



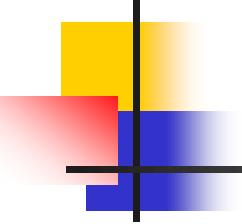
Big Data Analytics on Big Spatial Database

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Presented by Raymond Wong
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- Do you know what is the hot topic in June and July in 2014 (last year)?



World Cup

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- Do you know which country won the World Cup 2014?



Germany

FIFA WORLD CUP
Brasil

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- The Final Match in World Cup 2014
 - Germany vs. Argentina

1:0

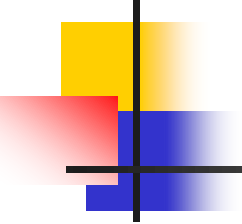
- The Semi-Final Match in World Cup 2014
 - Germany vs. Brazil

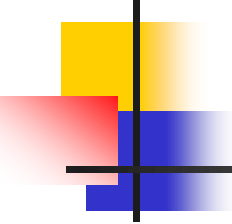
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- Do you know why Germany won the World Cup 2014?



It is related to Big Spatial Data.

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- The German Football Association (DFB) found SAP to develop an application called “Match Insights” (a spatial processing tool)
 - Each player puts a sensor under his sock
 - The receiver in the football field receives the current position
 - This analyzes a vast amount of data about members of the German team and their opponents, based on their on-field performance.

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- The tool also analyzes all videos recorded from other teams to know how they played in the football matches
 - The tool gives a strategy to the German team how to play with other teams in a smart way
 - In other words, each German player is instructed and no player will “show off” in the match.



- World Cup 2010

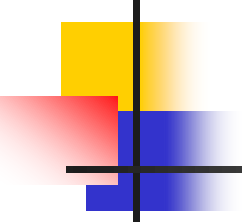
- According to the tool “Match Insights”

- The coaching staff could see the German players had been holding the ball for too long and there is a need to speed things up.
- The average ball possession time was 3.4 seconds

- World Cup 2014

- According to the tool “Match Insights”

- The average ball possession was reduced to 1.1 seconds

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- Now, we know a successful story of using big data.
 - Next, let us see mobile applications.

Applications



500+ location-based apps (appcrawlr.com)

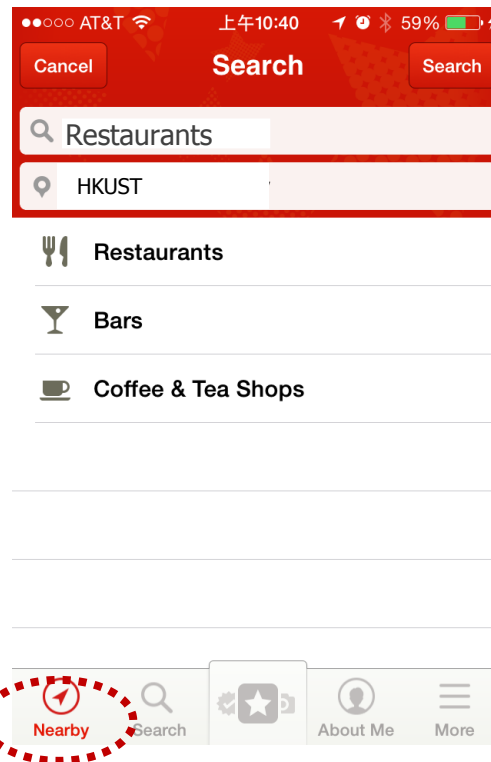
What do location-based Apps do?



