Components, Activity Lifecycles and Intents

CE881: Mobile and Social Application Programming

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1. Interesting Cultural Artefacts
2. The overall platform
3. Intents

Movies, Books and Websites

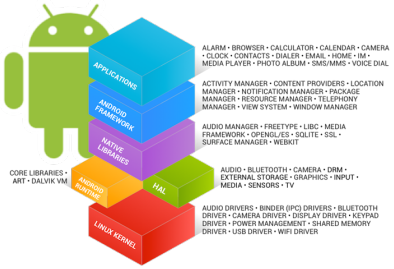
- Theme: "The Enterprise"
- Movies
  - Office Space
  - Clerks
  - Up in the air
- Businessweek

Apps

- Great enterprise Apps
  - Expensify
  - Google now
  - Linkedin
  - Audio Memos
  - Insightly

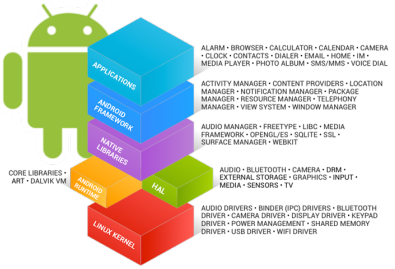
Android: The Big picture

- Android is (almost) a version of linux
- A software stack
  - Open source: http://source.android.com/
  - Hacked Kernel
  - Standard libaries



Android: The java stack

- JVM - Dalvik or ART (5.0)
- Moved recently to "Ahead of time compilation" from JIT



What happens when an app is launched?

- Android creates a new user
- User is unknown to the application
- A virtual machine is spawned
- "Princple of least privilege"
- Why take all these measures?

App components

- Four different kinds of components
  - **Activities**
    - Single Screen
  - **Services**
    - Background process
  - **Broadcast receivers**
    - Route, present to status bar
  - *Content providers*
    - Databases

Intents

- With the exception of content providers, all components exchange messages
  - These messages are called *intents*
  - Think of them as asynchronous method calls
- Why not direct method calls? Why exchange messages?

Design decisions

- Interoperability
  - You can start other app components
    - e.g, Take pictures, record sound, check battery
    - No need for run-time linking
- Security
  - Allows the platform to control access
- Robustness
  - One application crush shouldn't impact the system

Manifest file

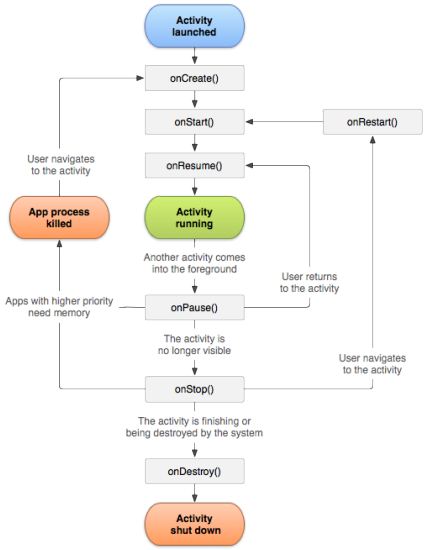
- **AndroidManifest.xml**
- All components have to be registered there
- http://developer.android.com/guide/topics/manifest/manifest-intro.html
- Android also picks up component information from here
- Other apps can make use of our components

Activity Subclasses

- Let's see some

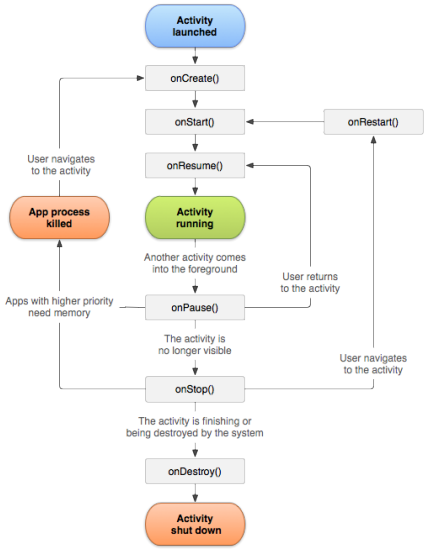
Activity Lifecycle

- Most important component type
- Controls the application flow
- Initiates intents
- Delegates to other activities



Activity Lifecycle: **OnCreate()**

- Activity on the foreground of the screen
- First thing called
- Called when screen is rotated
- Called when there is a language change

