MOBILITY TRENDS AND IMPLICATIONS

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HPTS
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Cellular

2011 – 5 billion

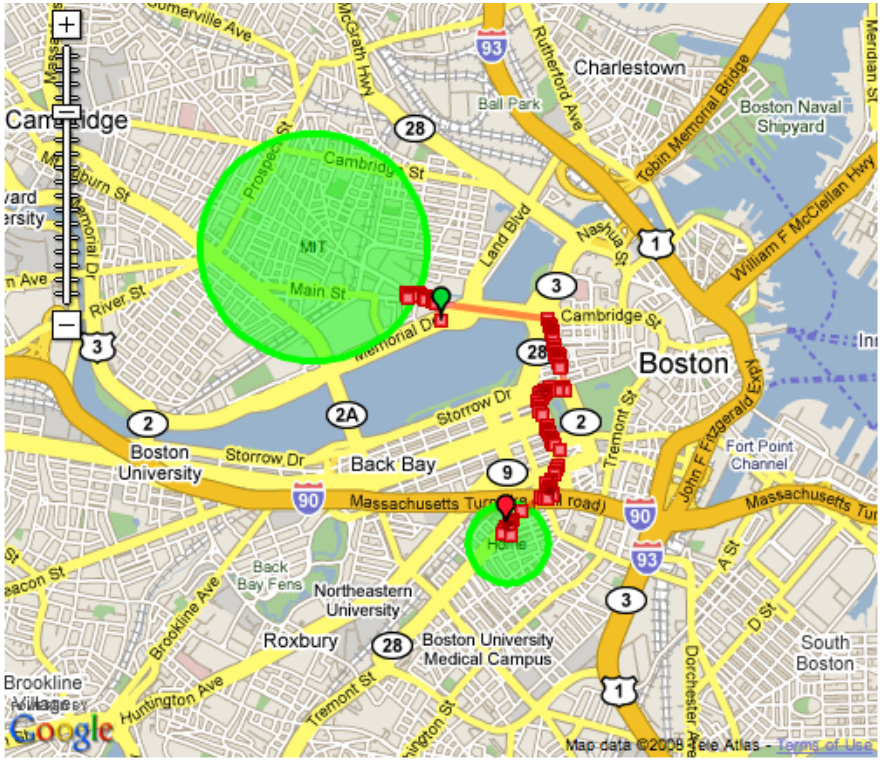
- More than # o brushes, or electricity (source IEA)

- 1 billion "mobil s

- Incredible source of data → many new applications
  - *Sensor data* – positions, movement, orientation, proximity, activity

CarTel: Sensing Roads With Phones

"Crowdsourced" collection of data from roads



Murano Wed Jul 16 08:57:23 20	13 m 12 s	7.4 km	Path	Raw Points	Delete	None
Murano Tue Jul 15 21:28:22 20	5 m 54 s	3.3 km	Path	Raw Points	Delete	None
Murano Tue Jul 15 21:17:00 20	11 m 21 s	13.7 km	Path	Raw Points	Delete	None
Murano Tue Jul 15 18:14:52 20	22 m 30 s	10.8 km	Path	Raw Points	Delete	None
Murano Mon Jul 14 19:01:40 20	10 m 18 s	7.3 km	Path	Raw Points	Delete	None
Murano Mon Jul 14 19:01:01 20	37 s	1.3 km	Path	Raw Points	Delete	None
Murano Mon Jul 14 14:42:47 20	57 m 39 s	69.8 km	Path	Raw Points	Delete	None

<< Prev 10 Next 10 >>

Show calendar view for these drives

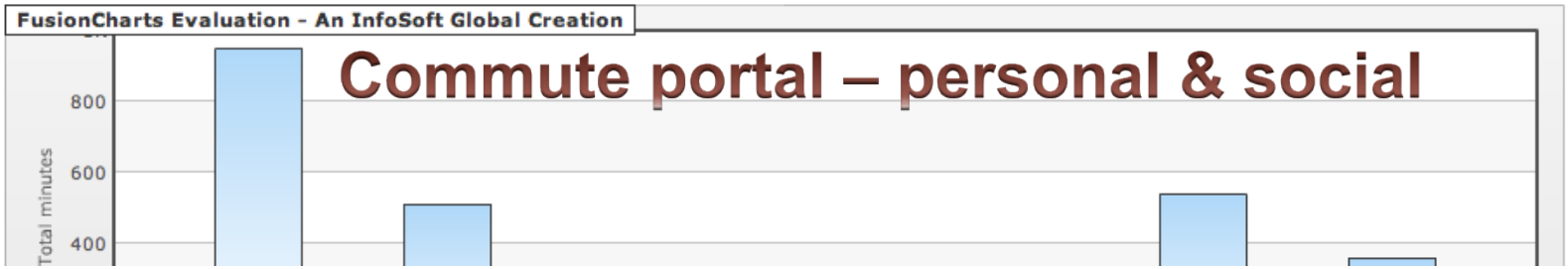
Select cars to show: ☑ Murano
(At least one car must be selected)