- Search-nearby

Find something nearby somewhere

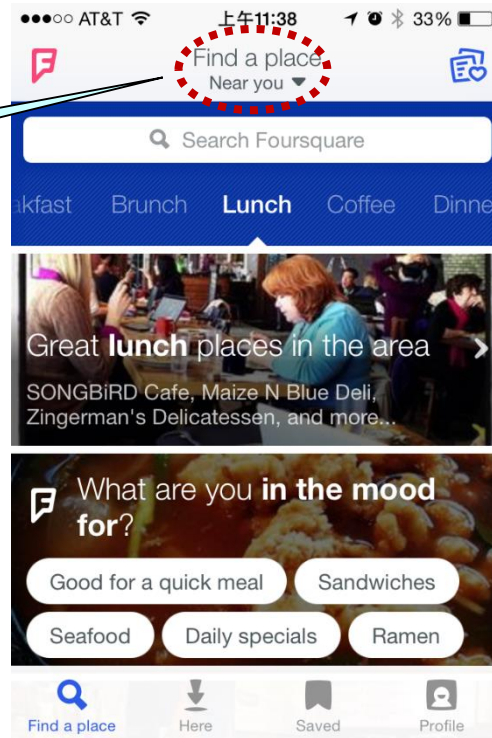
Search-nearby: Yelp



Search-nearby

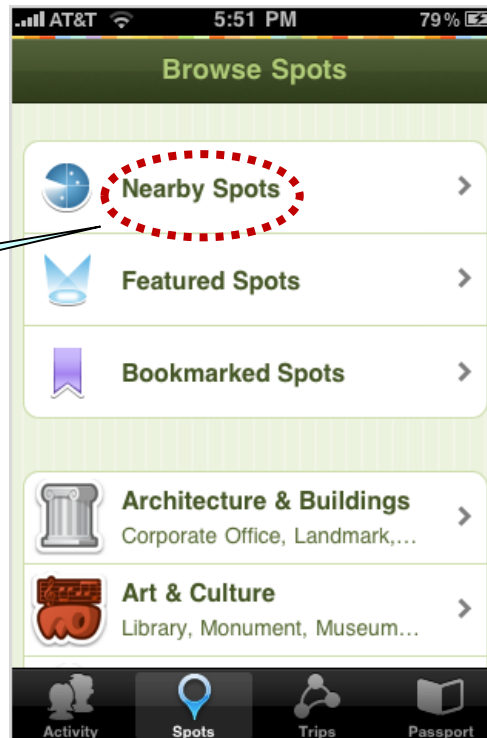
Search-nearby: Foursquare

Find a place
Near you



Search-nearby: Gowalla

Nearby Spots





Search-nearby

- My previous work
 - Exact Top-k Nearest Keyword Search in Large Networks (SIGMOD2015)
 - Hypersphere Dominance: An Optimal Approach (SIGMOD 2014)
 - Collective Spatial Keyword Queries: A Distance Owner-Driven Approach (SIGMOD 2013)
 - Efficient Method for Maximizing Bichromatic Reverse Nearest Neighbor (VLDB 2009)

What do location-based Apps do?

- Search-nearby

- Spatial Crowdsourcing

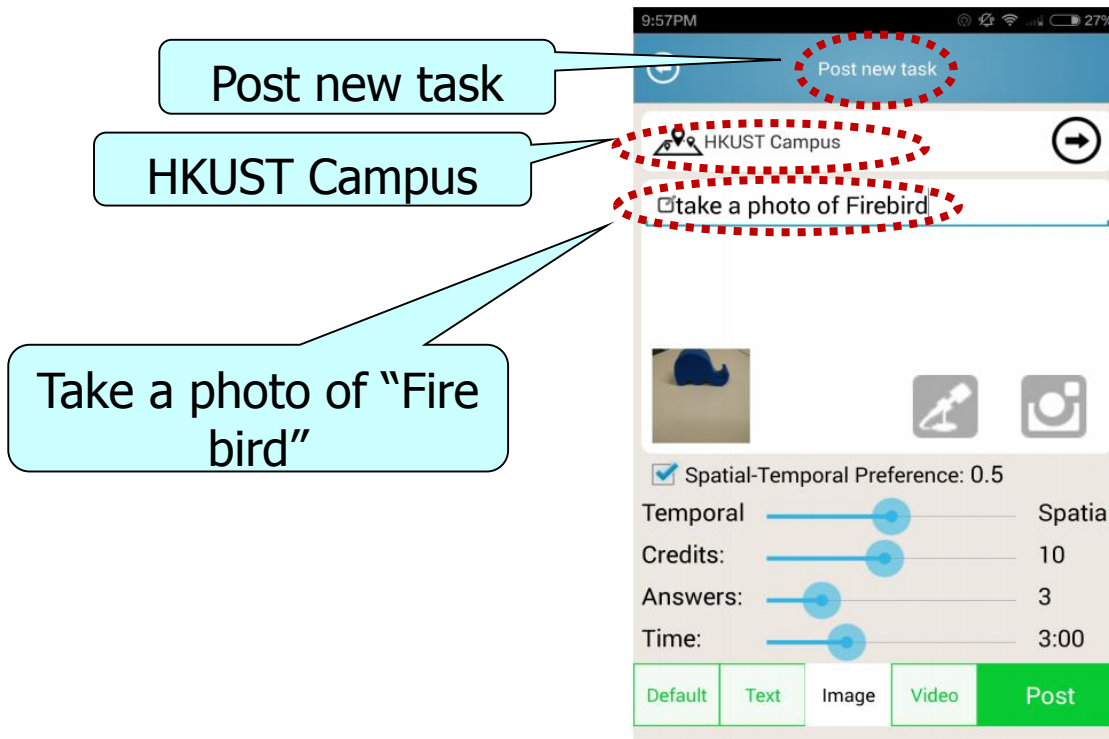
Crowdsourcing is a platform where people post tasks and some other people perform tasks

