Big Data Analytics on Big Spatial Database

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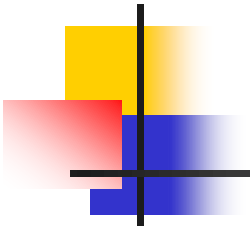
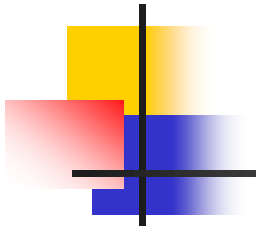


- Do you know what is the hot topic in June and July in 2014 (last year)?

World Cup

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

Germany

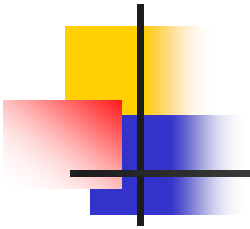


- The Final Match in World Cup 2014
  - Germany vs. Argentina

1:0

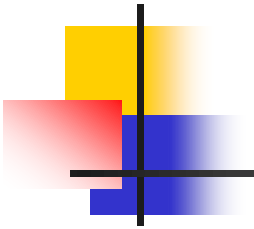
- The Semi-Final Match in World Cup 2014
  - Germany vs. Brazil

7:1

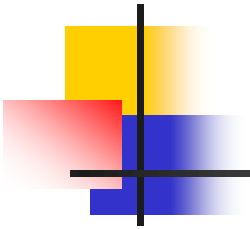


- Do you know why Germany won the World Cup 2014?

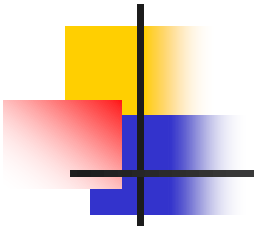
It is related to Big Spatial Data.



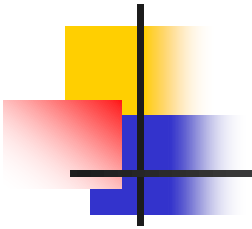
- The German Football Association (DBF) found SAP to develop an application called “Match Insights” (a spatial processing tool)
  - Each player puts a sensor under his sock
  - The receiver in the football field receives the current position
- This analyzes a vast amount of data about members of the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



- 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



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

Applications

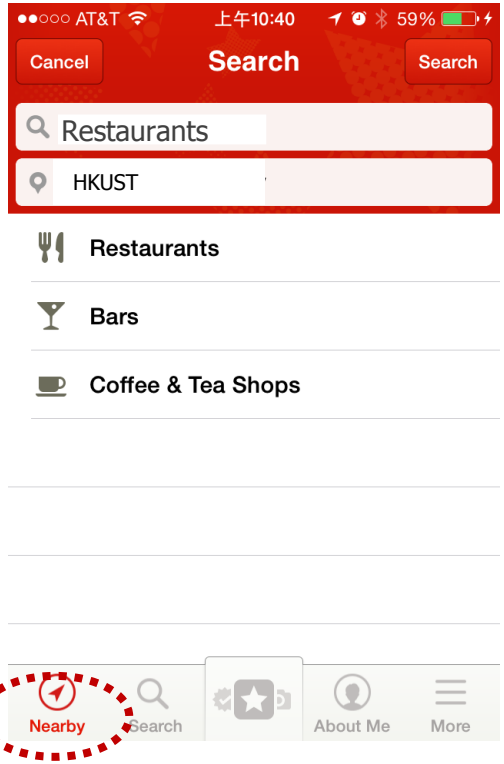
500+ location-based apps (appcrawlr.com)

What do location-based Apps do?

