ANDROID APPS DEVELOPMENT FOR MOBILE AND TABLET DEVICE (LEVEL I)

Lecture 6: Sensor and Storage

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Sensor Overview

- Most Android-powered devices have built-in sensors that measure motion, orientation, and various environmental conditions.
- These sensors are capable of providing raw data with high precision and accuracy, and are useful if you want to monitor three-dimensional device movement or positioning, or you want to monitor changes in the ambient environment near a device.

Categories of Sensors

- Android platform supports three broad categories of sensors:
  - Environmental Sensors
    - These sensors measure various environmental parameters, such as ambient air temperature and pressure, illumination, and humidity (barometers, photometers, and thermometers)
  - Motion Sensors
    - These sensors measure acceleration forces and rotational forces along three axes (Accelerometers, gravity sensors, gyroscopes, and rotational vector sensors)
  - Position Sensors
    - These sensors measure the physical position of a device. (Orientation sensors and magnetometers)

These sensors are hardware-based and are available only if a device manufacturer has built them into a device.

Environment Sensor

- Android provides four sensors that let you monitor various environmental properties.

Sensor Type	Unit	Sensor Event Data	Data Description
TYPE_AMBIENT_TEMPERATURE	°C	SensorEvent.values[0]	Ambient air temperature
TYPE_LIGHT	lx	SensorEvent.values[0]	Illuminance
TYPE_PRESSURE	hPa / mbar	SensorEvent.values[0]	Ambient air pressure
TYPE_RELATIVE_HUMIDITY	%	SensorEvent.values[0]	Ambient relative humidity

Position Sensor

- Android provides the geomagnetic field sensor and the orientation sensor that let you determine the position of a device. It also provide a proximity sensor that lets you determine how close the device to an object.

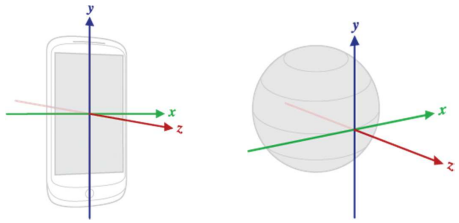
Sensor Type	Unit	Sensor Event Data	Data Description
TYPE_PROXIMITY	cm	SensorEvent.values[0]	Distance from object
TYPE_MAGNETIC_FIELD	μT	SensorEvent.values[0]	Geomagnetic field strength along the x axis
		SensorEvent.values[1]	Geomagnetic field strength along the y axis
		SensorEvent.values[2]	Geomagnetic field strength along the z axis

Motion Sensors Type

Sensor Type	Unit	Sensor Event Data	Data Description
TYPE_ACCELEROMETER	m/s^2	SensorEvent.values[0-2]	Acceleration force along the x, y, z axis
TYPE_GRAVITY	m/s^2	SensorEvent.values[0-2]	Force of gravity along the x, y, z axis.
TYPE_GYROSCOPE	rad/s	SensorEvent.values[0-2]	Rate of rotation around the x, y, z axis.
TYPE_LINEAR_ACCELERATION	m/s^2	SensorEvent.values[0-2]	Acceleration force along the x, y, z axis (excluding gravity).
TYPE_ROTATION_VECTOR		SensorEvent.values[0-3]	Rotation vector component along the x, y, z axis and rotation vector.

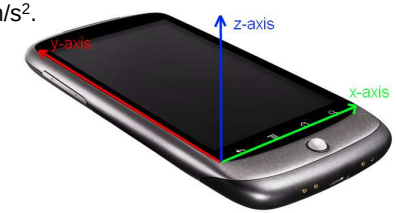
Motion Sensor

- Android provides several sensors that let you monitor the motion of a device.
- Accelerometer and gyroscope sensors are always hardware-based.
- Gravity, linear acceleration and rotation vector sensors can be either hardware-based or software-based .