Each task is associated with a **location**

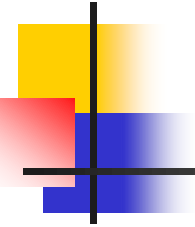
Workers need to go to the location physically in order to perform the task

E.g., take a video clip at Times Square of New York

Spatial Crowdsourcing: gMission



Spatial Crowdsourcing: LocalHands



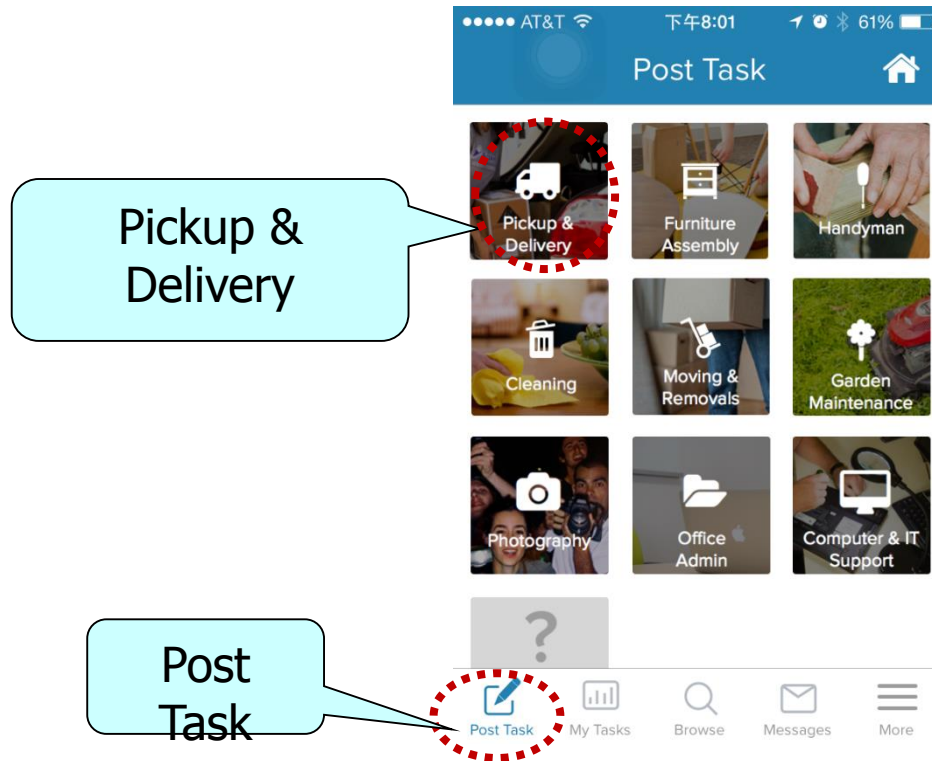
The screenshot shows the LocalHands mobile app interface. At the top, the status bar displays 'AT&T', signal strength, time '下午8:01', location, Bluetooth, and 61% battery. The app header is blue with the 'localHands' logo in white script. Below the header is a 2x3 grid of task categories, each with an icon and text: 'OUTDOOR HOME' (a person with a lawnmower), 'HANDYMAN' (a person with a tool), 'MOVE & HAUL' (a person with a dolly), and 'CLEANING' (a person cleaning a window). The 'OUTDOOR HOME' category is circled with a red dashed line. Below the grid is a navigation bar with four icons: a checkmark for 'Post Task', a credit card for 'Payments', a hand for 'LocalHands', and a person for 'About Us'. The 'Post Task' icon is also circled with a red dashed line. Three callout boxes are present: one pointing to 'OUTDOOR HOME' with the text 'Outdoor home', one pointing to the 'Post Task' icon with the text 'Post Task', and one pointing to the 'OUTDOOR HOME' icon with the text 'E.g., snow removal, leaf removal...'. The 'Post Task' icon is highlighted in blue.