Showing all drives (no filters set)

Add location filter: MIT Add
Additional filter: Weekdays Set

Plot Travel time
calculating the Total over my drives,
showing the results by Day of week

Compare my driving to: None
Reload Graph

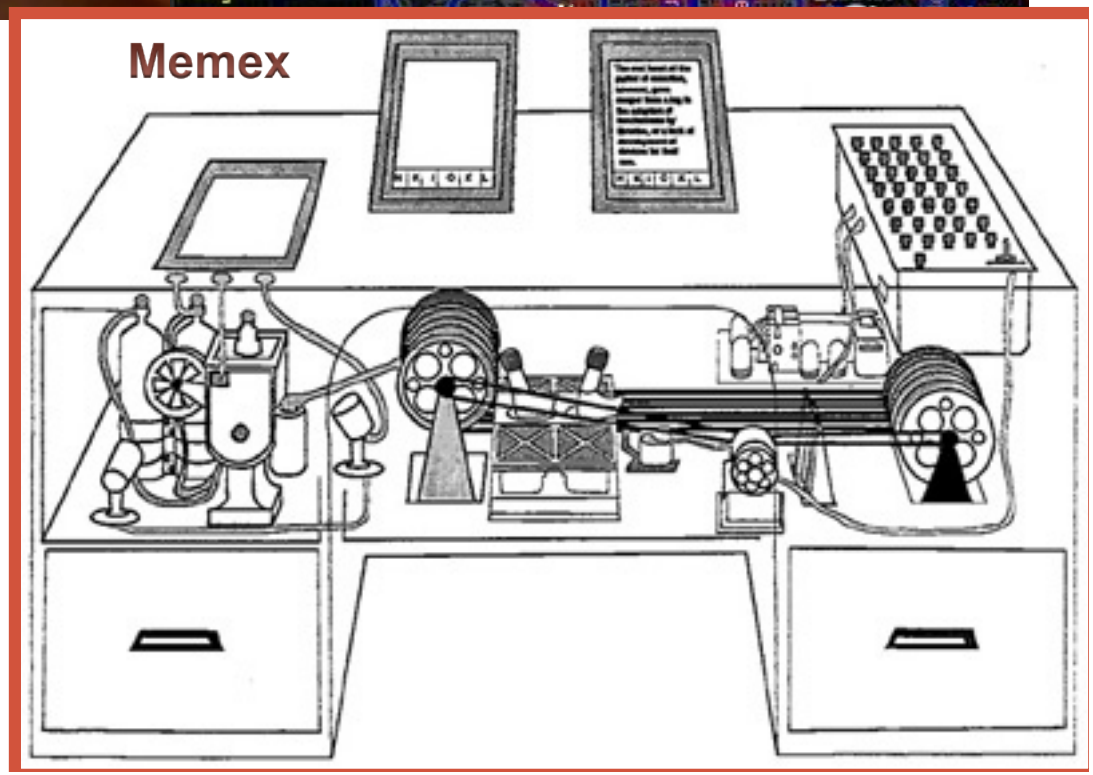


CarTel is a collaboration between Profs. Madden, Balakrishnan, and their students. See http://cartel.csail.mit.edu


81
Personal Medical Monitoring


Powell St & Geary St
Very Busy
29% above normal
Marina District
Bay St
North Beach
Doyle Dr
101
Baker Beach
Presidio of San Francisco
Lombard St
Chinatown
Richmond District
San Francisco
Divisadero St
Fell St
Oak St
Central Fwy
280
02 40 A
San Francisco currently is:
+22%
Busy
Urban Activity Monitoring