- Search-nearby

Find something nearby somewhere

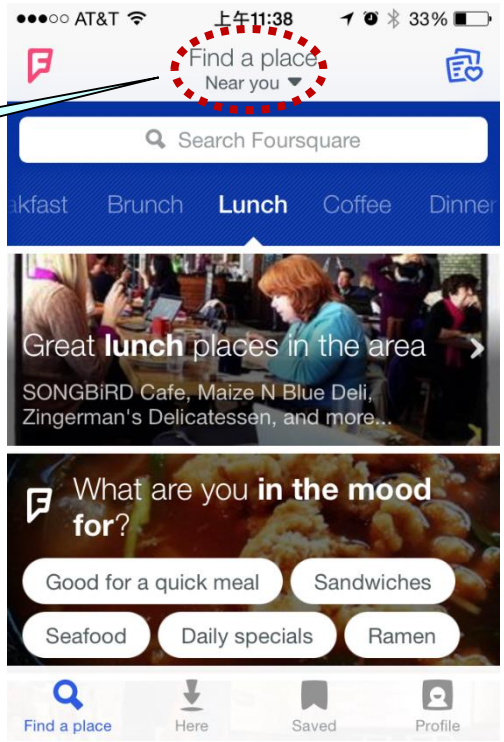
Search-nearby: Yelp



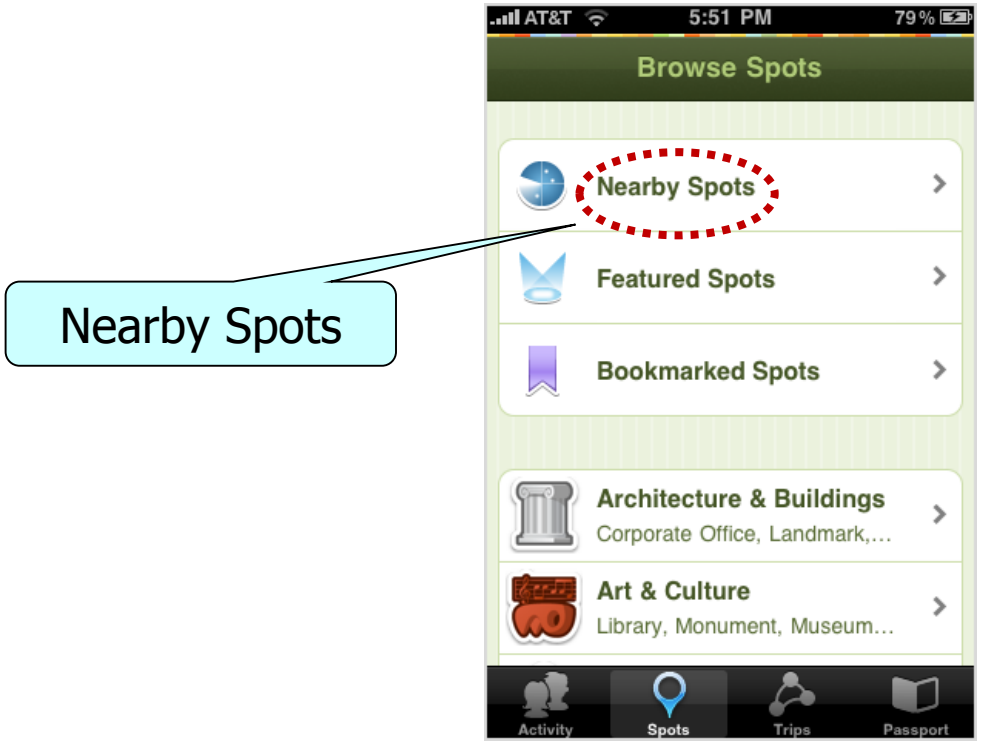
Search-nearby

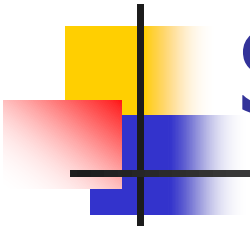
Search-nearby: Foursquare

Find a place
Near you



Search-nearby: Gowalla





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 Crowdsou