Outdoor home

E.g., snow removal, leaf removal...

Post Task

Spatial Crowdsourcing: Airtasker





Spatial Crowdsourcing

- My previous work
 - On Optimal Worst-Case Matching (SIGMOD 2013)
 - On Efficient Spatial Matching (VLDB 2007)

What do location-based Apps do?

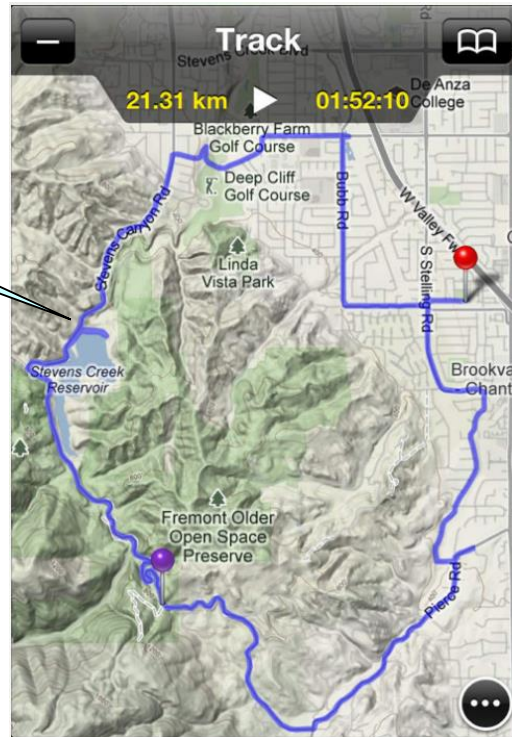
- Search-nearby
- Spatial Crowdsourcing
- Trace Tracking

