CMSC436: Programming Handheld Systems

Location & Maps

Today’s Topics

Location

Location support classes

Maps

Map support classes

Location Services

Mobile applications can benefit from being location-aware

Allows applications to determine their location and modify their behavior

Using Location Information

Find stores near the user’s current location

Direct a user from a current to a particular store

Define a geofence

Initiate action when user enters or exits the geofence

Location Architecture

Location

LocationProvider

LocationManager

LocationListener

Location

Represents a position on the Earth

A Location instance consists of:

- Latitude, longitude, timestamp and, optionally, accuracy, altitude, speed, and bearing

LocationProvider

Represents a location data source

Actual data may come from

- GPS satellites
- Cell phone towers
- WiFi access points

LocationProvider Types

Network – WiFi and cell tower

GPS - Satellite

Passive – Piggyback on the readings requested by other applications

NetworkProvider

Determines location based on cell tower and WiFi access points

Requires either

- android.permission.ACCESS_COARSE_LOCATION
- android.permission.ACCESS_FINE_LOCATION

GPSProvider

Determines location using satellites

Requires

- android.permission.ACCESS_FINE_LOCATION

PassiveProvider

Returns locations generated by other providers

Requires

- android.permission.ACCESS_FINE_LOCATION

LocationProvider

Different LocationProviders offer different tradeoffs between cost, accuracy, availability & timeliness

LocationProvider Tradeoffs

GPS – expensive, accurate, slower, available outdoors

Network - cheaper, less accurate, faster, availability varies

Passive – cheapest, fastest, not always available

LocationManager

System service for accessing location data

getSystemService(Context.LOCATION_SERVICE)

LocationManager

Determine the last known user location

Register for location updates

Register to receive Intents when the device nears or moves away from a given geographic area

LocationListener

Defines callback methods that are called when Location or LocationProvider status changes

LocationListener

```
void onLocationChanged (Location location)
void onProviderDisabled (String provider)
void onProviderEnabled (String provider)
void onStatusChanged (String provider,
                      int status,
                      Bundle extras)
```

Obtaining and Using Location Information

Start listening for updates from LocationProviders

Maintain a "current best estimate" of location

When estimate is “good enough”, stop listening for location updates

Use best location estimate

Determining Best Location

Several factors to consider

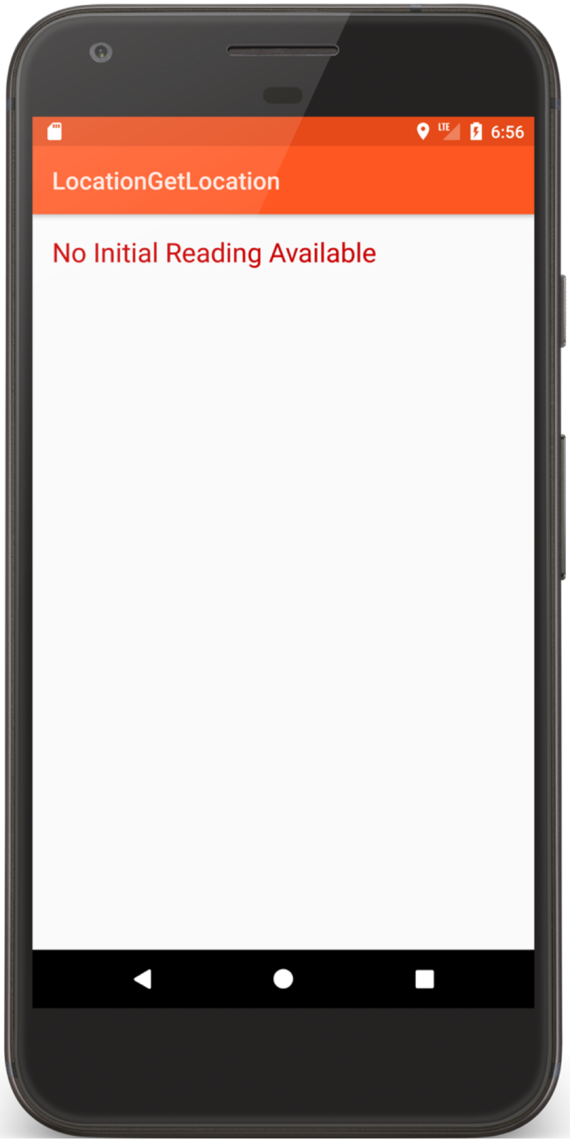
- Measurement time
- Accuracy
- Power usage