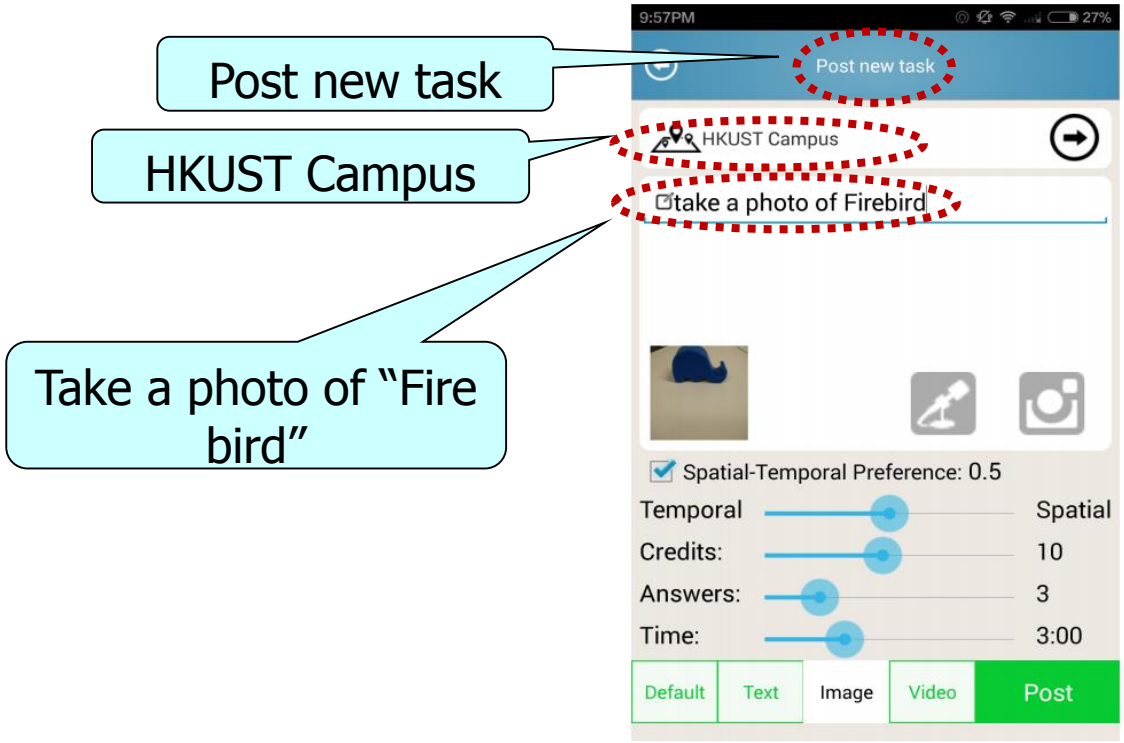
Crowdsourcing is a platform where people post tasks and some other people perform tasks

Each task is associated with a **location**

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

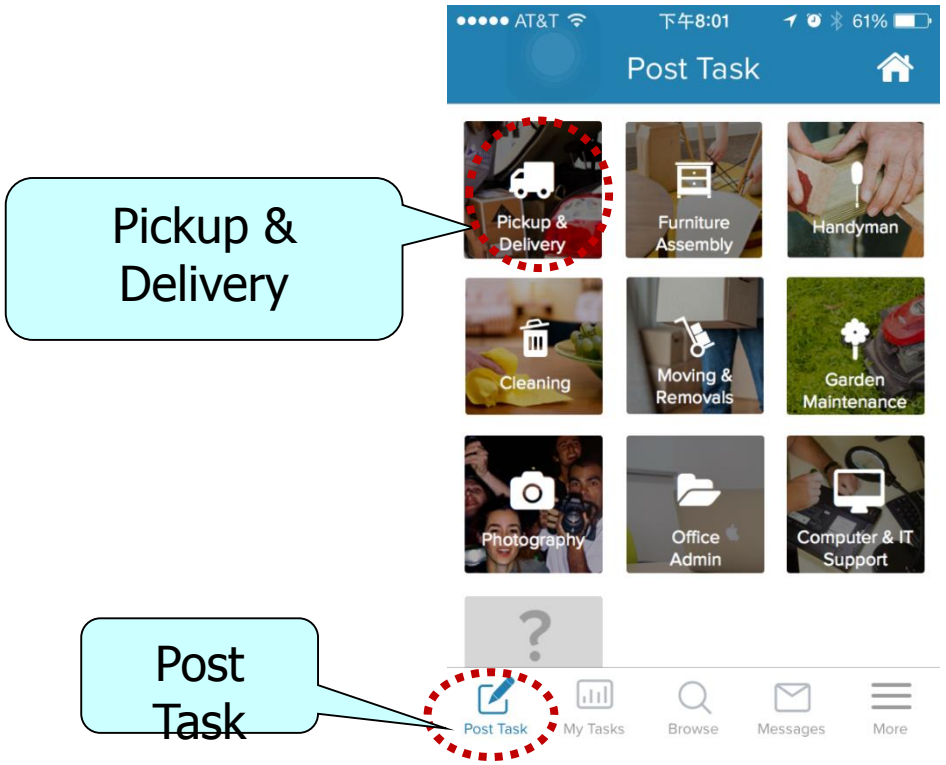
E.g., take a video clip at Times Square of New York