3G
9:41 AM
FASTRAK
Smart Tolling, Insurance

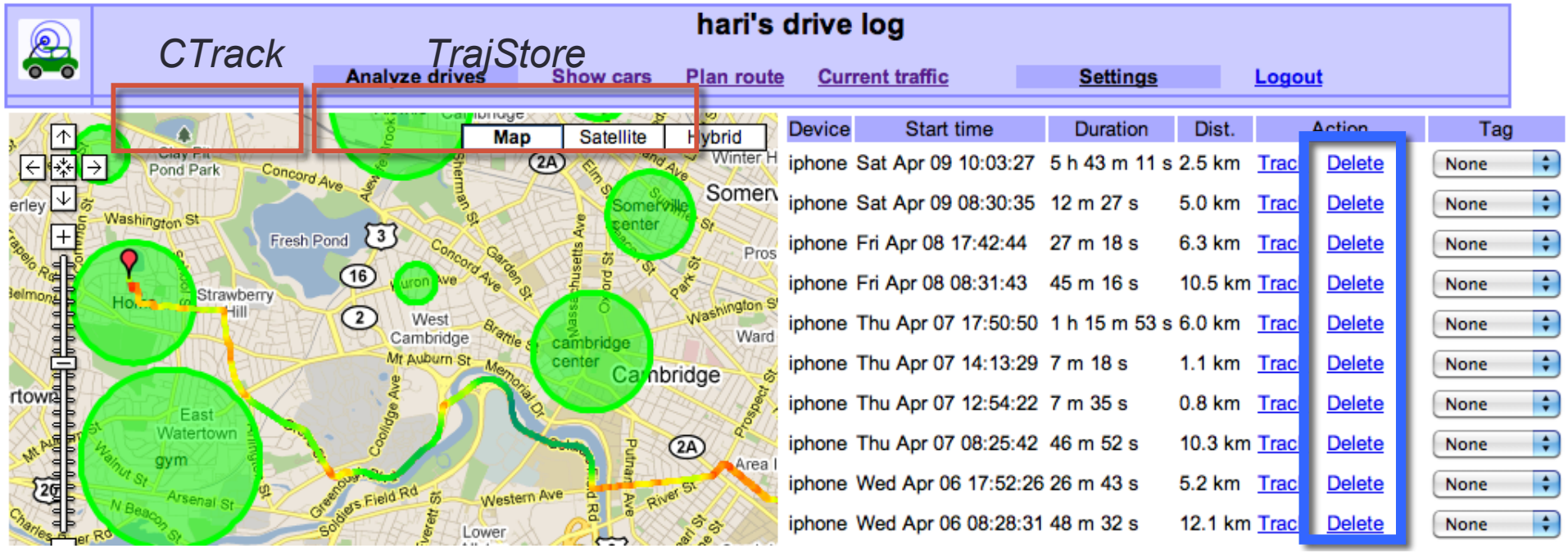

Memex

Sensor Data (Location) Analytics

- 500M+ locations from hundreds of phones and cars

