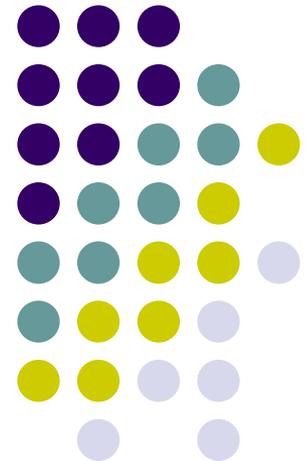


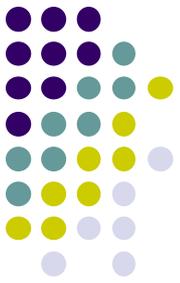
CS 4518 Mobile and Ubiquitous Computing

Lecture 7: Location-Aware Computing

Emmanuel Agu



Administrivia



- Project 3 mailed out tomorrow, due next Thursday
- Graded papers for projects 0 and 1 now on InstructAssist
- Quiz in class next Monday, February 5 (first 15 mins)
 - Lectures 6, 7 + any code referenced
 - Project 1, 2 code
- Groups should submit 1-slide on their final project (due 11.59PM on Monday, February 15)

Reminder: Final Project



- 1-slide from group next Monday (2/5):
 - 2/35 of final project grade
- Slide should cover 3 aspects
 - 1. Problem you intend to work on**
 - Solve WPI/societal problem (e.g. walking safe at night)
 - Use at least location, 1 sensor or camera
 - If games, must gamify solution to real world problem
 - 2. Why this problem is important**
 - E.g. 37% of WPI students feel unsafe walking home
 - 3. Summary of envisioned mobile app (?) solution**
 1. E.g. Mobile app automatically texts users friends when they get home at night
- Can bounce ideas of me (email, or in person)
- Can change idea any time



Final Project: Difficulty Score

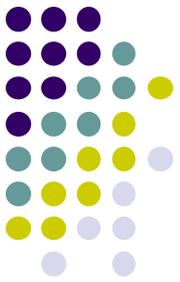
- **Project execution: 80%**
- **Project difficulty score: 20%**
- **Mobile Components and Android UI (4 points each)**
 - Every 5 Android screens (A maximum of 8 points can be earned for the UI)
 - Playback audio/video
 - Maps, location sensing
 - Camera: simply taking pictures
- **Ubiquitous Computing Components & Android UI (6 points each)**
 - Activity Recognition, sensor programming, step counting
 - GeoFencing, Mobile Vision API: e.g. Face/barcode detection/tracking
- **Machine/Deep Learning (10 points each)**
 - Machine/deep learning (i.e. run study to gather data or use existing dataset to classify/detect something)

Location-Aware Computing



- **Definition:** Location-aware applications generate outputs/behaviors that depend on a user's location
- **Examples:**
 - Map of user's "current location"
 - Print to "closest" printer
 - Apps that find user's friends "closeby"
 - Reviews of "closeby" restaurants
- Apps above require first determining user's location





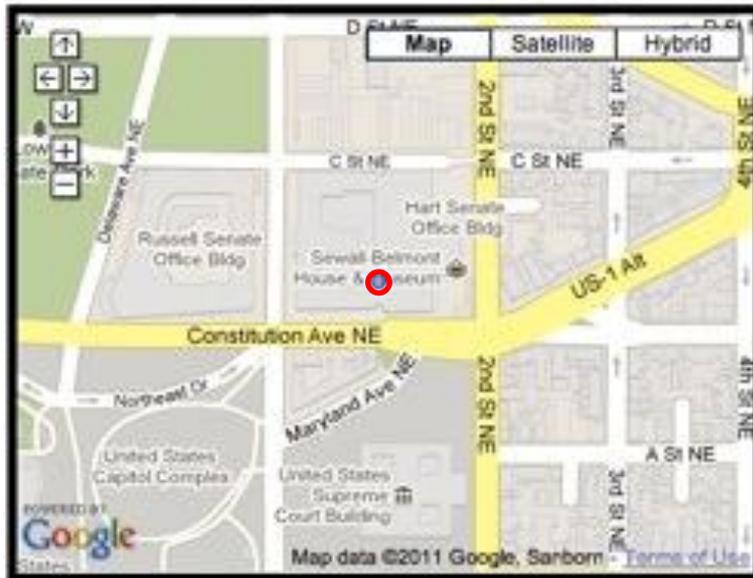
Determining User Location on Smartphones



Location Tracking on Smartphones

- **Outdoors:** Uses GPS (More accurate)
- **Indoors:** WiFi or cell tower signals (Location fingerprinting, less accurate)

GPS

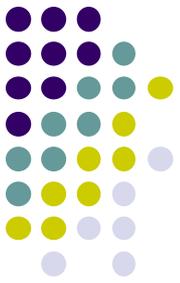
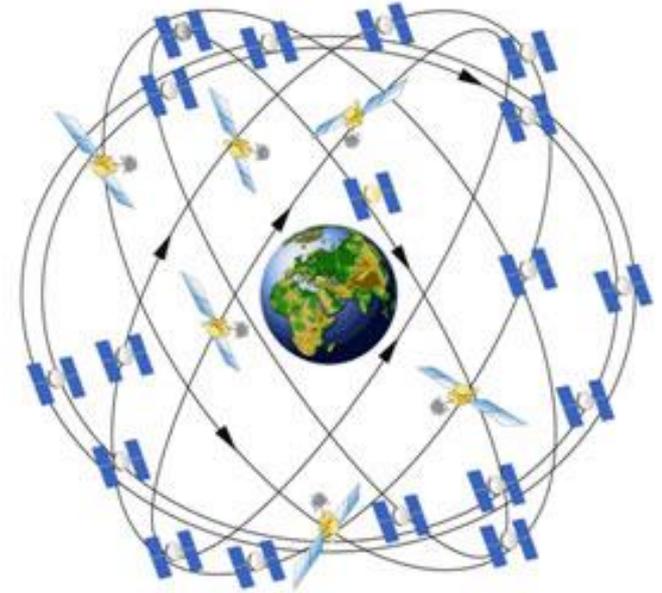


Wi-Fi



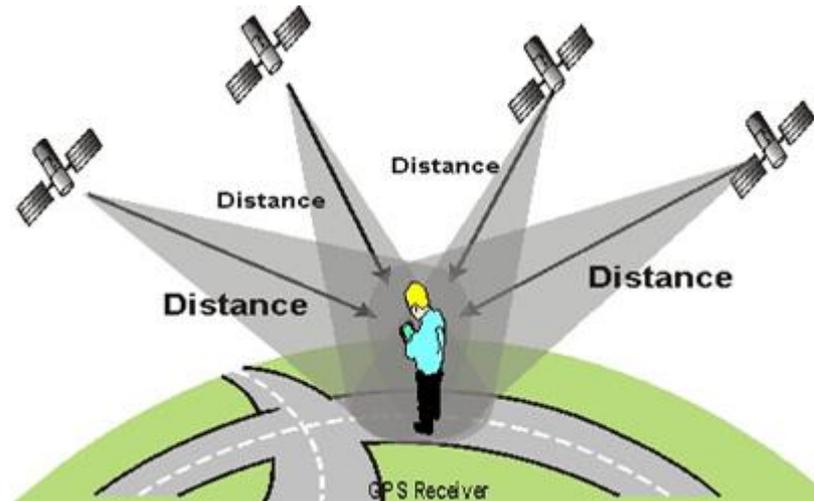
Global Positioning System (GPS)

- 27 satellites orbiting earth
- **20,000 km above earth** (Medium earth orbit)
- 6 orbital planes with 4 satellites each
- 4 satellites visible from any spot on earth
- Location of any location on earth specified as <longitude,latitude>
- E.g. Worcester MA has **Latitude:** 42.2625,
Longitude: -71.8027778

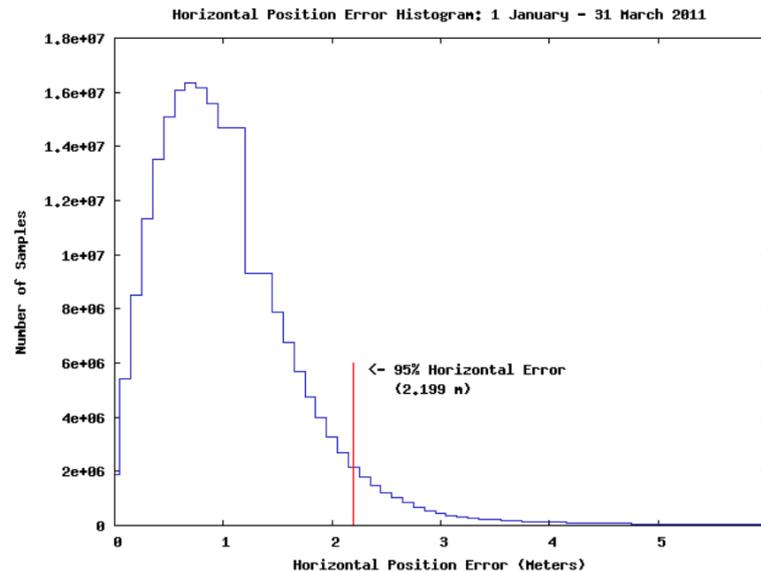


GPS User Segment

- **Triangulation:** GPS receiver calculates user's position by comparing time delay of signals to multiple satellites at known positions
- Accuracy within 5 - 10 meters (16-32 feet)