Acceleration Sensor

- An acceleration sensor measures the acceleration applied to the device, including the force of gravity.
- The force of gravity is always influencing the measured acceleration according to the following relationship:
  - $A = - g - \sum F / mass$
- To measure the real acceleration of the device, the force of gravity must be removed from the accelerometer data because:
  - When the device is sitting on a table, $g = 9.81 m/s^2$.
  - When the device is in free fall and therefore rapidly accelerating toward the ground at $9.81 m/s^2$, $g = 0 m/s^2$.



Sensor Rate

- The rate sensor events are delivered at. This is only a hint to the system. Events may be received faster or slower than the specified rate. Usually events are received faster.
  - SENSOR_DEPLAY_FASTEST – Get sensor data as fast as possible
  - SENSOR_DEPLAY_GAME – Rate suitable for games
  - SENSOR_DEPLAY_NORMAL – Default rate suitable for screen orientation changes
  - SENSOR_DEPLAY_UI – Rate suitable for the user interface (Slowest)

Using Sensor

```
public class MainActivity extends Activity implements SensorEventListener {
    private SensorManager mSensorManager;
    private Sensor mPressure;

    @Override
    public final void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        mSensorManager = (SensorManager) getSystemService(Context.SENSOR_SERVICE);
        mPressure = mSensorManager.getDefaultSensor(Sensor.TYPE_PRESSURE);
    }

    @Override
    public final void onAccuracyChanged(Sensor sensor, int accuracy) {
        // Do something here if sensor accuracy changes.
    }

    @Override
    public final void onSensorChanged(SensorEvent event) {
        float millibars_of_pressure = event.values[0];
    }

    @Override
    protected void onResume() {
        super.onResume();
        mSensorManager.registerListener(this, mPressure, SensorManager.SENSOR_DELAY_NORMAL);
    }

    @Override
    protected void onPause() {
        super.onPause();
        mSensorManager.unregisterListener(this);
    }
}
```

Used for receiving notifications from the SensorManager when sensor values have changed

Get an instance of the sensor service, and use that to get an instance of a particular sensor

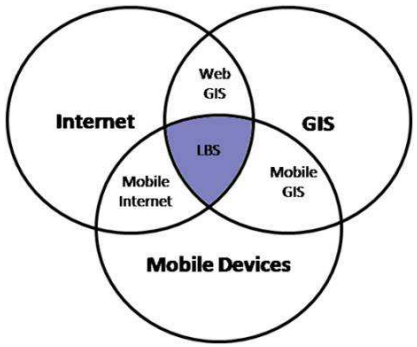
Handling incoming sensor data in the onSensorChanged() callback method

Register a listener for the sensor with specified rate

Unregister the sensor when the activity pauses

Introduction to LBS

- **Location Based Service (LBS)** is an information system driven by the ability of the central system to detect the geographical position of the mobile devices.

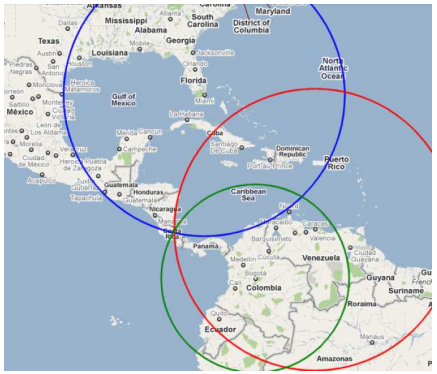


Examples:

- Locate the nearest bank, restaurant, gas station, hotel, golf course, hospital, police station, etc.
- Provide transportation information on how to go from 'here' to 'there'.
- Social networking is used to locate and reach events, friends and family members.

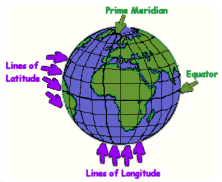
How the GPS Works?