LocationGetLocation

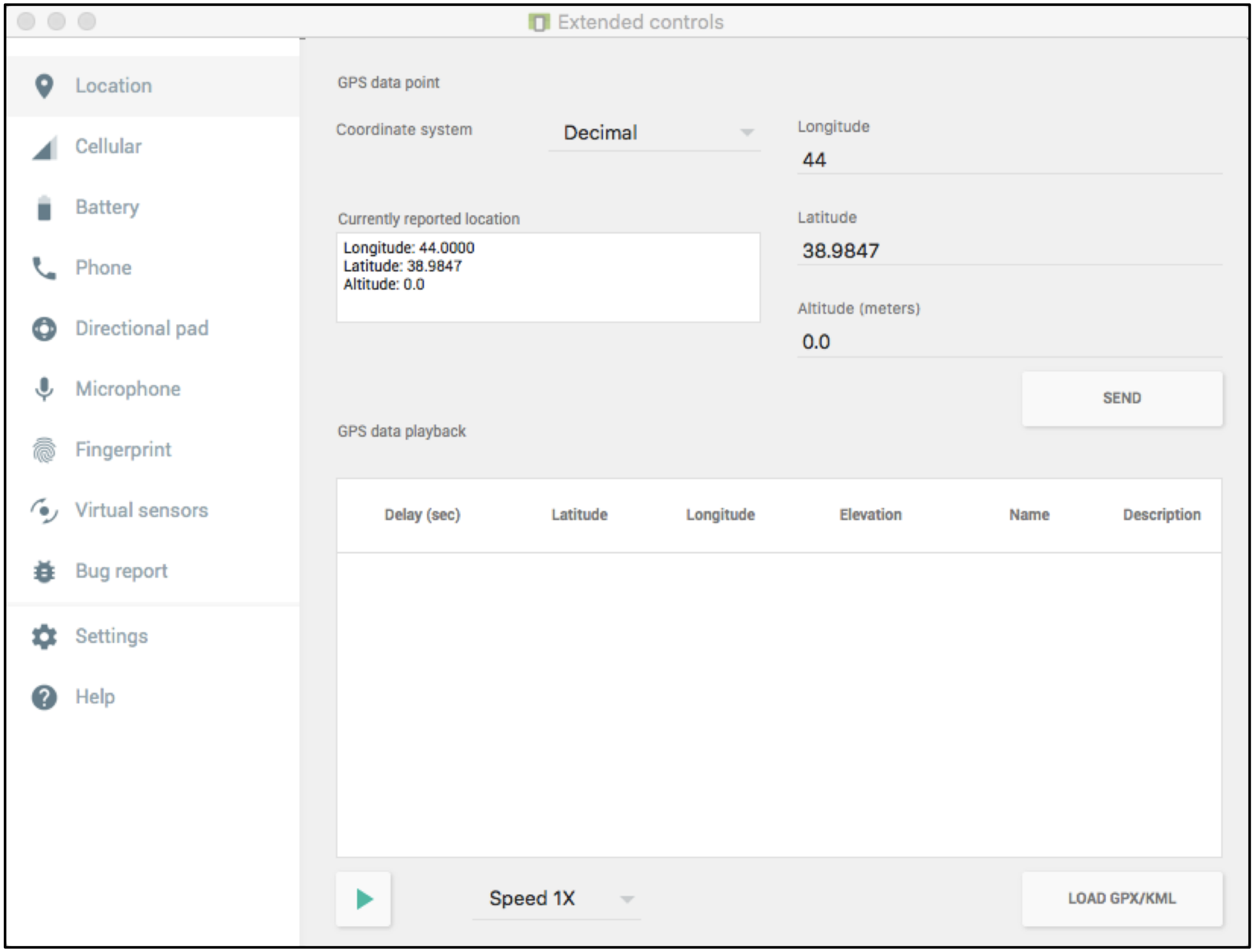
Application acquires and displays the last known locations from all providers