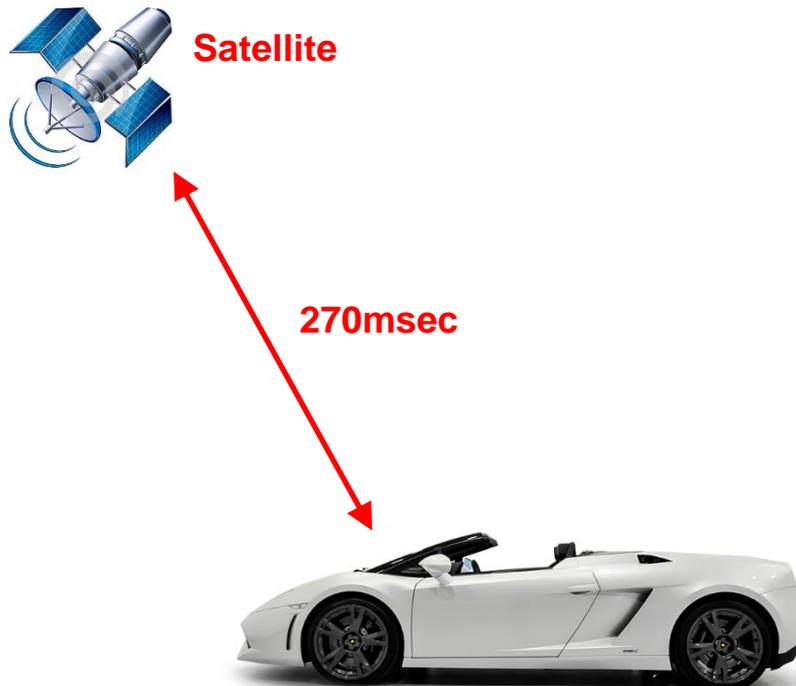
<http://adamswalk.com/gpx-2/>





Determining User Location

- GPS reasonably accurate but
 - Requires line-of-sight between satellite and car receiver
 - Only works OUTDOORS (signals don't penetrate buildings)
 - **Lag/delay** in acquiring satellites (~270 msec) or re-acquiring if lost
 - Drains battery power
- **Alternative:** Use Wi-Fi location sensing indoors

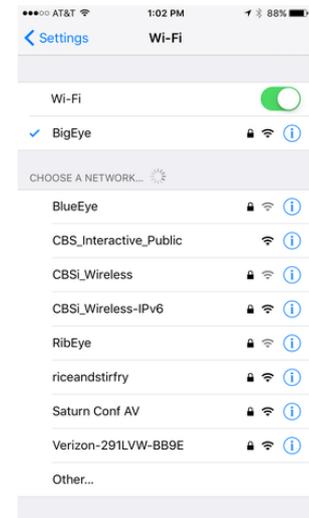
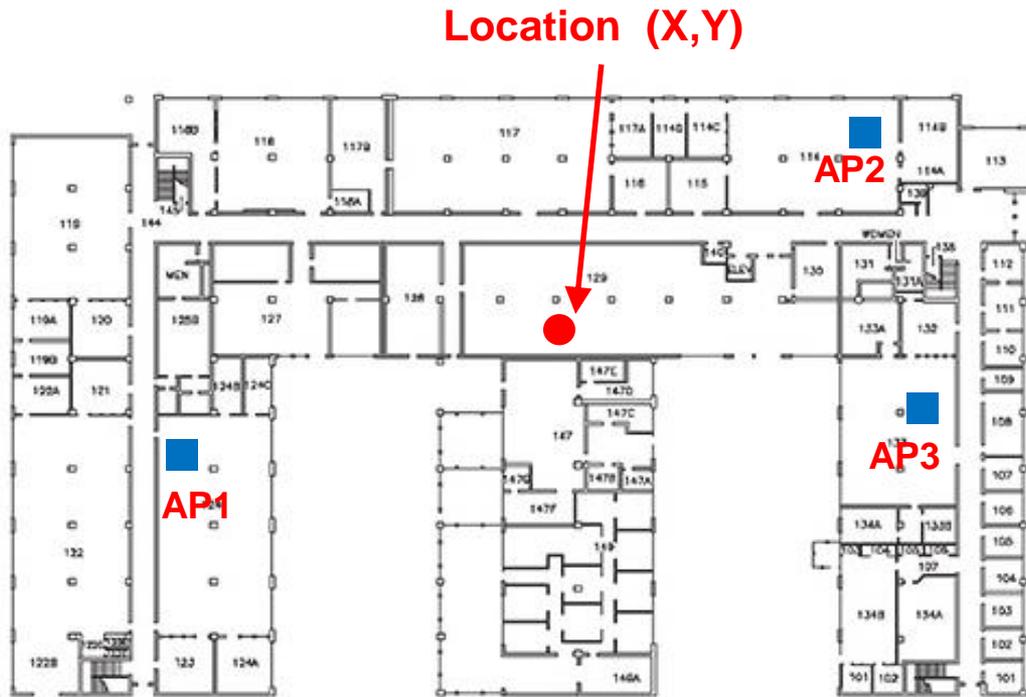


WiFi Location Fingerprinting



- **Key insight:** At each (X,Y) location, WiFi APs observed + their signal strengths, is unique

OBSERVED AP SIGNAL STRENGTH			
	AP1	AP2	AP3
(X,Y)	24	36	45



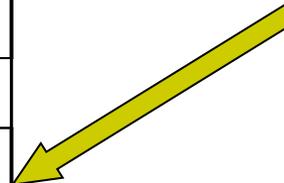
- **WiFi Location fingerprinting:** Infer device's location based on combination of Wi-Fi access points seen + Signal Strengths

Location Estimation using Wi-Fi Fingerprinting



PRE-RECORDED TUPLES					
LOCATION		SIGNAL STRENGTH			
X	Y	AP1	AP2	AP3	AP4
...
80	145	32	28	12	8
40	145	36	20	10	6
...
220	355	-	25	36	44
260	355	4	21	39	42
...
350	210	16	-	28	36
...
380	145	22	12	-	44
...

OBSERVED SIGNAL STRENGTH			
AP1	AP2	AP3	AP4
-	24	36	45

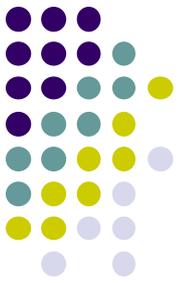


Location (X,Y)??

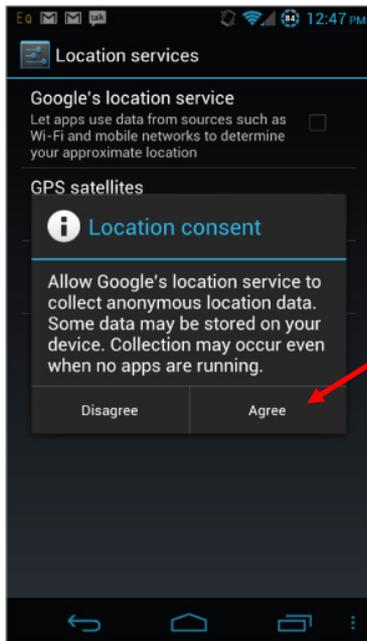
- ◆ Inference Algorithms
 - Min. Threshold
 - Euclidean Dist.
 - Joint Probability
 - Bayesian Filters

Google builds and stores this database (APs + Signal Strength) at each X,Y location)

How to Build table of APs observed at (X,Y) Locations?



- Devices (e.g. smartphone) with GPS and WiFi turned on simultaneously build table
- Send data to third party repositories (e.g. Wigle.net) or Google
- Also called **war driving**
- Can record cell tower signal strength instead of AP

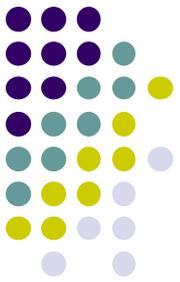


Google gathers Location, AP seen Data if you consent

PRE-RECORDED TUPLES					
LOCATION		SIGNAL STRENGTH			
X	Y	AP1	AP2	AP3	AP4
...
80	145	32	28	12	8
40	145	36	20	10	6
...
220	355	-	25	36	44
260	355	4	21	39	42

GPS gathers Location (X,Y)

WiFi card gathers APs seen + Signal Strength

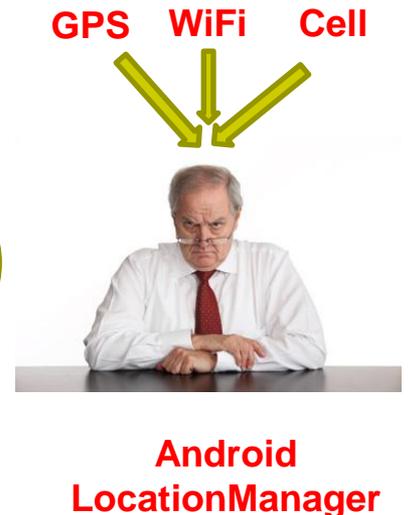
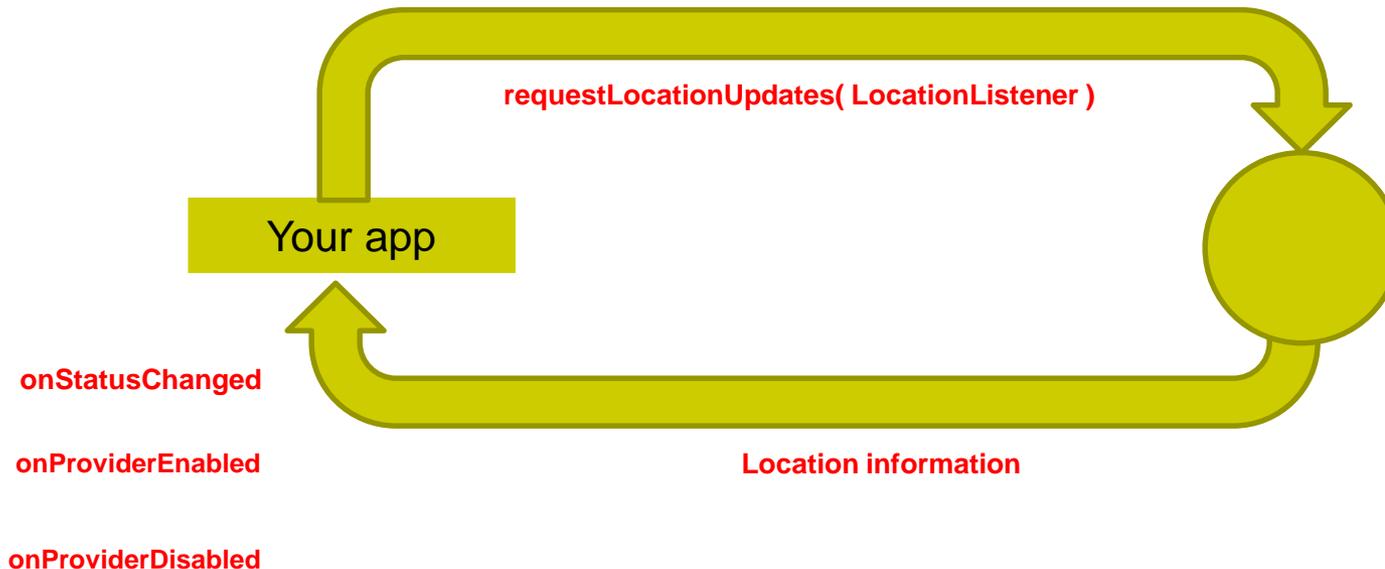
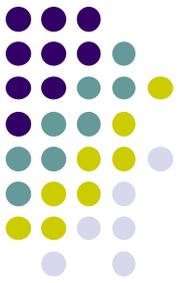