Record the trace of a movement

E.g., by sampling the positions of the trace periodically

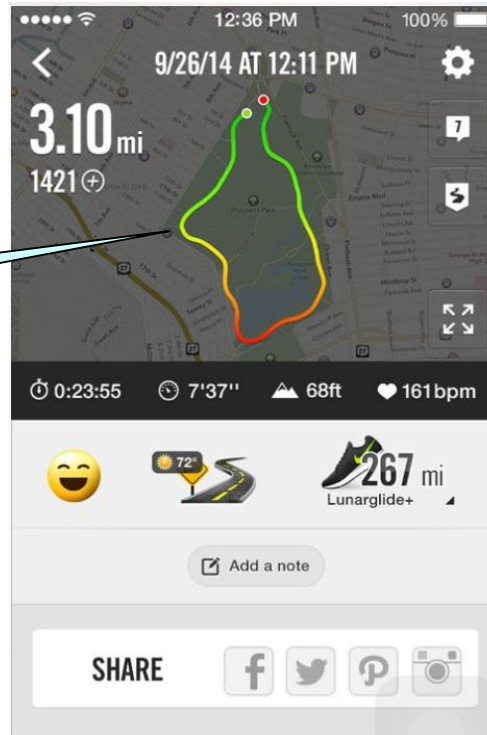
Trace tracking: Maps+

Trace



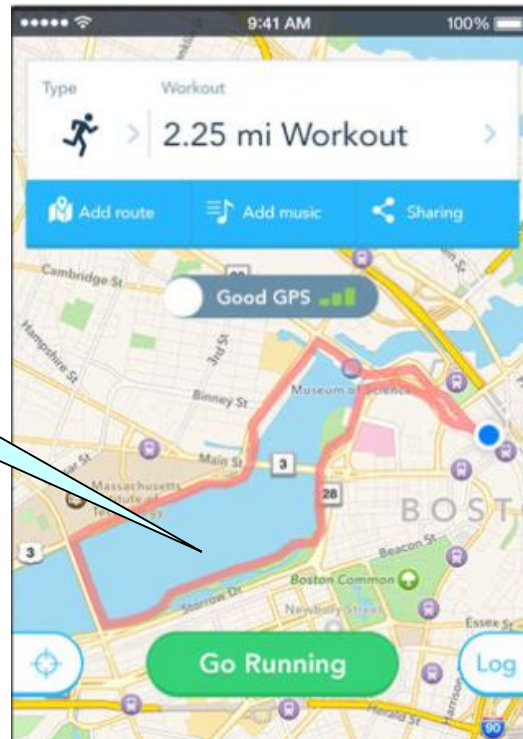
Trace tracking: Nike+

Trace



Trace tracking: Run Keeper

Run keeper






Trace tracking

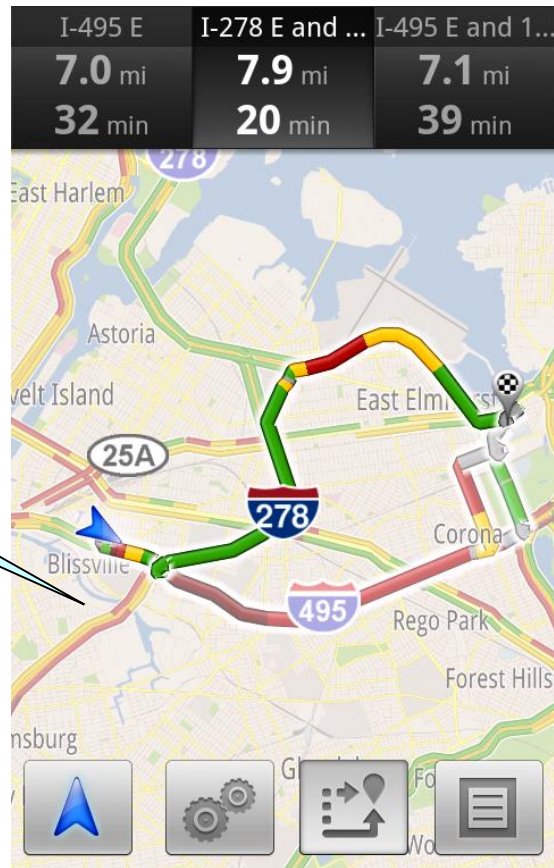
- My previous work
 - Trajectory Simplification: On Minimizing the Direction-based Error (VLDB 2015)
 - Direction-Preserving Trajectory Simplification (VLDB 2014)

What do location-based Apps do?



- Search-nearby
- Spatial Crowdsourcing
- Trace Tracking
- Shortest Distance 

Shortest Distance: Google Map





Shortest Distance

- My previous work
 - New Lower and Upper Bounds for Shortest Distance Queries on Terrains (VLDB 2016)
 - Finding Shortest Paths on Terrains by Killing Two Birds with One Stone (VLDB 2014)
 - Hop Doubling Label Indexing for Point-to-Point Distance Querying on Scale-Free Networks (VLDB 2014)
 - Terrain-Toolkit: A Multi-Functional Tool for Terrain Data (VLDB 2014 (Demo))
 - IS-Label: an Independent-Set based Labeling Scheme for Point-to-Point Distance Querying (VLDB 2013)
 - Finding Shortest Path on Land Surface (SIGMOD 2011)



Conclusion

- Search-nearby
- Spatial Crowdsourcing
- Trace Tracking
- Shortest Distance



Thank you