If necessary, acquires and displays new readings from all providers

Location
Get Location



No Initial Reading Available



Coordinate system Decimal

Longitude
44

Latitude
38.9847

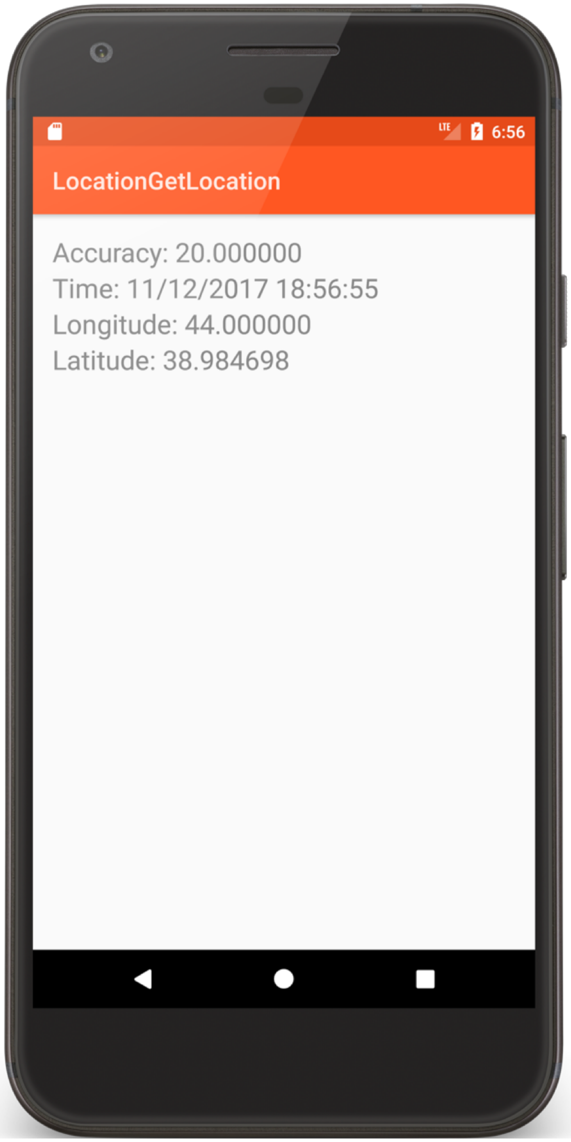
Altitude (meters)
0.0

Currently reported location

```
Longitude: 44.0000
Latitude: 38.9847
Altitude: 0.0
```

Delay (sec)	Latitude	Longitude	Elevation	Name	Description

Speed 1X



```
Accuracy: 20.000000
Time: 11/12/2017 18:56:55
Longitude: 44.000000
Latitude: 38.984698
```

LocationGetLocationServices

- The same as LocationGetLocation, but uses newer FusedLocationProvider class
  - Uses Google Play Services

Battery Saving Tips

Always check last known measurement

Return updates as infrequently as possible

Limit measurement time

Use the least accurate measurement necessary

Turn off updates in onPause()

Maps

A visual representation of area

Android provides Mapping support through the Google Maps Android v2 API

Map Types

Normal: traditional road map

Satellite – Aerial photograph

Hybrid - Satellite + road map

Terrain - Topographic details

Customizing the Map

Change the camera position

Add Markers & ground overlays

Respond to gestures

Indicate the user’s current Location

Some Map Classes

GoogleMap

MapFragment

Camera

Marker

Setting up a Maps Application

Set up the Google Play services SDK

Obtain an API key

Specify settings in Application Manifest

Add map to project

See: https://developers.google.com/maps
/documentation/android/start

Map Permissions

```
<uses-permission android:name=
                              "android.permission.INTERNET"/>

<uses-permission android:name=
         "android.permission.ACCESS_NETWORK_STATE"/>
```

Map Permissions

```
<uses-permission android:name=
  "android.permission.WRITE_EXTERNAL_STORAGE"/>

<uses-permission android:name=
         "com.google.android.providers.
                      gsf.permission.READ_GSERVICES"/>
```

Map Permissions

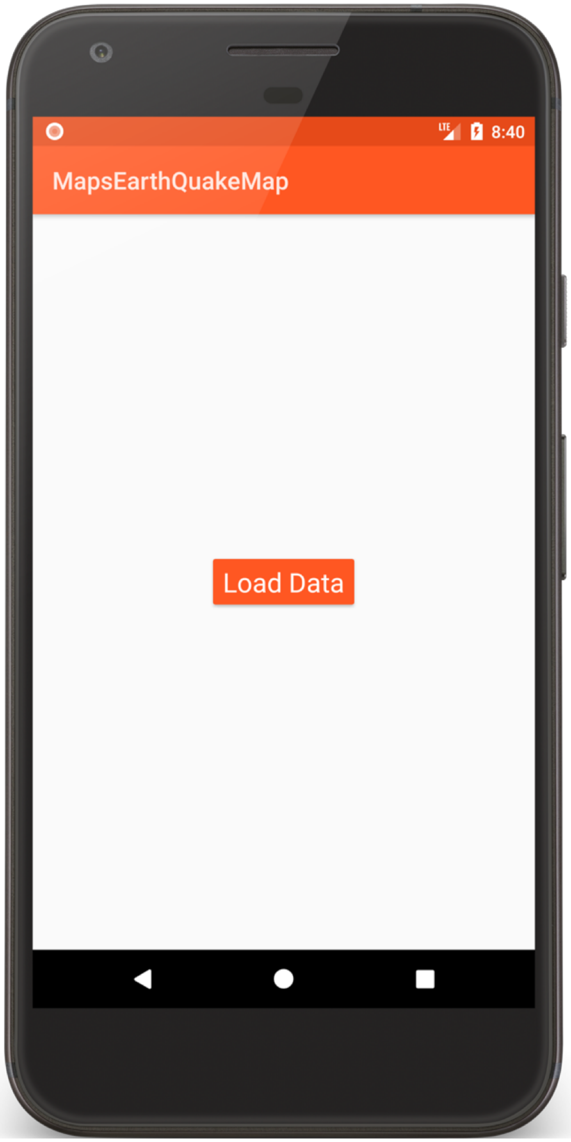
```
<uses-permission android:name=
   "android.permission.ACCESS_COARSE_LOCATION"/>

<uses-permission android:name=
   "android.permission.ACCESS_FINE_LOCATION"/>
```