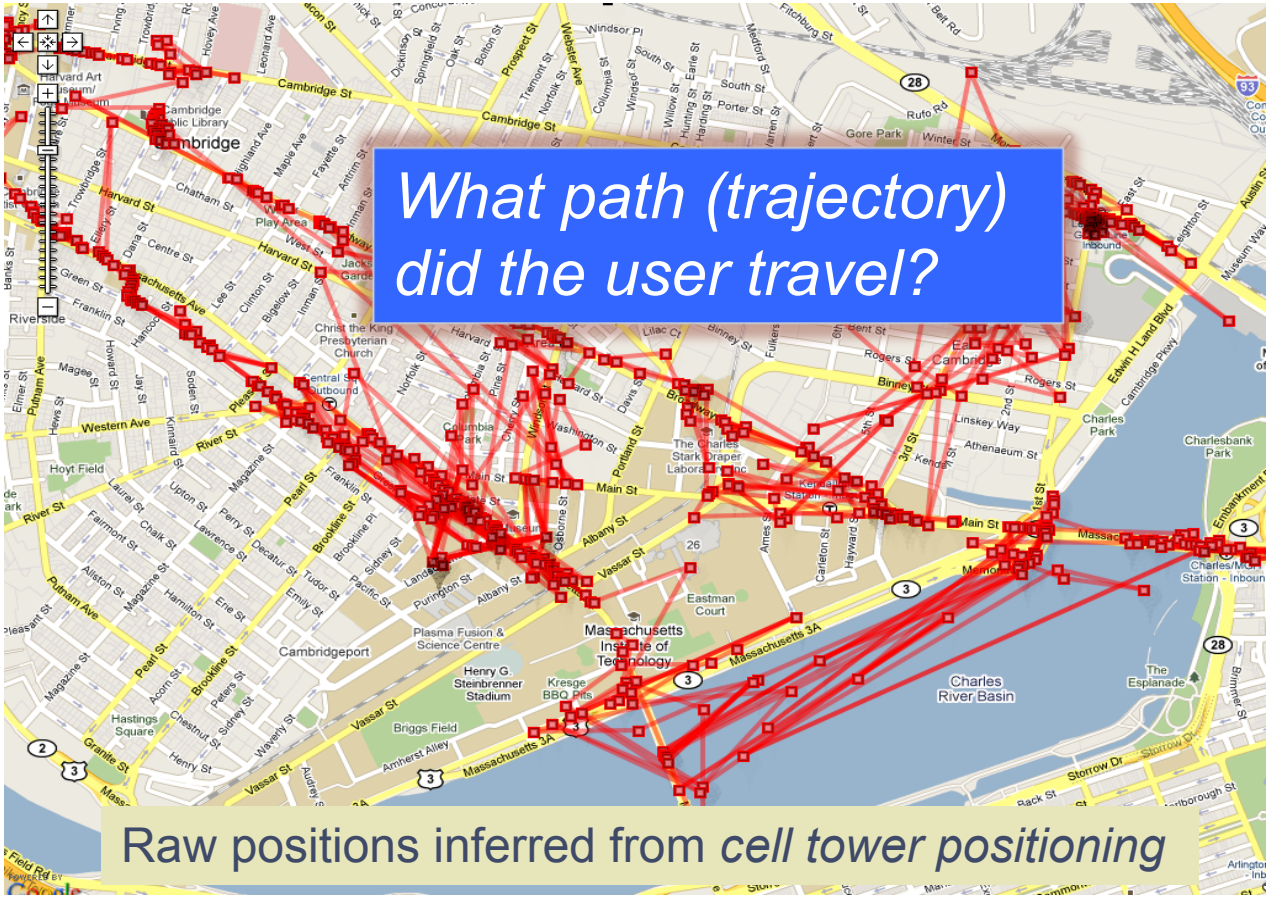
Privacy
Control &
Transparency

- Goal: Develop software to store and efficiently access such data ***while providing users control over privacy***



