3.0.2 All the timestamp fields in data coming from web application is of the format YYYY-MM-DD HH:MM:SS.
- [x] 3.0.3 All the timestamp fields in data coming from mobile application is a long integer interpreted as UNIX timestamps.
- [x] 3.0.4 Altitude in feet (-777 if not valid).
- [x] 3.0.5 Create a temporary identifier for each data line

4.0 Data Enrichment

4.1 Rules for data enrichment

- [x] 4.1.1 to each log line should be added “dist” column which represent the geo trajectory distance between current log line and previous chronological log line for the corresponding trajectory

- [x] 4.1.2 to each log line should be calculated “tdiffs” column which represent the time difference between current log line and previous chronological log line for the corresponding trajectory

- [x] 4.1.3 if previous timestamp of corresponding trajectory not older than current timestamp of the trajectory set the time difference is 0

- [x] 4.1.4 each calculation should be perform in real-time or near real-time mode

4.2 Post Enrichment

- [x] 4.2.1 Maintain a copy of valid raw GPS records in HBase.

- [x] 4.2.2 Move all valid records in HBase

5.0 Data Analysis

Data Analysis (SHOULD BE IMPLEMENTED IN SparkSQL) and should be using another sql engine to check the correctness of query result (where it is possible)

- [x] 5.0.1 Show users and their data collection period

- [x] 5.0.2 Determine top 10 users amount of trajectories.

- [x] 5.0.3 Determine top 10 trajectories by duration.

- [x] 5.0.4 Determine top 10 endured trajectory and which user they belong.

5.1. Challenges and optimization

☑ 5.1.1 Raw data and processed data comes to NoSQL database as a stream. All calculations and validations performed as a data streams.

☑ 5.1.2 Try to make joins as less expensive as possible.

☑ 5.1.3 Adopt appropriate monitoring to maintained to track the behaviour and overcome failures in the pipeline.

☑ 5.1.4 The data flow should be built around cloud compatible pipeline technologies

☑ 5.1.5 For data analytics in spark use technologies that could be work with Hadoop resource manager like YARN

☑ 5.1.6 Write data to HBase as a stream

6.0 Post Analysis

6.0.1. Moving result of analysis to the RDBMS for data storage and quick retrieval.

Contact

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Release history

Version 1.3 (released 2012/08/01)
Version 1.2 (released 2011/10/31)
Version 1.1 (released 2011/07/25)
Version 1.0 (released 2010/09/30)

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<< GeoLife GPS Trajectories>>

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