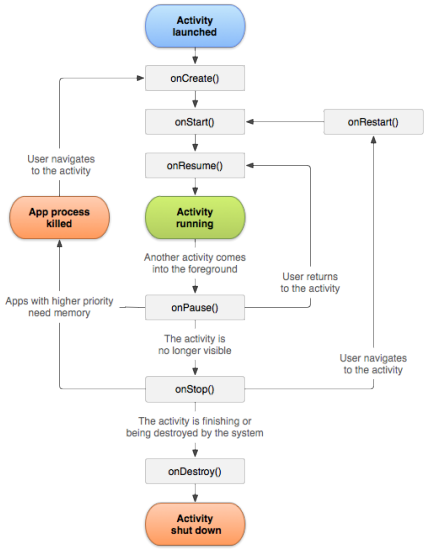


Activity Lifecycle: **onCreate()**

```
public void onCreate(Bundle savedInstanceState)
{
    // What are we missing here?
}
```

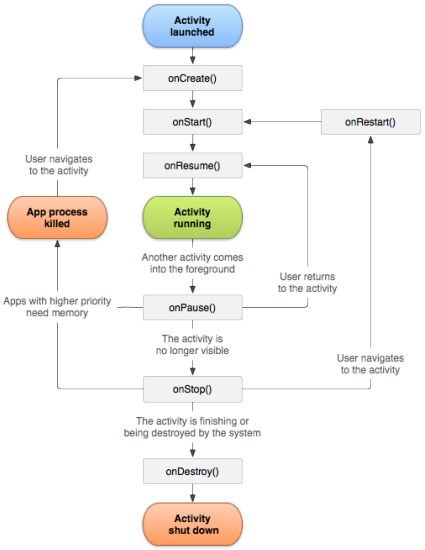

Activity Lifecycle: **OnPause()**

- Called when user brings another window up
- Application has to be visible
- State *might* be lost, if device low in memory



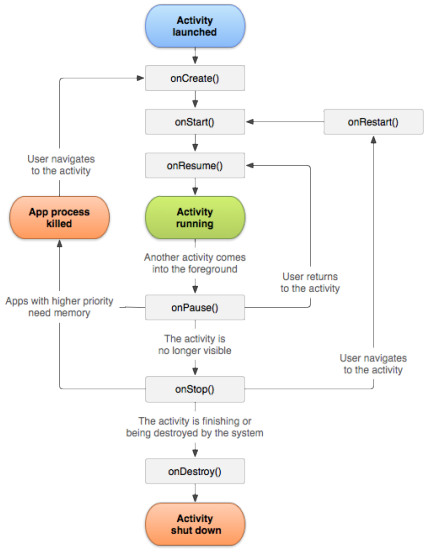
Activity Lifecycle: **OnStop()**

- Activity no longer visible
- All state lost, must be persisted somewhere



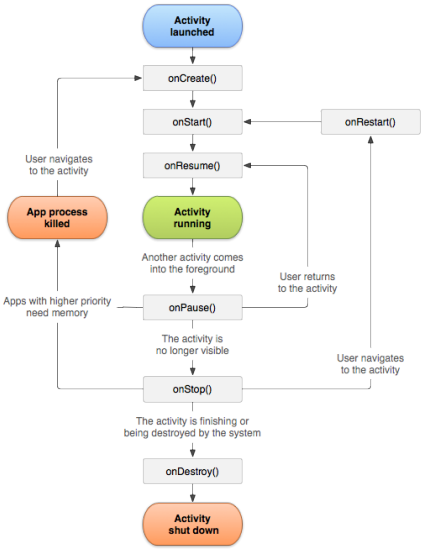
Activity Lifecycle: **OnStart()**

- Called after **onCreate()** and when user brings activity to the foreground
- When activity is brought to the foreground



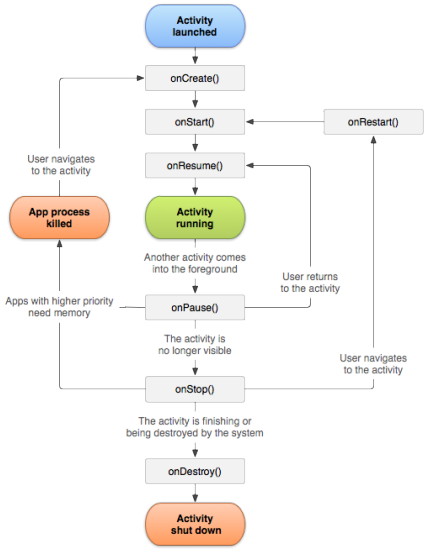
Activity Lifecycle: **OnResume()**

- The opposite of **onPause()**



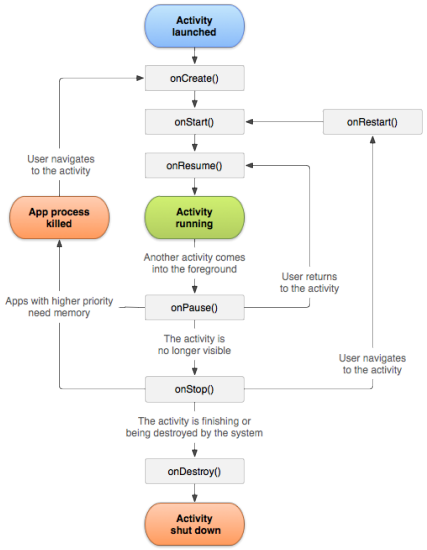
Activity Lifecycle: **onRestart()**

- Calls **onStart()**



Activity Lifecycle: **onDestroy()**

- Final exit
- Clean up happens automatically
- But if you have spawned any threads, you might have to kill them
- Might not be called at all!
- Don't save state here



