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 businesses near the user’s current location
Direct a user from a current location to a particular business
Define a geofence
Initiate action when user enters or exits the geofence
Location Architecture

Location
Permissions
FusedLocationProviderClient
LocationCallback
Location

Represents a position on the Earth

A Location instance consists of

Latitude, longitude, timestamp

Optionally: accuracy, altitude, speed, and bearing
Location Access Types

Category: Either foreground location or background location

Accuracy: Precise location or approximate location
Category

Foreground: app shares or receives location information only once, or for a defined amount of time

Background: app periodically shares location with other users or uses the Geofencing API
Accuracy

Approximate: Estimate typically accurate to 3km
Precise: Estimate typically accurate to 3m-50m
Permissions

Background locations require
  ACCESS_BACKGROUND_LOCATION

Approximate accuracy requires
  ACCESS_COARSE_LOCATION permission

Precise accuracy requires
  ACCESS_FINE_LOCATION permission

Should also request ACCESS_COARSE_LOCATION, because user can restrict accuracy
Types of Location Providers

Network – WiFi and cell tower

GPS - Satellite

Passive – Piggyback on the readings requested by other applications
Location Provider Tradeoffs

GPS – expensive, accurate, slower, available outdoors

Network - cheaper, less accurate, faster, availability varies

Cached information – cheapest, fastest, not always available
FusedLocationProviderClient

Location-providing class that fuses different location providers

Part of Google Play Services

See: https://developers.google.com/android/guides/setup
FusedLocationProviderClient methods

getLastLocation()
getCurrentLocation()
requestLocationUpdates()
Requesting Location Updates

Create FusedLocationProviderClient
Create and configure a LocationRequest
Check device settings
Implement LocationCallback interface
Register for location updates
LocationCallback

Defines callback methods that are called when FusedLocationProviderClient location information changes
LocationCallback Methods

onLocationAvailability(LocationAvailability locationAvailability) : Unit
onLocationResult(locationResult: LocationResult): Unit
Recipe for Obtaining and Using Location Information

Start listening for updates
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
LocationGetLocationServices

Application acquires and displays the last known location
If necessary, acquires and displays new readings
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 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"/>

* For versions earlier than 8.3
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
Next Time

The ContentProvider Class
Example Applications

Location
GetLocationServices
MapEarthQuakeMap