Location Sensing in Android Apps

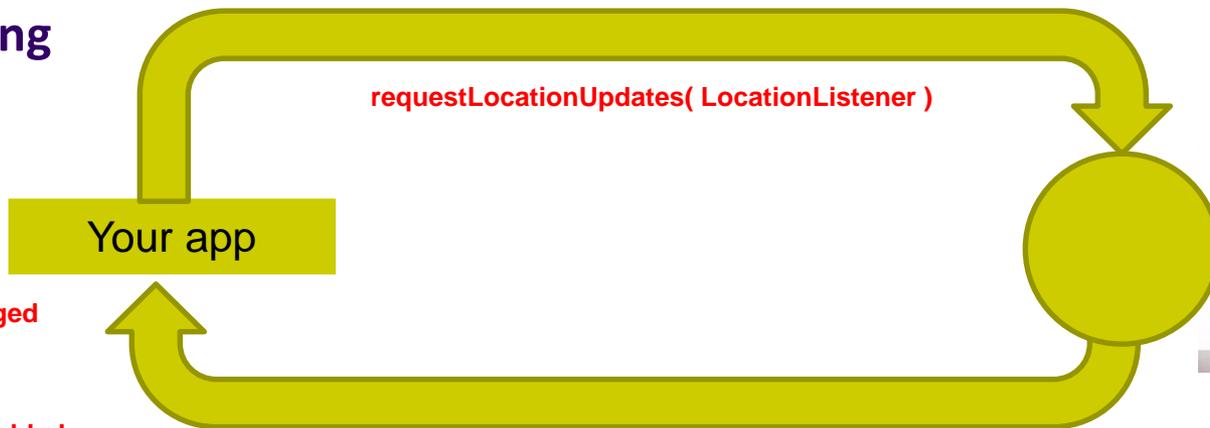
Google Location APIs

<https://developer.android.com/guide/topics/location/strategies.html>

- Android now has 2 location APIs (older vs newer)
- Newer location API is now part of Google Play Services
- Older Android framework location APIs (**android.location**)
 - Used by most books, online sources. We will use that
 - <http://developer.android.com/guide/topics/location/strategies.html>
- **LocationManager:**
 - Android module receives location updates from GPS, WiFi, etc
 - App registers/requests location updates from LocationManager



Requesting Location Updates



LocationManager

```
// Acquire a reference to the system Location Manager
LocationManager locationManager = (LocationManager) this.getSystemService(Context.LOCATION_SERVICE);

// Define a listener that responds to location updates
LocationListener locationListener = new LocationListener() {
    public void onLocationChanged(Location location) {
        // Called when a new location is found by the network location provider.
        makeUseOfNewLocation(location);
    }

    public void onStatusChanged(String provider, int status, Bundle extras) {}

    public void onProviderEnabled(String provider) {}

    public void onProviderDisabled(String provider) {}
};

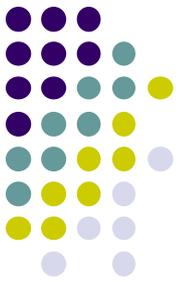
// Register the listener with the Location Manager to receive location updates
locationManager.requestLocationUpdates(LocationManager.NETWORK_PROVIDER, 0, 0, locationListener);
```

Create listener for Location info

Callback methods called by Location manager (e.g. when location changes)

Type of location Provider (e.g. cell tower and Wi-Fi based)

Listener that receives callbacks



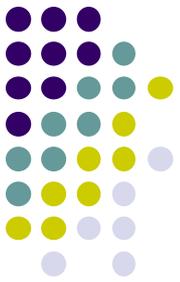
Requesting User Permissions

<https://developer.android.com/guide/topics/location/strategies.html>

- Need smartphone owner's permission to use their GPS

```
<manifest ... >
  <uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
  ...
  <!-- Needed only if your app targets Android 5.0 (API level 21) or higher. -->
  <uses-feature android:name="android.hardware.location.gps" />
  ...
</manifest>
```

- **ACCESS_FINE_LOCATION:** GPS
- **ACCESS_COARSE_LOCATION:** WiFi or cell towers



Getting Cached Copy of Location (Fast)

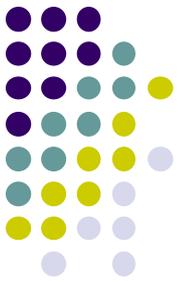
<https://developer.android.com/guide/topics/location/strategies.html>

- Getting current location may take a while
- Can choose to use location cached (possibly stale) from Location Manager

```
String locationProvider = LocationManager.NETWORK_PROVIDER;  
// Or use LocationManager.GPS_PROVIDER  
  
Location lastKnownLocation = locationManager.getLastKnownLocation(locationProvider);
```

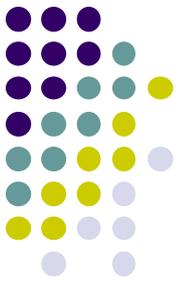
Stopping Listening for Location Updates

<https://developer.android.com/guide/topics/location/strategies.html>



- Location updates consume battery power
- Stop listening for location updates whenever you no longer need

```
// Remove the listener you previously added  
locationManager.removeUpdates(locationListener);
```

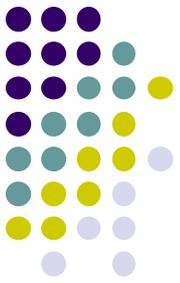


Distance Travelled Updates using Services

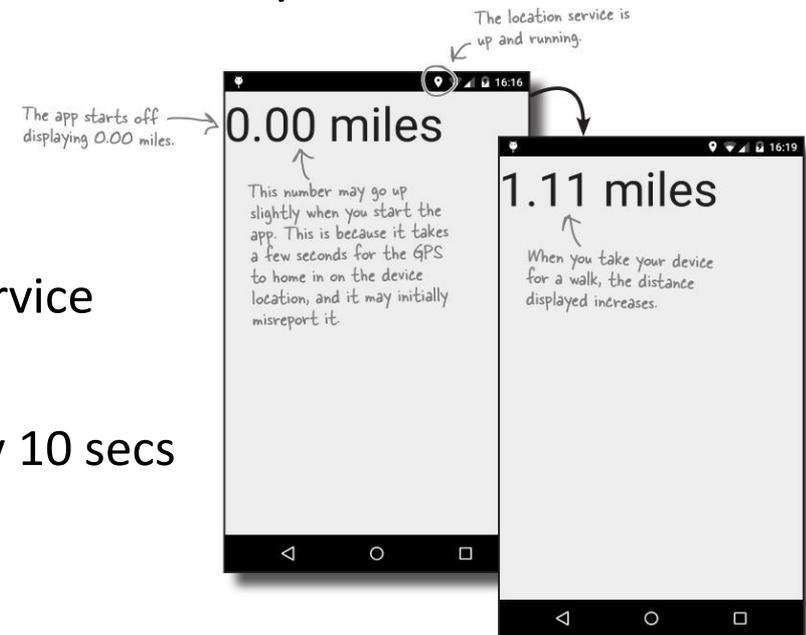
Example from Head First Android

Example: Odometer (Distance Travelled) updates as a Services

(Ref: Head First Android 2nd edition pgs 789 - 800)

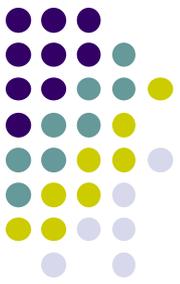


- **Services:** long running background processes, no UI
- May want background service (a module in our app) to continuously retrieve location updates from LocationManager, forward updates to our Activity
- Ref: Head First Android pg 789
 - Example of using a Service
 - Nice Example app using Odometer Service
 - Tracks distance travelled
 - Gets, displays distance travelled every 10 secs