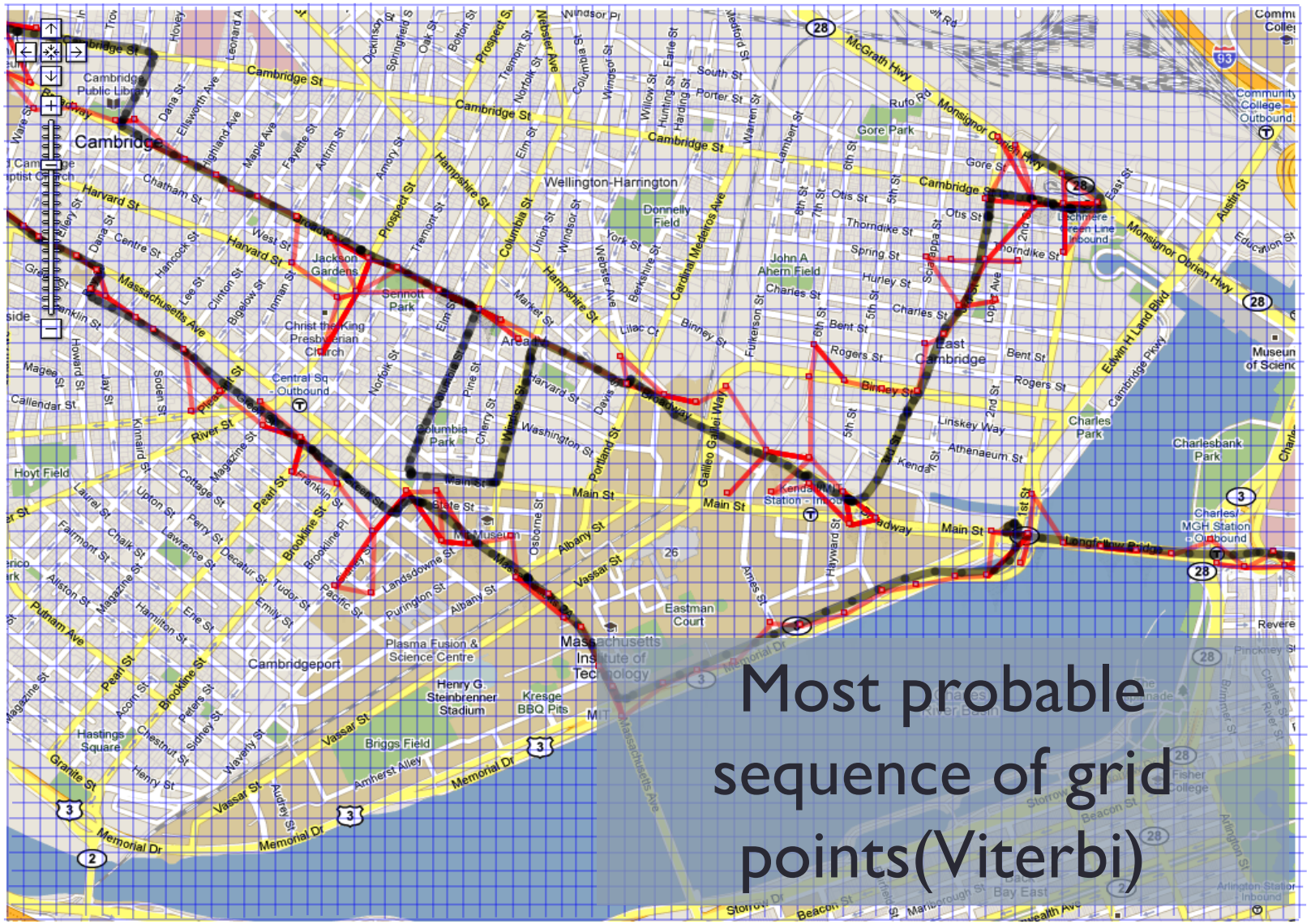
CTrack *Three step algorithm*

Challenge: Raw Data Points → Trajectories (Roads Driven)



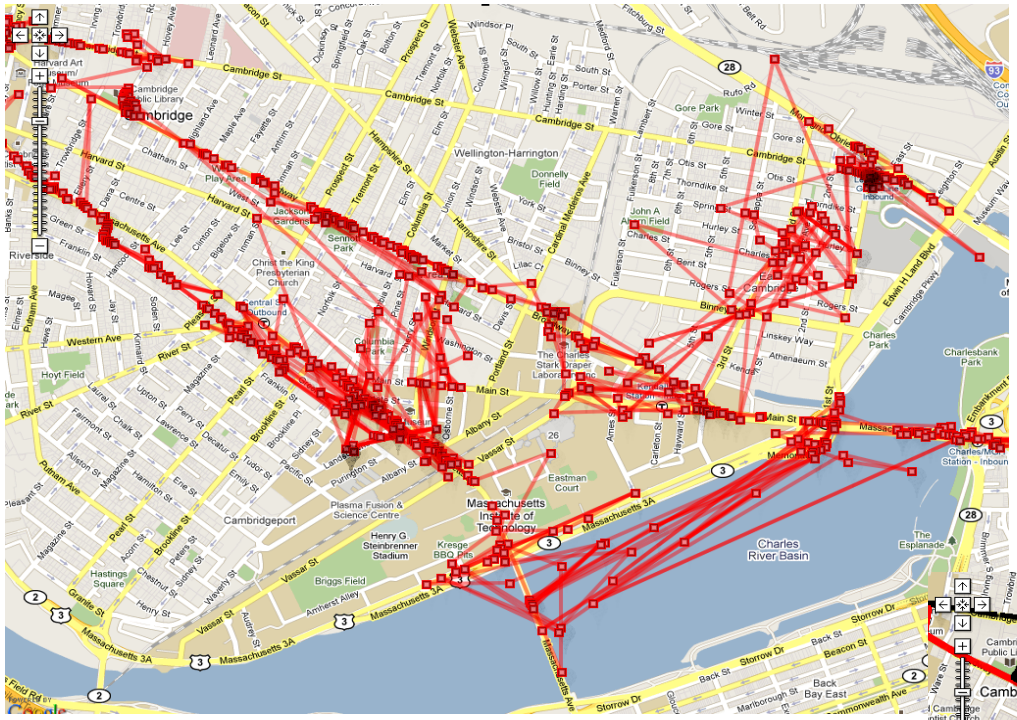
Thiagarajan, Ravindranath, Balakrishnan, and Madden. "Accurate, Low Energy Mapping for Mobile Devices." In Proceedings of NSDI, 2011.