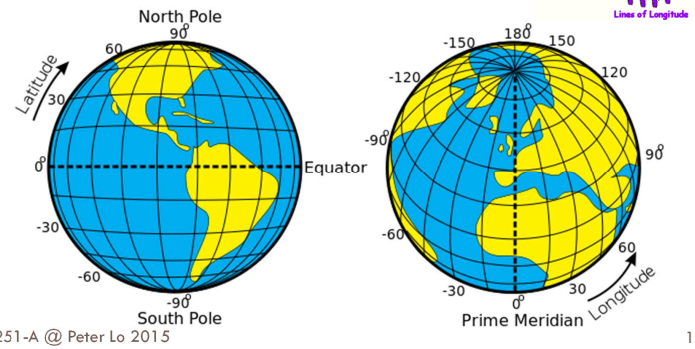
- Created by DOD-USA under the name NAVSTAR (Navigation System for Timing and Ranging) but it is commonly known as **Global Positioning System** (GPS).
- The system's backbone consists of 27 Earth-orbiting satellites (24 in operation and 3 in stand-by mode)
- The three circles intersect on the point over Central America.
- The actual location is: San Jose, Costa Rica.



Latitude and Longitude

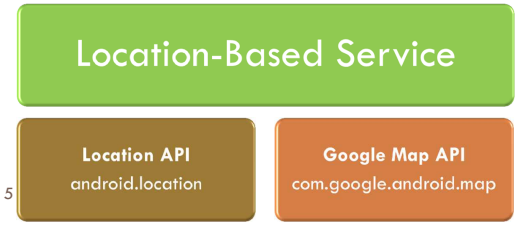
- Latitude in GPS-Decimal notation:
  - +90.00000 (North) to -90.000000 (South)
- Longitude GPS-Decimal notation:
  - +180.000000 (East) to -180.000000 (West)



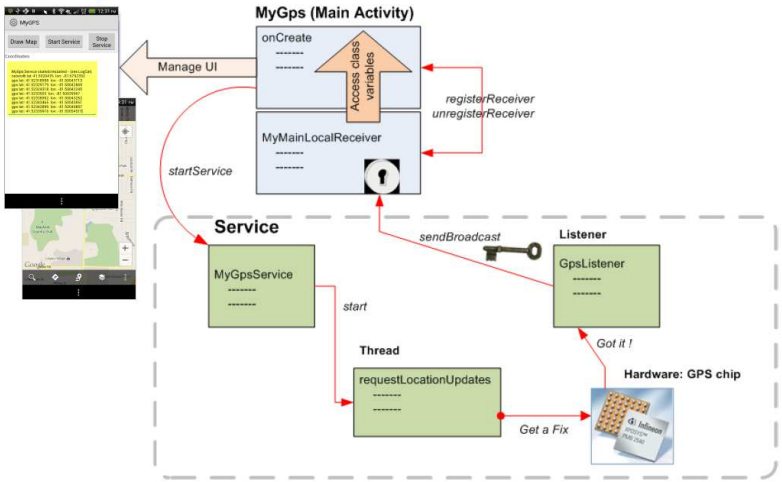


Main Component of LBS

- The Location-Based API includes two packages
  - Google Map API (*com.google.android.maps*)
  - Location API (*android.location*)
- They provide an initial look at the support in the Android platform for building location-based services.
- These API work over the internet to invoke services from Google servers



Android GPS Algorithm



Define Location Listener and Request Location Updates

Define the criteria how to select the location provider

Acquire a reference to the system Location Manager

```
locationManager = (LocationManager) getSystemService(Context.LOCATION_SERVICE);
criteria = new Criteria();
provider = locationManager.getBestProvider(criteria, false);
LocationListener locationListener = new LocationListener() {
    public void onLocationChanged(Location location) {
        // Make use of new location
    }
    public void onStatusChanged(String provider, int status, Bundle extras) {}
    public void onProviderEnabled(String provider) {}
    public void onProviderDisabled(String provider) {}
};
locationManager.requestLocationUpdates(provider, 0, 0, locationListener);
```

Called when a new location is found by the location provider

Define a listener that responds to location updates

Register the listener with the Location Manager to receive location updates

Requesting User Permissions

- In order to receive location updates from network provider or GPS provider, you must request user permission by declaring corresponding permission in your Android manifest file.

Permission	Provider
ACCESS_FINE_LOCATION	Allows the API to use the GPS to determine the device's location to within a very small area: • NETWORK_PROVIDER • GPS_PROVIDER
ACCESS_COARSE_LOCATION	Allows the API to use WiFi or mobile cell data (or both) to determine the device's location: • NETWORK_PROVIDER

Without these permissions, your application will fail at runtime when requesting location updates.