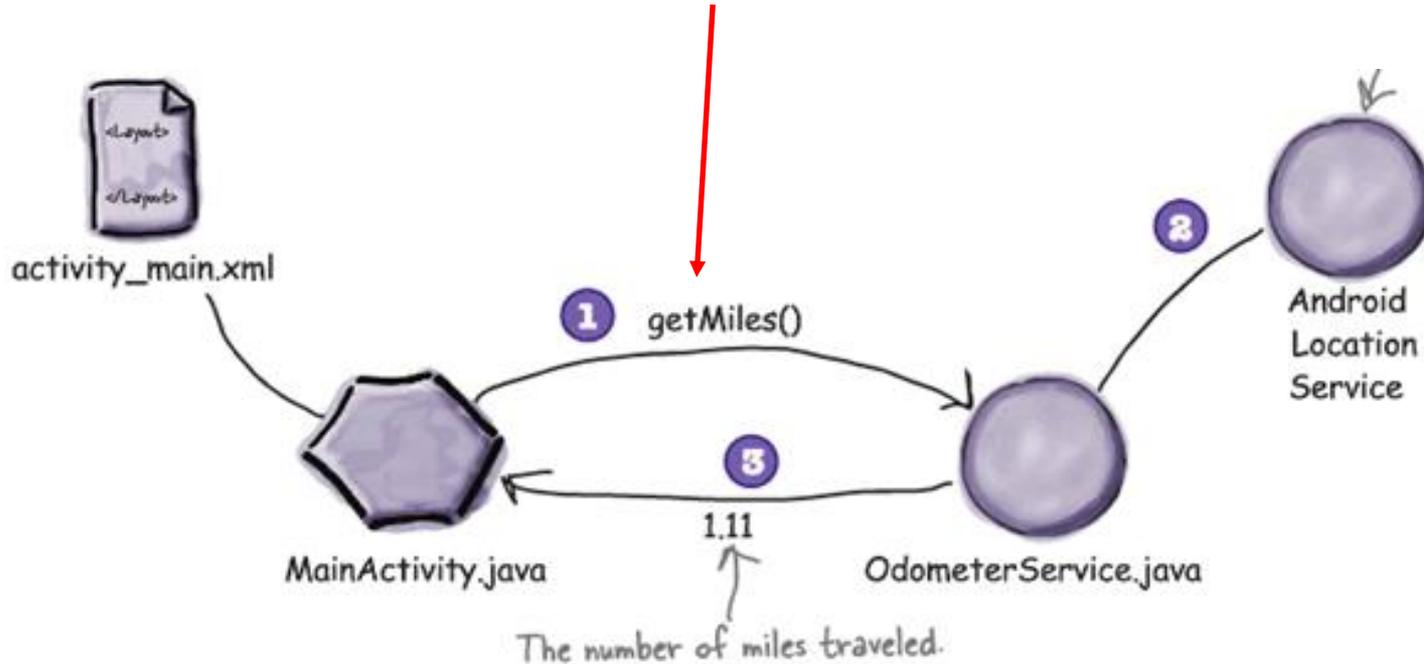


Example: Odometer (Distance Travelled) updates as a Services

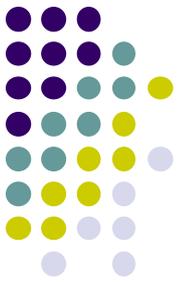
(Ref: Head First Android pg 789)



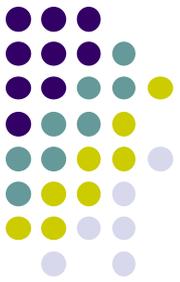
- Example odometer app that tracks distance travelled
- `getMiles()`, displays distance travelled every 10 seconds



Study this example!!!



Location Representation



Semantic Location

- GPS represents location as <longitude,latitude>
- **Semantic location** is better for reasoning about locations
- **E.g.** Street address (140 Park Avenue, Worcester, MA) or (building, floor, room)
- **Android supports:**
 - **Geocoding:** Convert addresses into longitude/latitude coordinates
 - **Reverse geocoding:** convert longitude/latitude coordinates into human readable address

Geocoding



Latitude: 37.422005 Longitude: -122.084095

Address:
1600 Amphitheatre Pkwy
Mountain View, CA 94043
Mountain View
94043
United States



**Reverse
Geocoding**

- **Android Geocoding API:** access to **geocoding** and **reverse geocoding** services using HTTP requests



Google Places API Overview

- Access information, **high-quality photos** of a place
- Users can also add place information to the database
 - E.g. business owners can add their business as a place in Places database
 - Other apps can then retrieve info after moderation

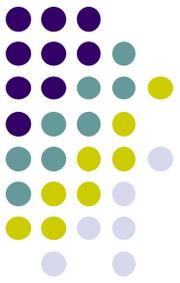
Local business results for **cupcakes** near **New York, NY**

Letter	Business Name	Website	Phone Number	Reviews
A	Crumbs Bake Shop	www.crumbs.com	(212) 480-7500	52 reviews
B	Sugar Sweet Sunshine	www.sugarsweetsunshine.com	(212) 995-1960	255 reviews
C	Babycakes NYC	www.babycakesnyc.com	(212) 677-5047	172 reviews
D	Billy's Bakery	www.billysbakerynyc.com	(212) 647-9956	219 reviews
E	Magnolia	www.magnoliabakery.com	(212) 462-2572	1055 reviews
F	Tribeca Treats	www.tribecatreats.com	(212) 571-0500	63 reviews
G	Butter Lane Cupcakes	www.butterlane.com	(212) 677-2880	78 reviews

Visit our website Sponsored

More results near **New York, NY** »

- **On-device caching:** Can cache places data locally on device to avoid roundtrip delays on future requests



Google Places

- **Place:** physical space that has a name (e.g. local businesses, points of interest, geographic locations)
 - E.g Logan airport, place type is **airport**
- **API:** Provides Contextual information about places near device.
- **E.g:** name of place, address, geographical location, place ID, phone number, place type, website URL, etc.
- Compliments geographic-based services offered by Android location services

Sample Place Types



accounting

airport

amusement_park

aquarium

art_gallery

atm

bakery

bank

bar

beauty_salon

bicycle_store

book_store

bowling_alley

bus_station

cafe

campground

car_dealer

car_rental

car_repair

car_wash

hospital

insurance_agency

jewelry_store

laundry

lawyer

library

liquor_store

local_government_office

locksmith

lodging

meal_delivery

meal_takeaway

mosque

movie_rental

movie_theater

moving_company

museum

night_club

painter

park

city_hall

clothing_store

convenience_store

courthouse

dentist

department_store

doctor

electrician

electronics_store

embassy

establishment (deprecated)

finance (deprecated)

fire_station

florist

food (deprecated)

funeral_home

furniture_store

gas_station

general_contractor (deprecated)

grocery_or_supermarket

gym

hair_care

hardware_store

health (deprecated)

hindu_temple

home_goods_store

physiotherapist

place_of_worship (deprecated)

plumber

police

post_office

real_estate_agency

restaurant

roofing_contractor

rv_park

school

shoe_store

shopping_mall

spa

stadium

storage

store

subway_station

synagogue

taxi_stand

train_station

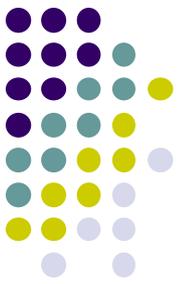
transit_station

travel_agency

university

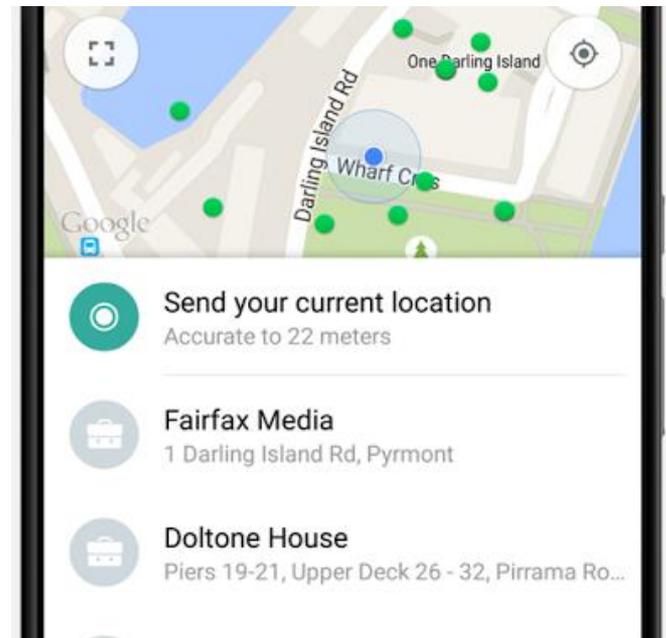
veterinary_care

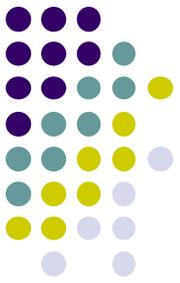
zoo



Google Places API Overview

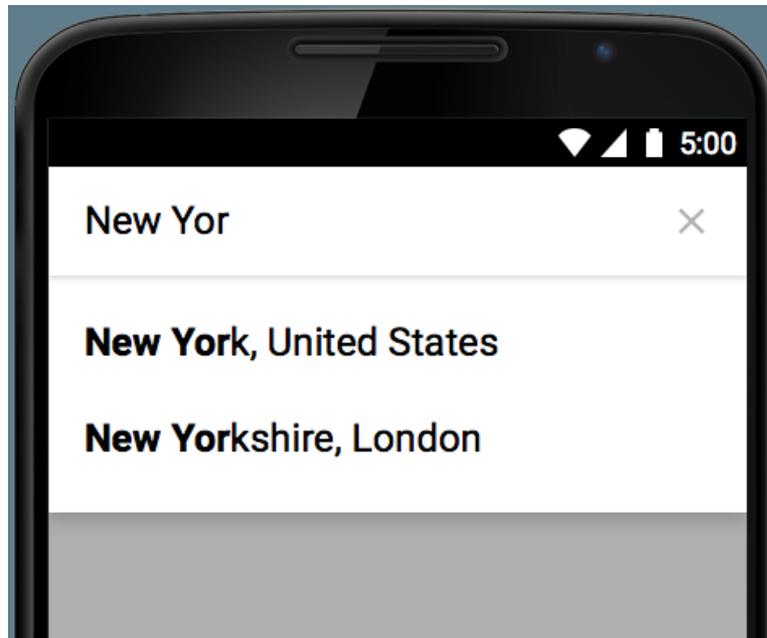
- **Use Place picker UI:** allows users select place from “possible place” on a map
- **Get current place:** place where device is last known to be located
 - Returns **list** of likely places + likelihood device is in that place