Screen Orientation

- Each time the screen is rotated, the current activity is destroyed, and then re-created
- Predefined onCreate() method retrieves state of any View components (i.e. components that sub-class View; this eases the job of the programmer)
- Rationale:
  - Typically a new layout may be needed, involving new resource allocation
  - Cleanest solution: always destroy and re-create
  - Note: apps can specify to always operate in a particular orientation

Managing State Between Orientation Changes

Tips for State Management

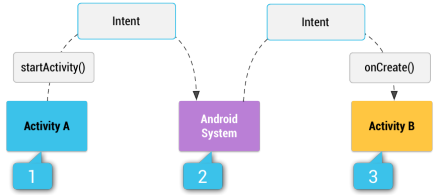
- Save any important information frequently or immediately
  - Mobile device: the battery could die any time!
- Override **onPause** to save useful permanent state
- You should also use **onSaveInstanceState(Bundle)** to save transient state

Starting a new activity

- Define a class that sub-classes Activity
- Add some GUI control to invoke it from the parent activity
- Listen for the relevant event, then launch a new Intent
- This will indirectly call the new Activity's method:
  - **onCreate(Bundle savedInstance)**
- The new activity will start and enter then Resumed state via the call graph shown previously

Pretty pictures

- Looks like this
- Using messages



Intents

- "An intent is an abstract description of an operation to be performed." (developer.android.com)
- A bit like a method call
- Two flavours: explicit and implicit
  - An explicit Intent specifies exactly which Activity should be started
  - An implicit Intent is more declarative: it explains what the Activity should do
  - The system will then search for Activities that match by checking the Intent filters
  - Example: opening a Web Page (more on this later)

Example

- The following example adds an Activity to provide information about an App
  - A menu item called "About" is added to the options menu
  - We listen for onOptionItemSelected events within the main activity
  - Create an Intent, then call startActivity with the Intent as an argument
  - When the user has finished reading the HTML page, the back button can be used to return to the main app
  - This behaviour is automatic use of the ""back stack"; no need to program it

AboutActivity

- Simple example uses a hard-coded HTML file name; import statements are omitted
- Uses a WebView to display an HTML page specified in loadUrl method)

```
public class AboutActivity extends Activity {
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        WebView wb = new WebView(this);
        wb.loadUrl(
        "http://www.google.com");
        setContentView(wb);
    }
}
```


Updating the AndroidManifest.xml

```
<application android:label="@string/app_name">
  <activity android:name="MyActivity"
            android:label="@string/app_name">
    <intent-filter>
       <action
         android:name="android.intent.action.MAIN"/>
       <category
         android:name="android.intent.category.LAUNCHER"/>
    </intent-filter>
  </activity>

  <activity android:name="AboutActivity" />

</application>
```


Explicit calling

```
Intent intent = new Intent(this, AboutActivity.class);
startActivity(newAct);
```


Add the menu / launching Intent

```
public boolean onCreateOptionsMenu(Menu menu) {
    menu.add("About");
    return true;
}

public boolean onOptionsItemSelected(MenuItem item) {
    if (item.getTitle().equals("About")) {
        Intent intent =
            new Intent(this, AboutActivity.class);
        startActivity(intent);
        return true;
    }
    return super.onOptionsItemSelected(item);
}
```

Quick Discussion

Anyone notice something non-ideal about this line of code?

menu.add("About");

What's wrong, and how would you fix it?

Implicit intent?

- Instead of specifying exactly which Activity class should handle the intent, can instead specify an action e.g. via a URL

```
Intent intent = new Intent(Intent.ACTION_VIEW);

intent.setData(Uri.parse("http://www.google.com"));

startActivity(intent);
```


Another example, google maps

```
Intent intent = new Intent(Intent.ACTION_VIEW);
intent.setData(Uri.parse("geo:" + 42.516845 +
    "," + -70.898503));
startActivity(intent);
```


Intent filters

- Each activity can declare filters

```
<intent-filter>
 <action android:name="android.intent.action.ACTION_VIEW"/>
 <category android:name="android.intent.category.DEFAULT"/>
 <data android:mimeType="text/html"/>
</intent-filter>
```

Filter creation

- How can we call our activity implicitly ?
- Where should we add this filter in our case ?

Overall

- Android Stack
- App lifecycle, and which state transition methods to override in order to save and re-create state
- Explicit and implicit intents