Data Storage

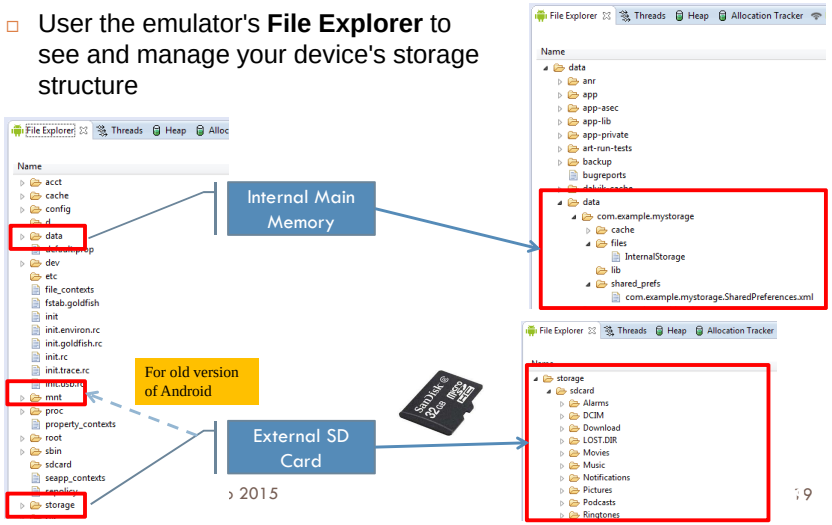
- Android provides several options for you to save persistent application data.

Storage Option	Description
Shared Preferences	Store private primitive data in key-value pairs.
Internal Storage	Store private data on the device memory.
External Storage	Store public data on the shared external storage (e.g. SD Card).
SQLite Databases	Store structured data in a private database.
Network Connection	Store data on the web with network server

The solution you choose depends on your specific needs, such as whether the data should be private to your application or accessible to other applications and how much space your data requires

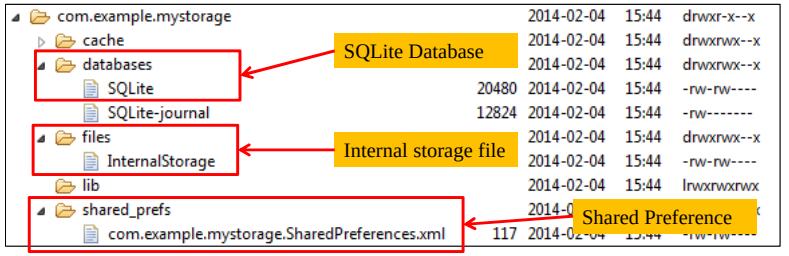
Android Folder Structure

- User the emulator's **File Explorer** to see and manage your device's storage structure



Android File Structure

- Android allows to persists application data via the file system.
- For each application the Android system creates a *data/data/[application package]* directory.
- On Android, all internal application data objects (including files) are private to that application.



Shared Preferences

- Is an Android lightweight mechanism to store and retrieve <Key-Value> pairs of primitive data types.
- If you have a relatively small collection of key-values that you'd like to save, you should use the Shared Preferences.
- It is typically used to keep state information and shared data among several activities of an application.
- In each entry of the form <key-value> the key is a string and the value must be a primitive data type.

key	value
firstName	Bugs
lastName	Bunny
location	Earth

Shared preferences are not strictly for saving "user preferences" such as what ringtone a user has chosen.

Get a Handle to a SharedPreferences

- There are two methods to access the preference:
  - getPreferences()
    - Use this from an Activity if you need to use only **one** shared preference file for the activity.

```
SharedPreferences sharedPref = getActivity().getPreferences(Context.MODE_PRIVATE);
```

  - getSharedPreferences()
    - Use this if you need **multiple** shared preference files identified by name, which you specify with the first parameter.