Grid Sequence



Smooth + Interpolate Grid Sequence

Smoothed Grid → Road Segments



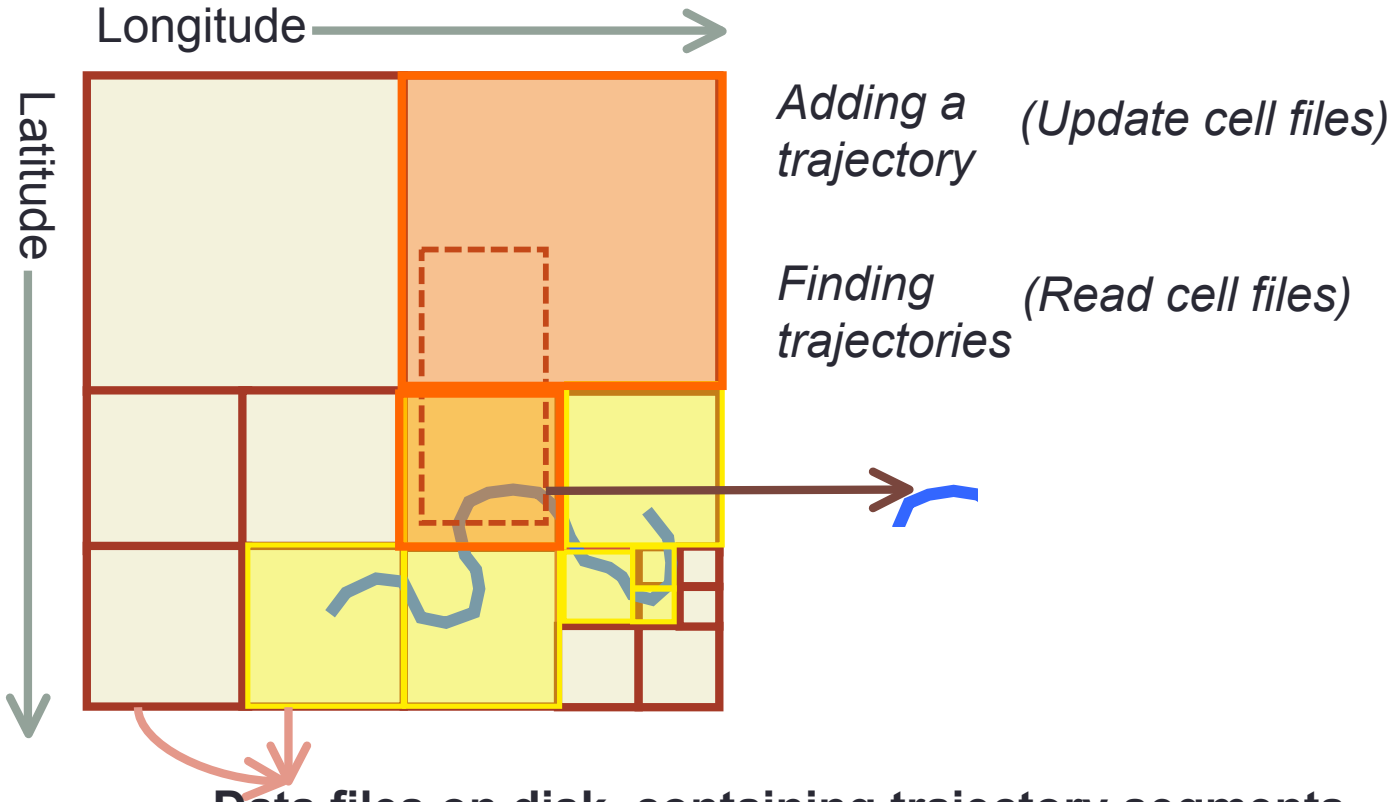
From this…

To this…

TrajStore

Cells split as density of data grows

- Storage system for indexing and querying trajectories

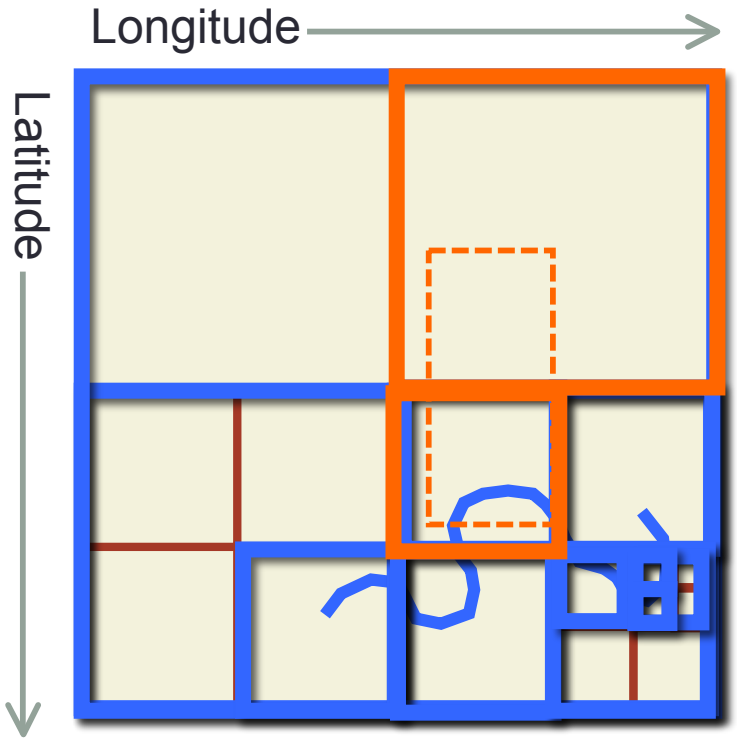


Cudré-Mauroux, Wu, Madden.
"TrajStore: an Adaptive Storage System for Very Large Trajectory Data Sets." In Proceedings of ICDE, 2010.