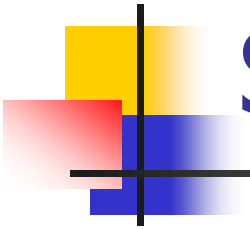
Spatial Crowdsourcing: gMission



Spatial Crowdsourcing: LocalHands

Spatial Crowdsourcing: Airtasker





Spatial Crowdsourcing

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

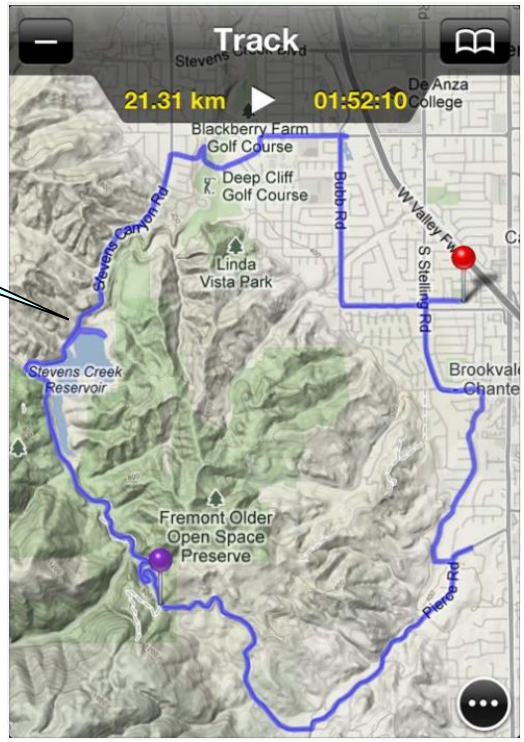
What do location-based Apps do?