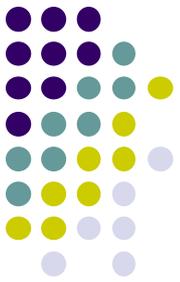




Google Places API Overview

- **Autocomplete:** queries the location database as users type, suggests nearby places matching letters typed in





Learning Google Places API

- Official Google Places website is “decent”, up to date:
 - <https://developers.google.com/places/>
- Two great references:
 - a) Getting started with Google Places API
<https://developers.google.com/places/android-api/start>
 - b) Tutorial by Paul Trebilcox-Ruiz may be more readable:
 - <http://code.tutsplus.com/articles/google-play-services-using-the-places-api--cms-23715>



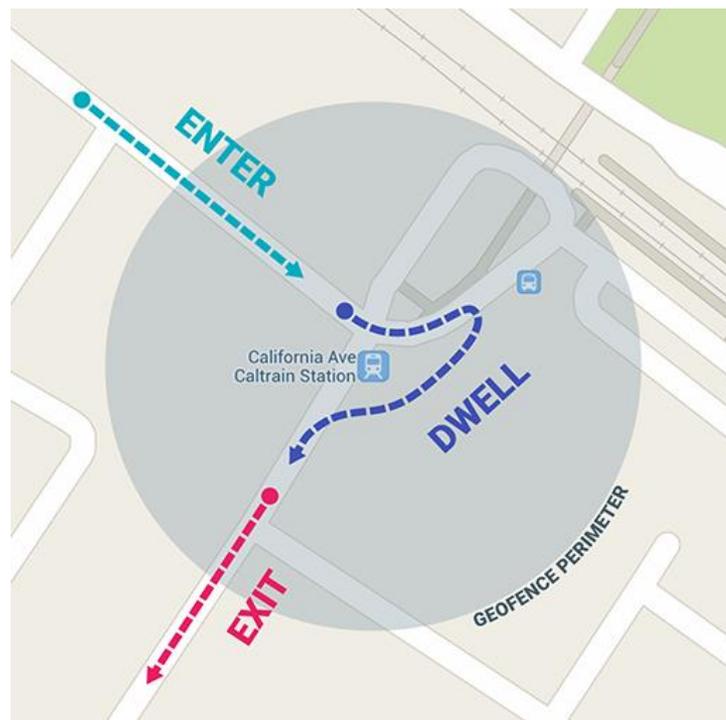
Other Useful Google Maps/Location APIs

GeoFencing

<https://developer.android.com/training/location/geofencing.html>



- **Geofence:** Sends alerts when user is within a certain radius to a location of interest
- Can be configured to send to app:
 - **ENTER** event when user enters circle
 - **EXIT** event when user exits circle
- Can also specify a duration or **DWELL** user must be in circle before triggering event



GeoFencing

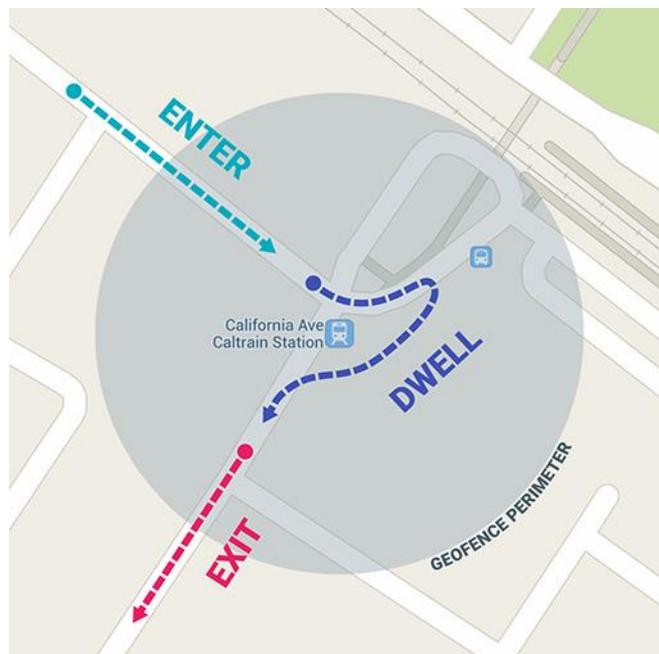
<https://developer.android.com/training/location/geofencing.html>



- **Great reference:**

- How to work with GeoFences on Android by Tin Megali

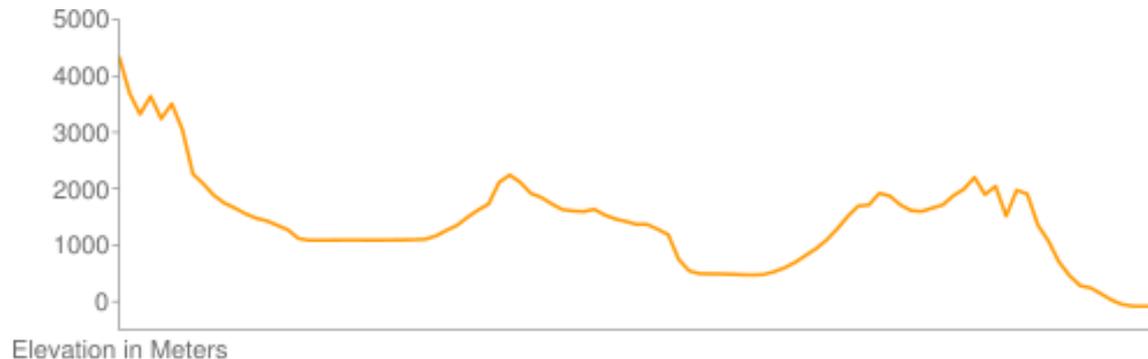
<https://code.tutsplus.com/tutorials/how-to-work-with-geofences-on-android--cms-26639>





Other Maps/Useful Location APIs

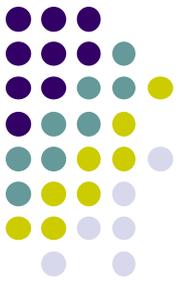
- **Maps Directions API:** calculates directions between locations (walking, driving) as well as public transport directions
- **Distance Matrix API:** Calculate travel time and distance for multiple destinations
- **Elevation API:** Query locations on earth for elevation information, calculate elevation changes along routes



Other Useful Maps/Location APIs



- **Roads API:**
 - snaps set of GPS coordinates to road user was likely travelling on (best fit)
 - Returns posted speed limits for any road segment (premium plan)
- **Time Zone API:** request time zone for location on earth

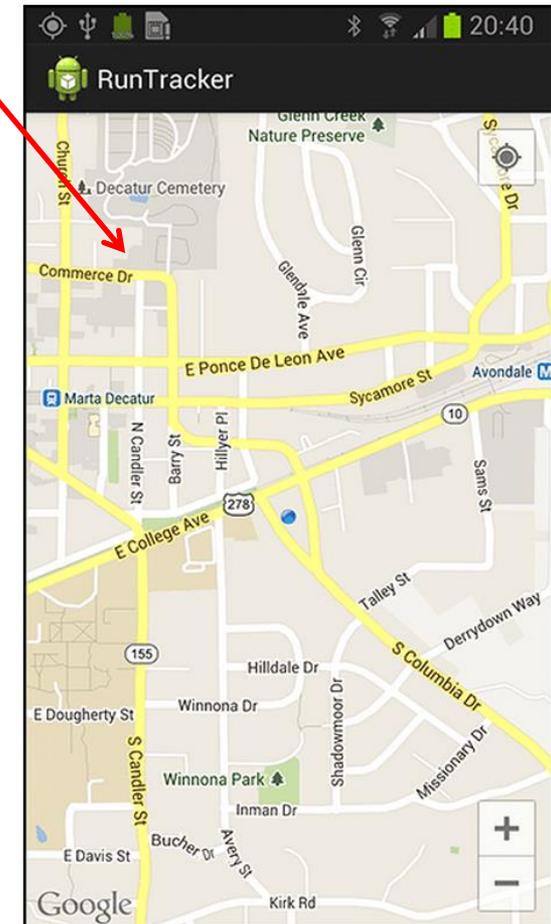


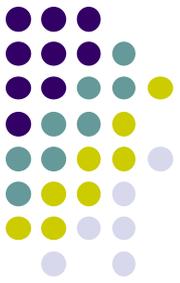
Using Maps



MapView and MapActivity

- **MapView:** UI widget that displays maps
- **MapActivity:** java class (extends Activity), handles map-related lifecycle and management for displaying maps.