TrajStore

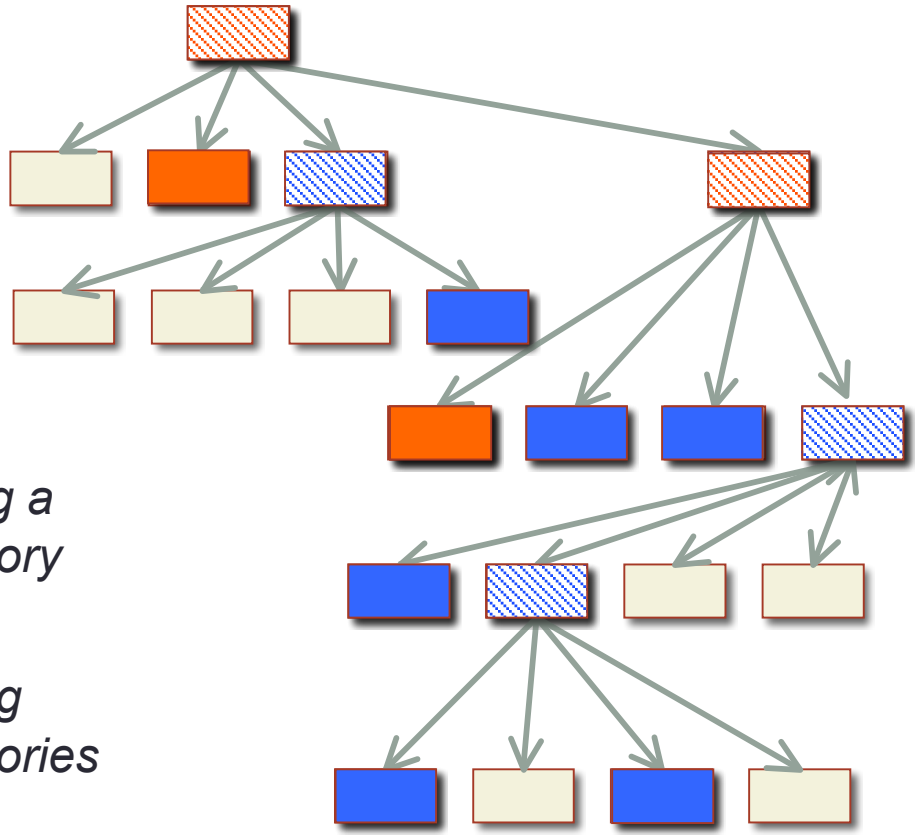
Cells split as density of data grows

- Storage system for indexing and querying trajectories



Adding a trajectory

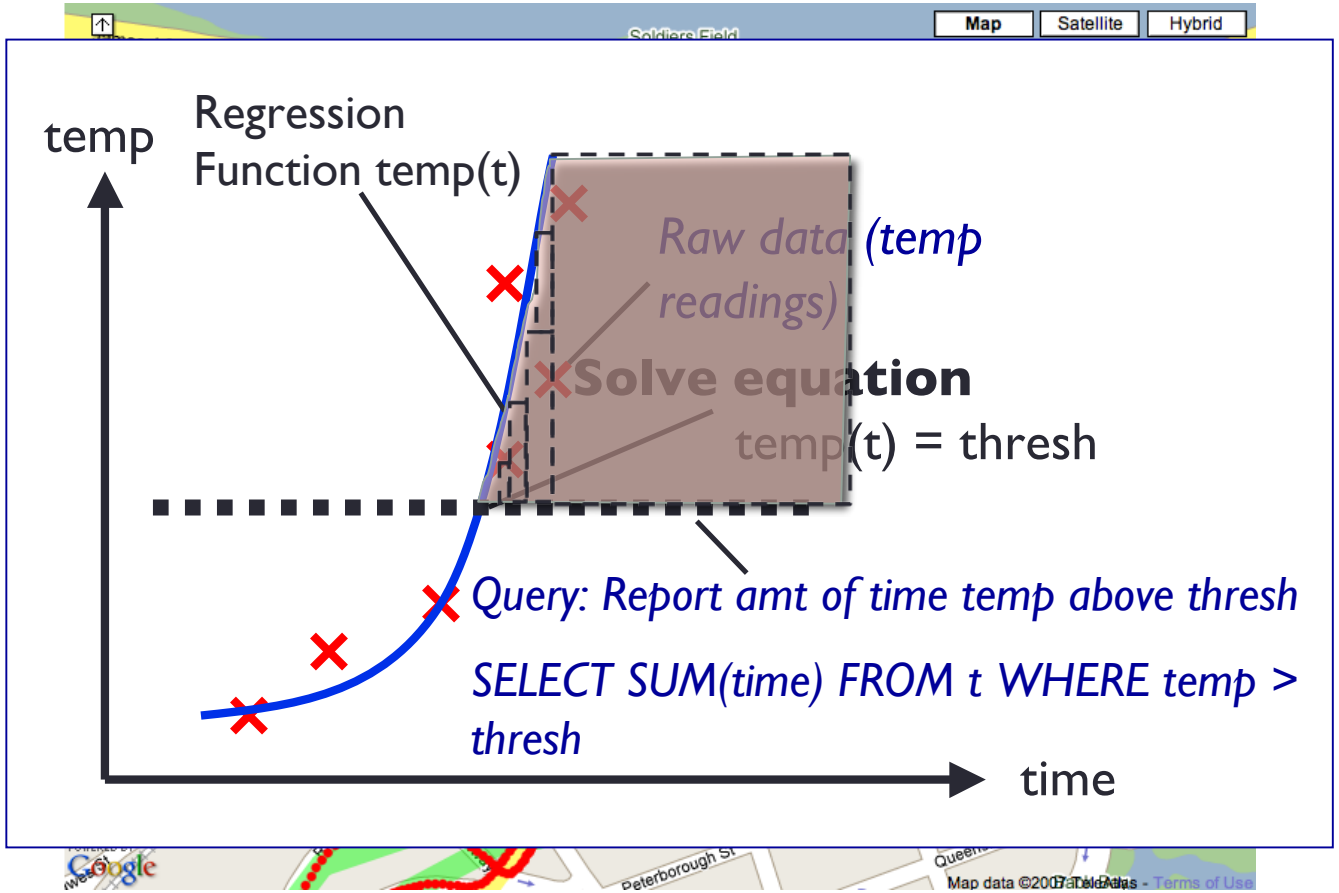
Finding trajectories



FunctionDB

System for asking questions over trajectories

E.g., find paths that went through a rectangle



SELECT trajectories
FROM trajectoryDB
WHERE trajectory
INTERSECT
rectangle

Query answering via function solving

FunctionDB discretizes region of interest into hypercubes

Makes solving tractable

Summary

- Location-aware mobile devices incredible “driver” of new applications and source of data
- CarTel Applications: traffic, potholes, commute portal, …
- New approaches needed to filter, store, query this data
- Two technologies:
  - CTrack: Noisy positions → Trajectories
  - TrajStore: Storage System for Trajectory Data

Implications for Database Weenies?

Rest of This Session

- Three other uses of location data

- Oliver Senn, MIT