RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

MINING DATA FROM MOBILE DEVICES

Introduction

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Tutorial plan

Introduction (Spiros)
- Overview
- Mobile technology overview

Algorithms & Applications I (Spiros)
- Mobile sensing
- Urban sensing
- Healthcare

Break (15 minutes)

Algorithms & Applications II (Tina)
- Location
- Context
- Ads
- Privacy

Conclusions (Spiros)

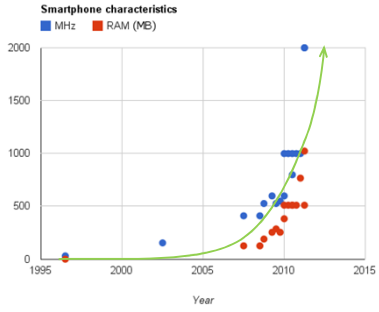
Mobile devices

Mobile devices: smartphones

Embedded sensors:
- GPS & compass
- Accelerometer & gyro
- Proximity
- Camera
- Speech recognition
- (Humidity, Temperature, Barometer/altimeter)
- …

(more later)

So what?



…you have a pretty powerful computer in your pocket!
…and it's connected!

So what?

'It's what I and many others have worked towards our entire careers. It's just happening *now*.'
– Eric Schmidt (on cloud computing)

- The same could be said about mobile sensing and mining
  - Sensing & sensor networks
  - Ubiquitous computing
  - Mobility tracking
  - …
- But all are becoming mainstream now!

Example applications

- Geo-location
- Urban computing
- Quantified self
- Healthcare
- Security
- …many more!

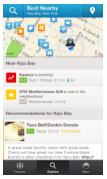
Geo-location
Example applications

What most people think (mainstream applications):


Google Maps

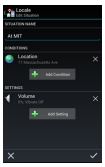

Waze

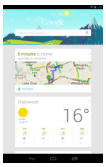

Yelp


Foursquare

- Maps
- Navigation
- Local search (+ social)

Geo-location
Example applications


Locale


Google Now


Glympse

- Context-based:
  - Locale: e.g., "if I'm within 0.5mi of work address and I have a meeting on my calendar, then set my phone to silent"
  - Google Now: "if I have a dentist appointment on my calendar, notify me when I need to leave, based on current traffic conditions, to be on time" or "if my email contains records of a booked flight, show flight status"
- Location reporting and sharing: Glympse, Google Latitude, etc.

Urban computing

Use broadly collected data for:

- Zoning and planning
- Traffic monitoring and management
- Public transportation planning
- Crisis detection and management
- Energy consumption sensing
- Air quality monitoring

Much of this data comes from traces of mobile activity!

Quantified self
Example applications


Withings devices


Sleep Cycle


Instant HR

- Measure "self", visualize, and correlate
- Idea dates back to 70s; term coined ~2007 by Kevin Kelly
- Both peripheral sensors as well as just apps; e.g.
  - Heart rate, Sleep quality
  - Weight, Activity
  - …

http://quantifiedself.com/

Healthcare

Quantified self: log everything


Medical applications: glucose, asthma, ECG, …

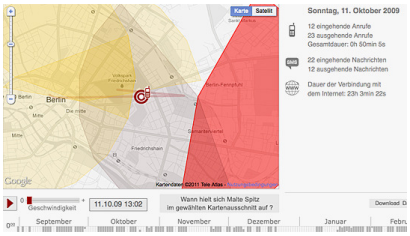
- Related to quantified self
  - Many of these services can send data to your doctor
- Our distinction: specific goal vs. "log everything" approach

Healthcare

Micro level / personal; e.g.
- Fall detection
- Activity detection
- Mood detection
- …

Macro level / population; e.g.
- Disease propagation (mobile, Twitter & Foursquare, …)

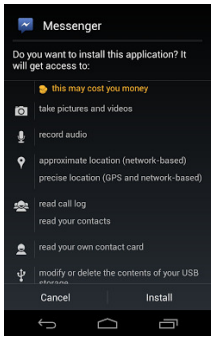
Privacy
Examples



- Vast data that allows quite accurate activity tracking or inferences
- Clearly raises privacy concerns
- Policy (& technology ?)

"Tell-all telephone" – Die Zeit & Malte Spitz

Security & Malware
Examples



- Mobile malware: 6x [Juniper]
- E.g., BadNews: malware on Google Play (30+ apps, 2M downloads, fake app update prompts, mobile "pickpocketing")

Some challenges:
- Role mining: characterize groups of permissions more meaningfully
- Unusual activity detection

Mobile mining

- The mobile "revolution" (like the "PC revolution") brings together many disciplines and touches many areas
- So, we had to draw some (occasionally arbitrary) divisions, and leave several things out

This tutorial focuses on:
- Work with a substantial inference / analytics component
- Data collected via smartphones (although we'll touch on others sensors briefly, but we won't go into sensing or ubiquitous computing territories—much)

The rest of this tutorial

Algorithms & Applications I:
- Mobile sensing
  - Focus: low-level activity detection and localization
- Urban computing
- Healthcare

Algorithms & applications II:
- Location and context
- Advertising
- Social

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