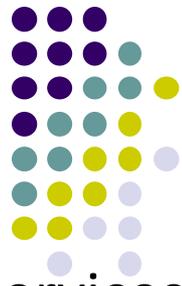
7 Steps for using Google Maps Android API

<https://developers.google.com/maps/documentation/android-api/start>

1. Install Android SDK (Done!!)
 - <https://developer.android.com/studio/index.html>
2. Add Google Play services to Android Studio
3. Create a Google Maps project
4. Obtain Google Maps API key
5. Hello Map! Take a look at the code
6. Connect an Android device
7. Build and run your app

Step 2: Add Google Play Services to Android Studio

<https://developers.google.com/maps/documentation/android-api/start>



- Google Maps API v2 is part of Google Play Services SDK
- Use Android Studio SDK manager to download Google Play services

Open SDK Manager
Click on SDK Tools

Check Google Play Services, then Ok

Default Settings

Appearance & Behavior > System Settings > Android SDK

Manager for the Android SDK and Tools used by Android Studio

Android SDK Location: C:\Users\emmanuel\AppData\Local\Android\Sdk [Edit](#)

SDK Platforms | **SDK Tools** | SDK Update Sites

Below are the available SDK developer tools. Once installed, Android Studio will automatically check for updates. Check "show package details" to display available versions of an SDK Tool.

Name	Version	Status
<input checked="" type="checkbox"/> Android SDK Build-Tools		Installed
<input type="checkbox"/> CMake		Not Installed
<input type="checkbox"/> LLDB		Not Installed
<input type="checkbox"/> Android Auto API Simulators	1	Not installed
<input type="checkbox"/> Android Auto Desktop Head Unit Simulator	1.1	Not installed
<input checked="" type="checkbox"/> Android SDK Platform-Tools 25.0.3	25.0.3	Installed
<input checked="" type="checkbox"/> Android SDK Tools 25.2.5	25.2.5	Installed
<input checked="" type="checkbox"/> Documentation for Android SDK	1	Installed
<input type="checkbox"/> GPU Debugging tools	1.0.3	Not installed
<input type="checkbox"/> GPU Debugging tools	3.1.0	Not installed
<input type="checkbox"/> Google Play APK Expansion library	1	Not installed
<input type="checkbox"/> Google Play Billing Library	5	Not installed
<input type="checkbox"/> Google Play Licensing Library	1	Not installed
<input type="checkbox"/> Google Play services	38	Not installed
<input checked="" type="checkbox"/> Google USB Driver	11	Installed
<input type="checkbox"/> Google Web Driver	2	Not installed
<input checked="" type="checkbox"/> Intel x86 Emulator Accelerator (HAXM installer)	6.0.5	Installed
<input type="checkbox"/> NDK	13.1.3345770	Not installed
<input type="checkbox"/> Support Repository		
<input type="checkbox"/> ConstraintLayout for Android		Not installed

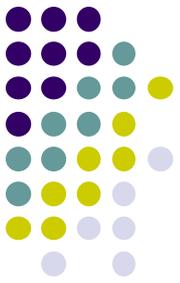
[Launch Standalone SDK Manager](#)

Show Package Details

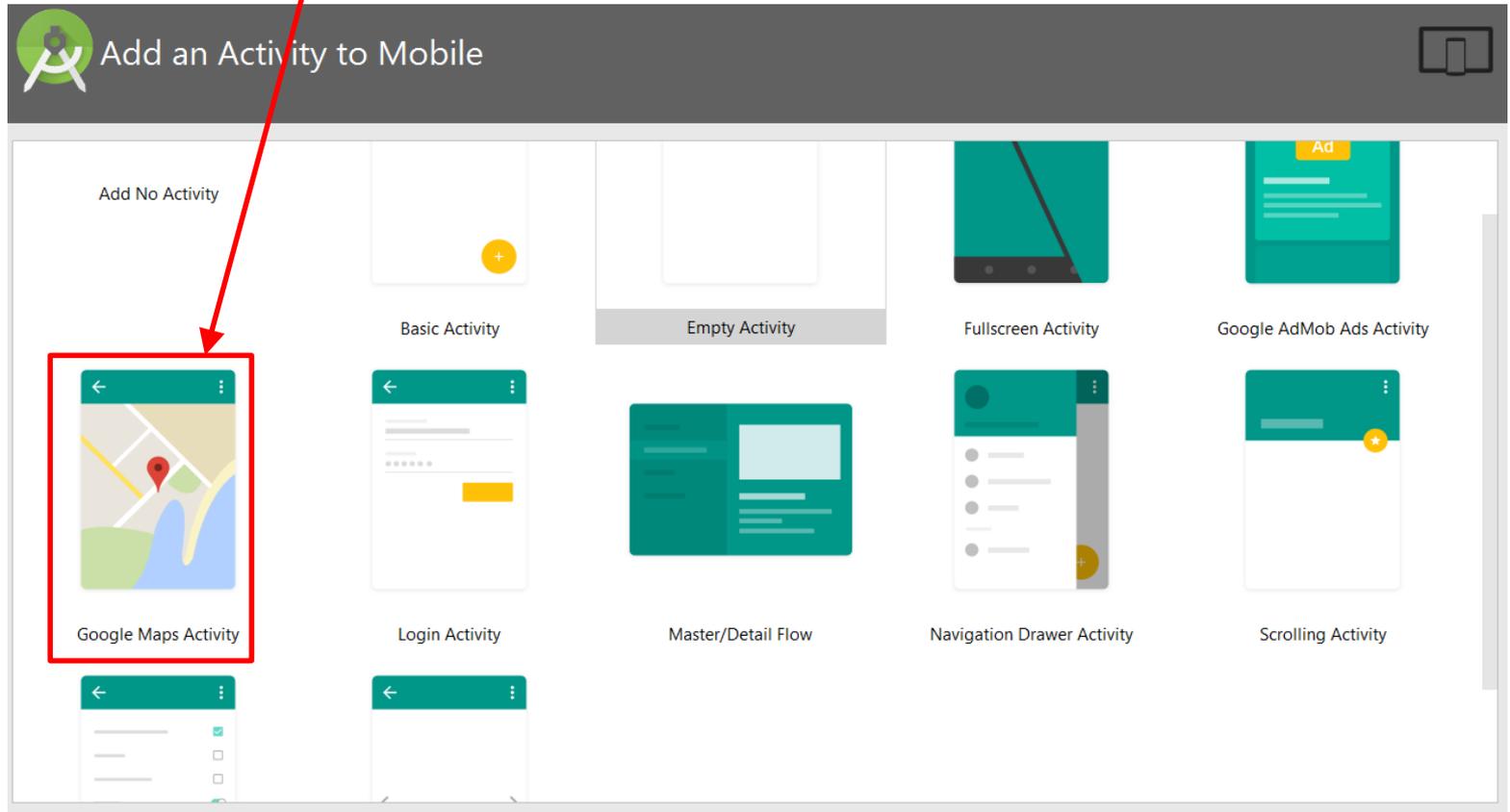
OK Cancel Apply Help

Step 3: Create new Android Studio Project

<https://developers.google.com/maps/documentation/android-api/start>

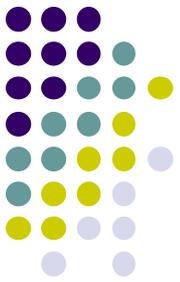


- Select “Google Maps Activity, click Finish



Step 4: Get Google Maps API key

<https://developers.google.com/maps/documentation/android-api/start>



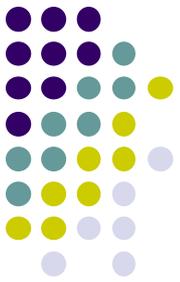
- To access Google Maps servers using Maps API, must add Maps API key to app
- Maps API key is free. E.g.

Your API key
AIzaSyCc0_1EEjP11TLnPkVsX10YIY7oBa9XsXs 

- Google uses API key to uniquely identify your app, track its resource usage, etc

Step 4a: Fast, Easy way to get Maps API Key

<https://developers.google.com/maps/documentation/android-api/start>



- Copy link provided in **google_maps_api.xml** of Maps template into browser
- Goes to Google API console, auto-fills form
- Creates API key

Register your application for Google Maps Android API in Google API Console

Google API Console allows you to manage your application and monitor API usage.

You have no existing projects. A new project named "My Project" will be created.

Please email me updates regarding feature announcements, performance suggestions, feedback surveys and special offers.

Yes No

I agree that my use of any [services and related APIs](#) is subject to my compliance with the applicable [Terms of Service](#).

Yes No

Agree and continue

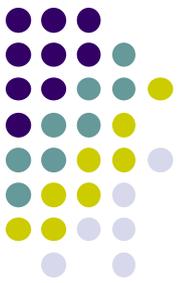


The API is enabled

The project has been created and Google Maps Android API has been enabled.

Next, you'll need to create an API key in order to call the API.

Create API key



Step 4a: Fast, Easy way to get Maps API Key

<https://developers.google.com/maps/documentation/android-api/start>

- If successful, Maps API key generated

API key created

Use this key in your application by passing it with the `key=API_KEY` parameter.

Your API key

AIzaSyCc0_1EEjP11TLnPkVsX10YIY7oBa9XsXs

⚠ Restrict your key to prevent unauthorized use in production.