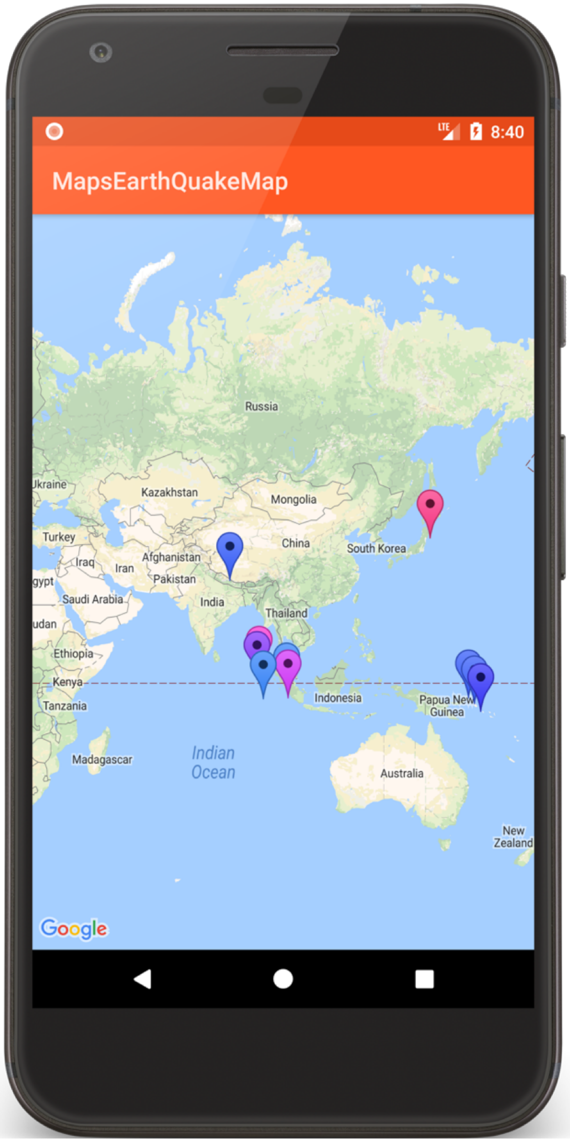
MapEarthQuakeMap

This application acquires earthquake data from a server

Then it displays the data on a map, using clickable markers

MapEarth
QuakeMap





```
public class MapsEarthquakeMapActivity extends Activity implements
                RetainedFragment.OnFragmentInteractionListener, OnMapReadyCallback {
…
public void onCreate(Bundle savedInstanceState) {
   // Set up UI and get earthquake data
         …
   // The GoogleMap instance underlying the GoogleMapFragment defined in main.xml
      MapFragment map = ((MapFragment) getFragmentManager()
                                                                              .findFragmentById(R.id.map));
      map.getMapAsync(this);
   }
```

```
// Called when Map is ready
public void onMapReady(GoogleMap googleMap) {

    mMapReady = true;
    mMap = googleMap;
    mMap.moveCamera(
       CameraUpdateFactory.newLatLng(new LatLng(CAMERA_LAT, CAMERA_LNG)));

    if (mDataReady) {
      placeMarkers();
      mMapReady = false;
    }
  }
```

```
// Called when data has been downloaded
public void onDownloadfinished() {
    mDataReady = true;
    if (mMapReady) {
      placeMarkers();
      mDataReady = false;
    }
  }
```

```
private void placeMarkers() {
  // Add a marker for every earthquake
  for (EarthQuakeRec rec : mRetainedFragment.getData()) {
    // Add a new marker for this earthquake
    mMap.addMarker(new MarkerOptions()
        // Set the Marker's position
        .position(new LatLng(rec.getLat(), rec.getLng()))
        // Set the title of the Marker's information window
        .title(String.valueOf(rec.getMagnitude()))
        // Set the color for the Marker
        .icon(BitmapDescriptorFactory.defaultMarker(
                                  getMarkerColor(rec.getMagnitude()))));
  }
}
```

Next Time

The ContentProvider Class

Example Applications

LocationGetLocation

LocationGetLocationServices

MapEarthQuakeMap