- Search-nearby
- Spatial Crowdsourcing
- Trace Tracking

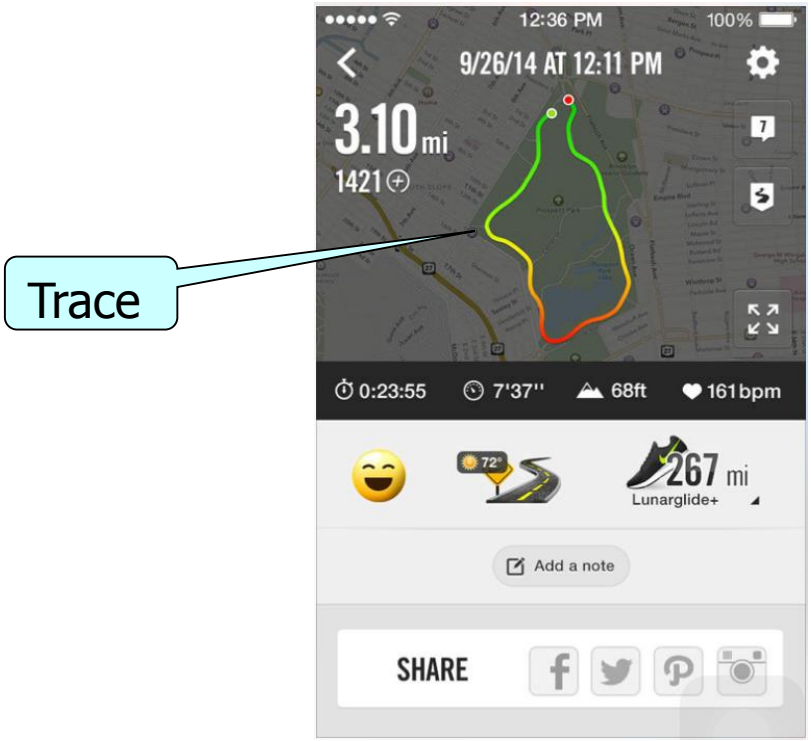
Record the trace of a movement

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

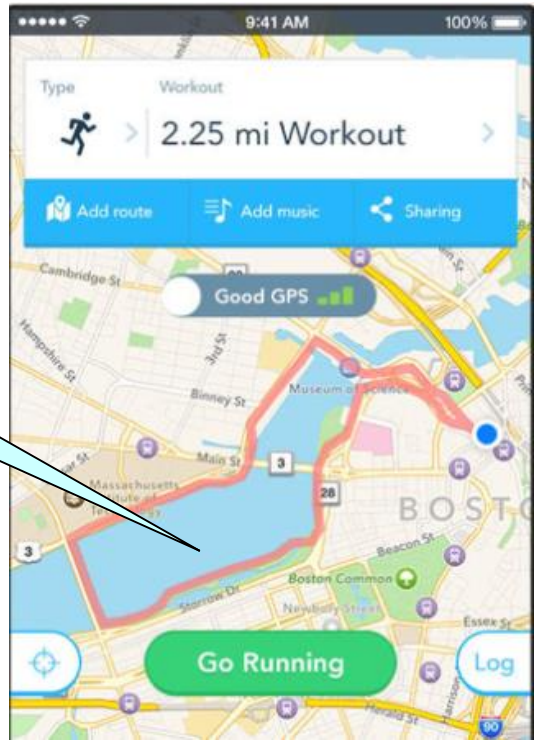
Trace tracking: Maps+



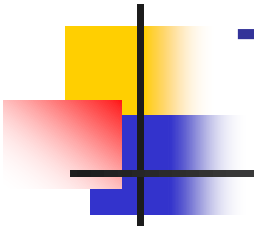
Trace tracking: Nike+



Trace tracking: Run Keeper



Run keeper



Trace tracking

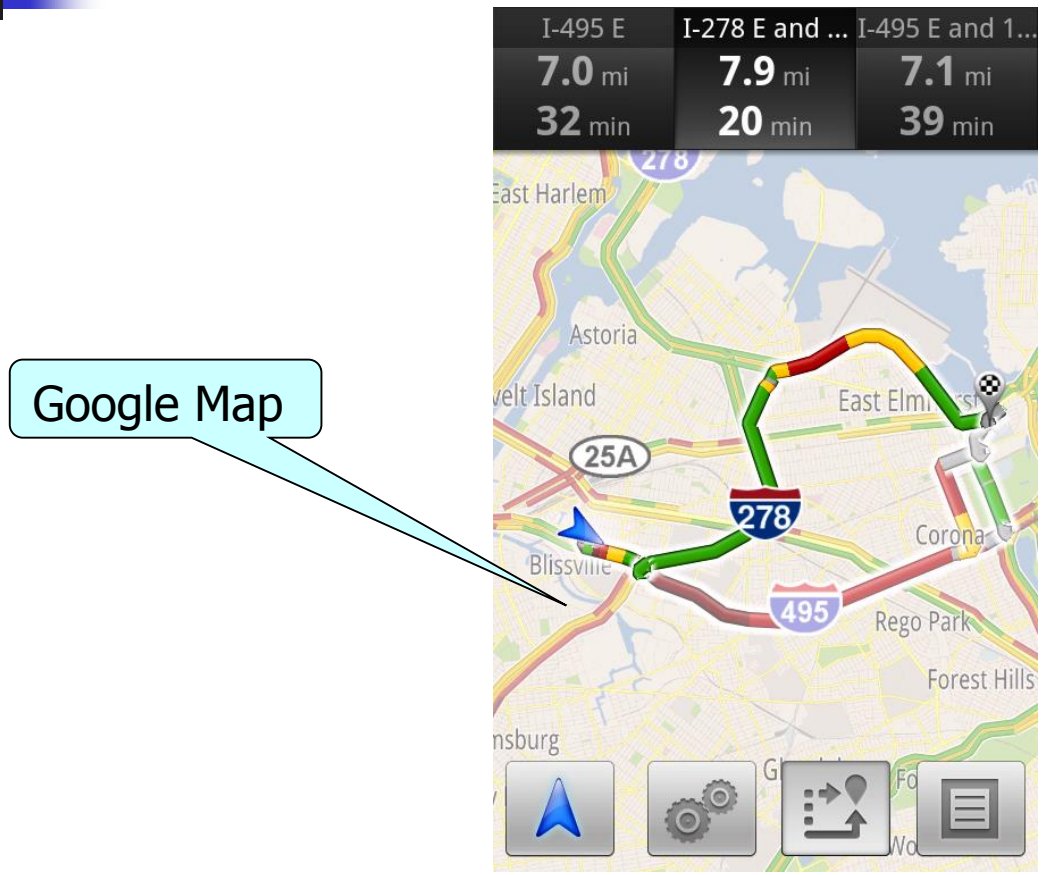
- My previous work
  - Trajectory Simplification: On Minimizing the Direction-based Error (VLDB 2015)
  - Direction-Preserving Trajectory Simplification (VLDB 2014)

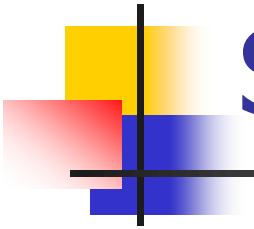
What do location-based Apps do?

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

Finding Shortest Distance

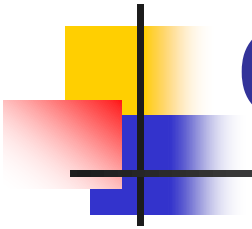
Shortest Distance: Google Map





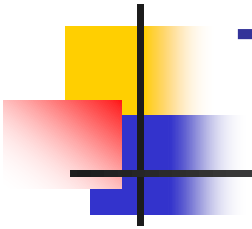
Shortest Distance

- 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