CLOSE

RESTRICT KEY

- Copy key, put it in `<string>` element in `google_maps_api.xml` file

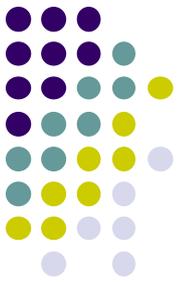
```
<string name="google_maps_key" templateMergeStrategy="preserve" translatable="false">AIzaSyCc0_1EEjP11TLnPkVsX10YIY7oBa9XsXs</string>
```



Step 4b: Longer (older) way to API key

- If easy way doesn't work, older way to obtain a Maps API key
- Follow steps at:
 - See: <https://developers.google.com/maps/documentation/android-api/signup>

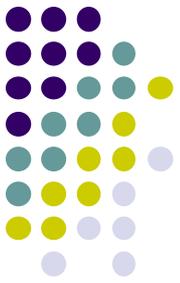
Step 5: Examine Code Generated by Android Studio Maps Template



- XML file that defines layout is in **res/layout/activity_maps.xml**

```
<fragment xmlns:android="http://schemas.android.com/apk/res/android"
  xmlns:tools="http://schemas.android.com/tools"
  android:layout_width="match_parent"
  android:layout_height="match_parent"
  android:id="@+id/map"
  tools:context=".MapsActivity"
  android:name="com.google.android.gms.maps.SupportMapFragment" />
```

Step 5: Examine Code Generated by Android Studio Maps Template



- Default Activity file is **MapActivity.java**

```
import android.os.Bundle;
import android.support.v4.app.FragmentActivity;
import com.google.android.gms.maps.CameraUpdateFactory;
import com.google.android.gms.maps.GoogleMap;
import com.google.android.gms.maps.OnMapReadyCallback;
import com.google.android.gms.maps.SupportMapFragment;
import com.google.android.gms.maps.model.LatLng;
import com.google.android.gms.maps.model.MarkerOptions;

public class MapsActivity extends FragmentActivity implements OnMapReadyCallback {

    private GoogleMap mMap;

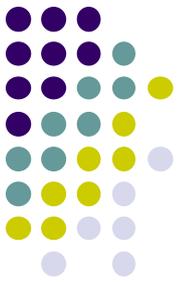
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_maps);
        SupportMapFragment mapFragment = (SupportMapFragment) getSupportFragmentManager()
            .findFragmentById(R.id.map);
        mapFragment.getMapAsync(this);
    }

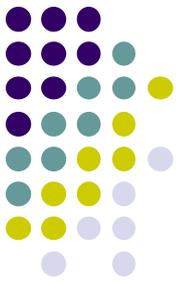
    @Override
    public void onMapReady(GoogleMap googleMap) {
        mMap = googleMap;

        // Add a marker in Sydney, Australia, and move the camera.
        LatLng sydney = new LatLng(-34, 151);
        mMap.addMarker(new MarkerOptions().position(sydney).title("Marker in Sydney"));
        mMap.moveCamera(CameraUpdateFactory.newLatLng(sydney));
    }
}
```

Steps 6, 7

- **Step 6:** Connect to an Android device (smartphone)
- **Step 7:** Run the app
 - Should show map with a marker on Sydney Australia
- More code examples at:
 - <https://github.com/googlemaps/android-samples>



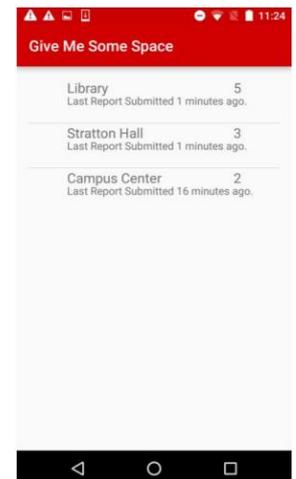
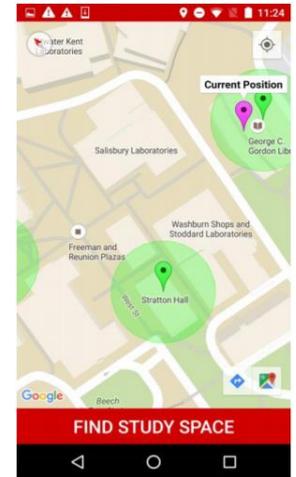


Location-Aware Apps from Past Offerings

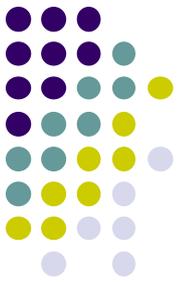
Location-Aware Ideas from Previous Offerings



- **Ground rules:**
 - Apps must use mobile, location or sensors
 - Try to solve problems of benefit to WPI community
- More than half of apps used location.
- **Give me some space:** Bianchi, Chow, Martinez '16
 - Find available study spaces on campus during exam week
 - Set up geoFences at study locations, count users in/out

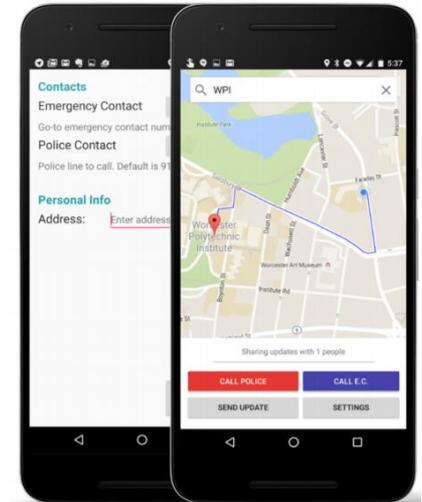


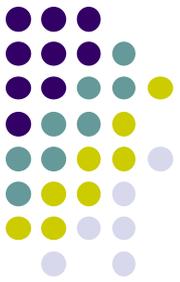
Location-Aware Ideas from Previous Offerings



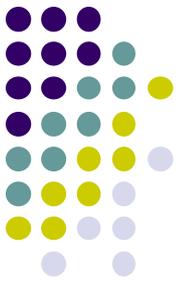
- **HomeSafe:** Nickerson, Feeley, Faust '16
 - Safety app
 - Automatically sends message to users' subscribers when they get home safely

- Project from grad class:
 - **Mansoor *et al*:** WPI automatic parking tracking/finder



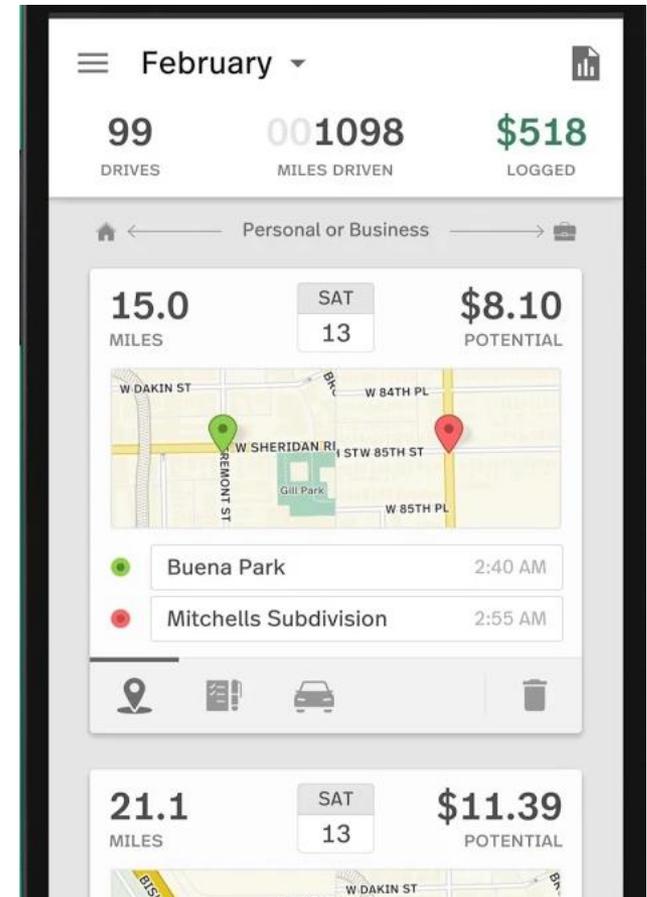


Some Interesting Location-Aware Apps



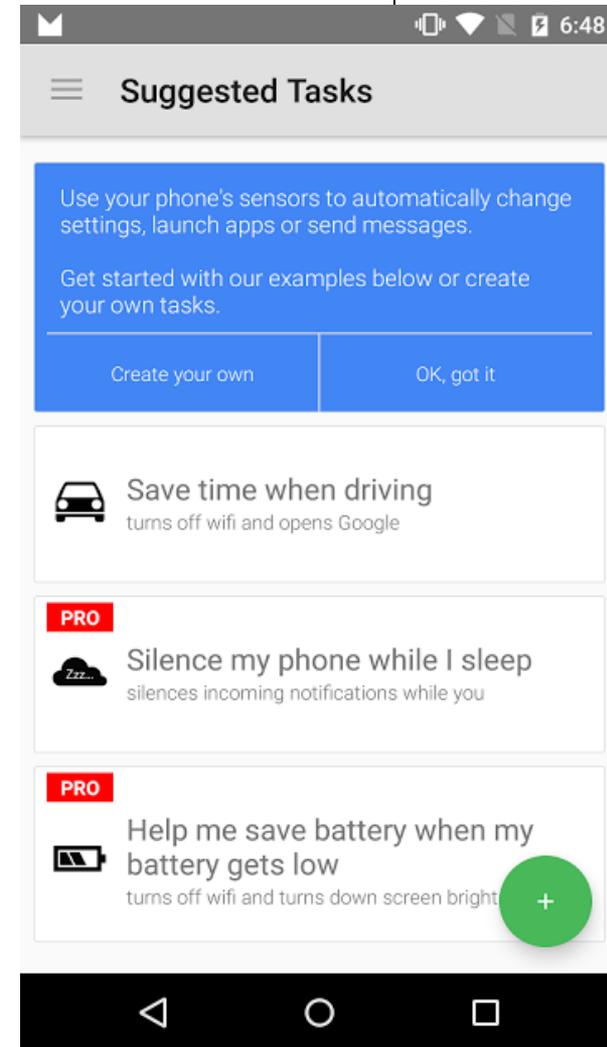
MileIQ

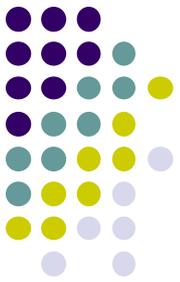
- **The Problem:** Mileage tracking is useful but a burden.
 - IRS deductions on taxes
 - Some companies reimburse employees for mileage,
- Passively, automatically tracks business mileage, IRS compliant
- Swipe right after drive to indicate it was a business trip
- Project idea? Implement some of this functionality
- **How Android modules? For what?**
- **What stats to decide if this is tackling important problem?**