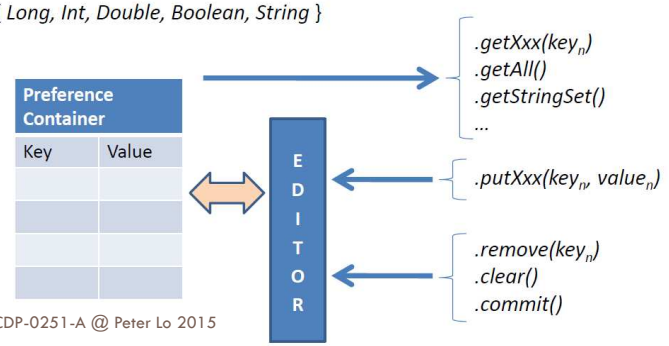
```
Context context = getActivity();
SharedPreferences sharedPref = context.getSharedPreferences(
        getString(R.string.preference_file_key), Context.MODE_PRIVATE);
```

When naming your shared preference files, you should use a name that's uniquely identifiable to your app, such as "com.example.myapp.PREFERENCE_FILE_KEY“

Using Preferences API calls

- All of the get preference methods return a preference object whose contents can be manipulated by an editor that allows put and get commands to place data in and out of the preference container.

Xxx = { Long, Int, Double, Boolean, String }



Read from Shared Preferences

- To retrieve values from a shared preferences file, call methods such as *getInt()* and *getString()*, providing the key for the value you want, and optionally a default value to return if the key isn't present.

```
// Retrieve and hold the contents of the preferences file
SharedPreferences preferences = getSharedPreferences(PREFERENCE_FILE, Context.MODE_PRIVATE);

// Retrieve a String value from the preferences
mDataString = preferences.getString(PREFERENCE_KEY, "");
```

Default value to return if the preference not exist

Operating mode
- Use 0 or MODE_PRIVATE for the default operation,
- MODE_WORLD_READABLE and MODE_WORLD_WRITEABLE to control permissions.
- MODE_MULTI_PROCESS used if multiple processes are mutating the same SharedPreferences file.

Write to Shared Preferences

- To write to a shared preferences file, create a *SharedPreferences.Editor* by calling *edit()* on your Shared Preferences.
- Pass the keys and values you want to write with methods such as *putInt()* and *putString()*.
- Call *commit()* to save the changes.

```
// Retrieve and hold the contents of the preferences file
SharedPreferences preferences = getSharedPreferences(PREFERENCE_FILE, Context.MODE_PRIVATE);

// Create a new Editor for these preferences
SharedPreferences.Editor editor = preferences.edit();

// Set a String value in the preferences editor
editor.putString(PREFERENCE_KEY, mDataString);

// Commit your preferences changes
editor.commit();
```


Publishing Overview

- Publishing is the general process that makes your Android applications available to users. When you publish an Android application you perform two main tasks:
  - You prepare the application for release.
    - During the preparation step you build a release version of your application, which users can download and install on their Android-powered devices.
  - You release the application to users.
    - During the release step you publicize, sell, and distribute the release version of your application to users.

Publishing Checklist

- Understand the publishing process
- Understand Google Play policies and agreements
- Test for Core App Quality
- Determine your app's content rating
- Determine country distribution
- Confirm the app's overall size
- Confirm the app's platform and screen compatibility ranges
- Decide whether your app will be free or priced
- Consider using In-app Billing
- Set prices for your products
- Start localization
- Prepare promotional graphics, screenshots, and videos
- Build and upload the release-ready APK
- Plan a beta release
- Complete the app's product details
- Use Google Play badges and links in your promotional campaigns
- Final checks and publishing
- Support users after launch

Open Distribution

- Distributing through an App Marketplace
  - To reach the broadest possible audience, usually distribute the apps through a marketplace (Google Play).
- Distributing your application through email
  - Prepare the app for release and then attach it to an email and send it to a user. When users open the email message on their Android-powered device, the Android system will recognize the APK and display an "**Install Now**" button in the email message
- Distributing through a web site
  - When users browse to the download link from their Android-powered devices, the file is downloaded and Android system automatically starts installing it on the device