Mapping Career Pathways in Geography

- Today
- 4:00-5:30pm
- ED 116
- [http://geography.uoregon.edu/mapping-career-pathways-in-geography/](http://geography.uoregon.edu/mapping-career-pathways-in-geography/)
Location

- Traditional methods (GNSS)
- New methods (Cell, WiFi, GNSS, Others, combined sources)
- Balance between accuracy, power, time
Cellular Positioning

- Every cell tower has a unique identifier
- Database of unique identifiers combined with location of tower
- Low accuracy (better in areas with high number of towers)
- Low battery usage
- Low time to first fix
- Accuracy issues can be offset if multiple towers are known as well as signal strength
Example of Cell database

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Mozilla Location Service
Issues with Cellular Positioning

- Perceived Accuracy
- Real Accuracy
- Cell phone tracking (fake cell towers)
- Cellular network limitations
WiFi Positioning

- Database of access points BSSID, RSSI (received signal strength indicator), and location
- Medium accuracy
- Medium battery usage
- Medium time to first fix
- Accuracy offset by better database and TTFF offset by local database slices
- Allows non cellular-based systems to have location information (iPad, Android tablets, iPod Touch)
## WiFi Database examples

<table>
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WiFi issues

- Apple iPhone local database issue (http://en.wikipedia.org/wiki/iPhone#Secret_tracking)
- Wardriving - the act of searching for Wi-Fi wireless networks by a person in a moving vehicle, using a portable computer or smartphone
- Lawsuit against Google about data collected by Google StreetView Car over Wifi (http://en.wikipedia.org/wiki/Google_Street_View_privacy_concerns#United_States)
Global Navigation Satellite System (GNSS)

- Array of satellites (GPS, GLONASS)
- Receivers use trilateration to determine location (4 satellites minimum)
  - High accuracy
  - High battery usage
  - High time to first fix
- TTFF offset by Assisted GPS (AGPS)
GPS history

- Developed by United States military, maintained by US Air Force
- President Reagan made it freely available for civilian use once completed after a Korean Air Lines flight was shot down after straying into the USSR's prohibited airspace in 1983
- Selective availability (intentional time varying errors up to 100m on civilian signals) turned off in 2000 from a policy directive in 1996 from President Clinton
- First satellite launched in 1989
- 24th satellite launched in 1994 (24 needed for global coverage)
- Total launched: 69
- Operational: 31
- Retired: 34
How GPS works

- Satellites have highly accurate atomic clock
- Each satellite broadcasts a pseudo random message of an exact size starting at a specific time at a specific speed
- Receivers play same message internally
- Receivers receive the message from the satellite and compare the difference in time between the message section. Based on that, distance between the receiver’s position on earth and satellite can be calculated.
- With the distances between position on earth and 4+ satellites known, position can be determined using trilateration
GNSS Issues

- Time to first fix (AGPS can offset)
- Urban canyons
- Battery usage
Geofencing

- Infrastructure-less implementation
- Define region of interest (usually center point with radius
- Based on location of device
- Can be notified based on:
  - Enter geofence
  - Exit geofence
  - Dwell (remain) within geofence longer than X
Issues

- Smallest circle supported by phones usually 100m radius
- Can get higher accuracy but uses more battery (custom solution)
- Balance between battery usage and accuracy
Applications

- Reminders
  - Pick up dry-cleaning when near location
- Advertising
  - Display deals for nearby businesses
- Points of Interest
  - Link to wikipedia article about nearby place
- Automation
  - When I leave my house, turn off the lights
Group Activity

- Split into groups
- Come up with an application for geofencing
- Answer following points:
  - Purpose
  - Intended audience
  - Would your application use enter, exit, dwell, or some combination of the three?
  - Data requirements
  - Anticipated issues