Trigger

- Use geofences, NFC, bluetooth, WiFi connections, etc to set auto-behaviors
 - Battery low -> turn off bluetooth + auto sync
 - Silence phone every morning when you get to work
 - Turn off mobile data when you connect to your home WiFi
 - Silence phone and set alarm once I get into bed
 - Use geofence for automatic foursquare checkin
 - Launch maps when you connect to your car's bluetooth network
- Project idea? Implement subset of these features
- **What triggers would be useful for a WPI student?**



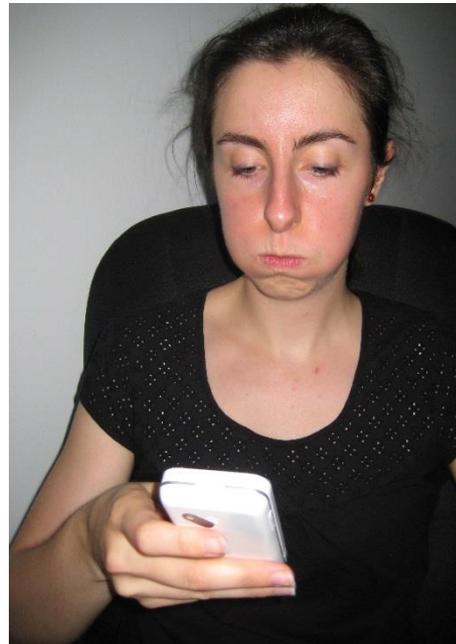


AsyncTask API

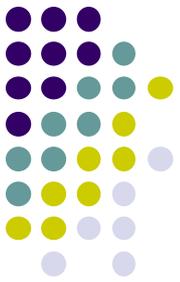


AsyncTask API

- For compute intensive tasks, remote or tasks that take a long time, doing it in main activity blocks
- **AsyncTask**: spawn separate thread to offload such task, free up main Activity



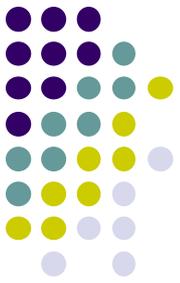
One thread
=
Frustrated user !



Playing Audio and Video in Android

MediaPlayer

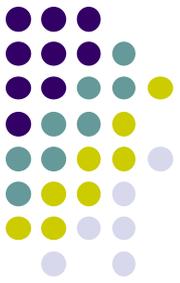
<http://developer.android.com/guide/topics/media/mediaplayer.html>



- Classes used to play sound and video in Android
 - **MediaPlayer:** Plays sound and video
 - **AudioManager:** plays only audio
- MediaPlayer can fetch, decode and play audio or video from:
 - Audio/video files stored in app's resource folders (e.g. **res/raw/** folder)
 - External URLs (over the Internet)
- Any Android app can use MediaPlayer APIs to integrate video/audio playback functionality

MediaPlayer

<http://developer.android.com/guide/topics/media/mediaplayer.html>



- MediaPlayer supports:
 - **Streaming network protocols:** RTSP, HTTP streaming
 - **Media Formats:**
 - Audio (MP3, AAC, MIDI, etc),
 - Image (JPEG, GIF, PNG, BMP, etc)
 - Video (MPEG-4, H.263, H.264, H.265 AVC, etc)
- 4 major functions of a Media Player
 - **User interface**, user interaction
 - Handle **Transmission errors**: retransmissions, interleaving
 - **Decompress** audio
 - **Eliminate jitter**: Playback buffer (Pre-download 10-15 secs of music)

Using Media Player:

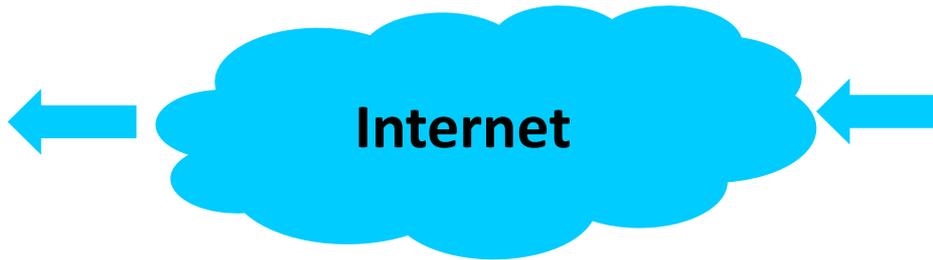
<http://developer.android.com/guide/topics/media/mediaplayer.html>

Step 1: Request Permission in AndroidManifest or Place video/audio files in res/raw



- If streaming video/audio over Internet (network-based content), request network access permission in AndroidManifest.xml:

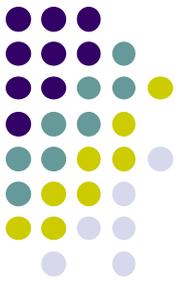
```
<uses-permission android:name="android.permission.INTERNET" />
```



- If playing back local file stored on user's smartphone, put video/audio files in **res/raw** folder

Using MediaPlayer

Step 2: Create MediaPlayer Object, Start Player



- To play audio file saved in app's **res/raw/** directory

```
MediaPlayer mediaPlayer = MediaPlayer.create(context, R.raw.sound_file_1);  
mediaPlayer.start(); // no need to call prepare(); create() does that for you
```

- **Note:** Audio file opened by create (e.g. sound_file_1.mpg) must be encoded in one of supported media formats

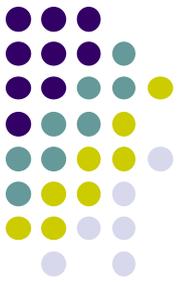
Using MediaPlayer

Step 2: Create MediaPlayer Object, Start Player



- To play audio from remote URL via HTTP streaming over the Internet

```
String url = "http://....."; // your URL here
MediaPlayer mediaPlayer = new MediaPlayer();
mediaPlayer.setAudioStreamType(AudioManager.STREAM_MUSIC);
mediaPlayer.setDataSource(url);
mediaPlayer.prepare(); // might take long! (for buffering, etc)
mediaPlayer.start();
```

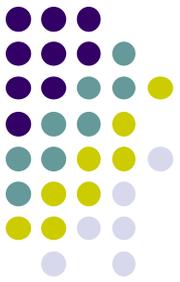


Releasing the MediaPlayer

- MediaPlayer can consume valuable system resources
- When done, call **release()** to free up system resources
- In **onStop()** or **onDestroy()** methods, call

```
mediaPlayer.release();  
mediaPlayer = null;
```

- **MediaPlayer in a Service:** Can play media (e.g. music) in background while app is not running
 - Start MediaPlayer as service

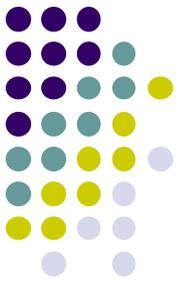


Playing Audio File using MediaPlayer

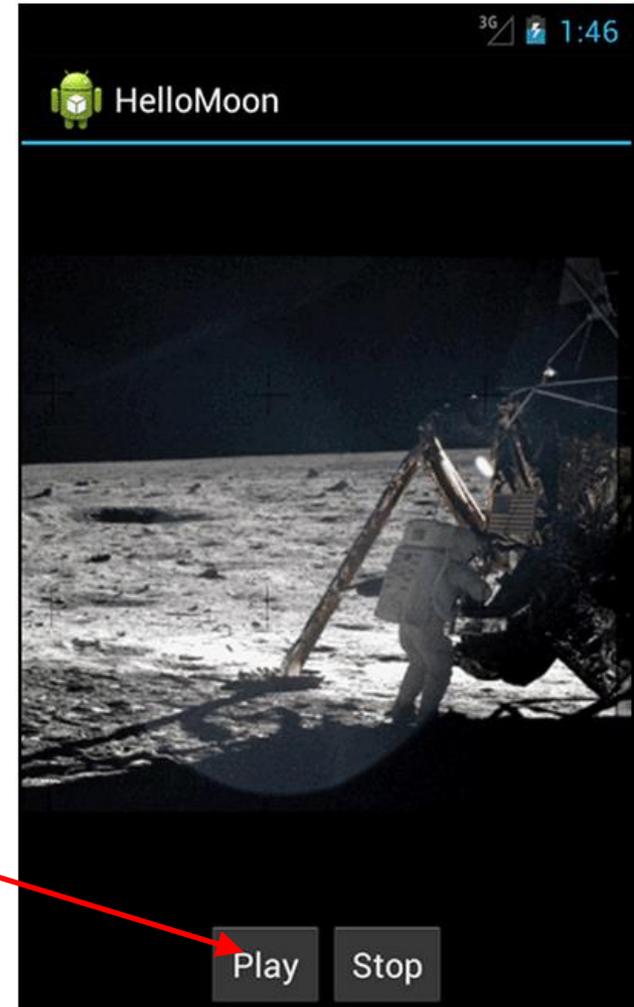
Example from Android Nerd Ranch 1st edition

MediaPlayer Example to Playback Audio

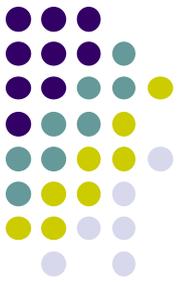
from Android Nerd Ranch (1st edition) Ch. 13



- **HelloMoon app** that uses **MediaPlayer** to play audio file



Buttons to
start/stop audio



References

- John Corpuz, 10 Best Location Aware Apps
- Liane Cassavoy, 21 Awesome GPS and Location-Aware Apps for Android,
- Head First Android
- Android Nerd Ranch, 2nd edition
- Busy Coder's guide to Android version 6.3
- CS 65/165 slides, Dartmouth College, Spring 2014
- CS 371M slides, U of Texas Austin, Spring 2014