Android: an introduction to development
(from a mainframe development viewpoint)

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Android usage

- Android is an Stateless Open Source Operating System
  - Mobile telephony
  - Mobile data/web access
  - Platform independent computing
- Android runs on (in screen size order)
  - Smart phones (the Android default)
  - Padds (intermediate size)
  - Tablets (biggest size)
- Now hardware linkup with Motorola mobility
  - >50% of the market before this (August 2011)
Development Environment

• Based on the standard Eclipse IDE
  ▪ Standard Java development environment
  ▪ Debugging via an emulator or on a real device

• Android is OO Java
  ▪ Override methods to do user code
  ▪ Java methods all available for functional use
  ▪ Android APIs to build screens, links etc.

• Android Applications
  ▪ Use XML to define things (screen layout, literals)
  ▪ Operate via the AndroidManifest.xml file
Code in Java Classes (a screen)

Launcher Icon

Screen layouts

Application Menu

Constants

Manifest file

Android supplies build tools to generate an .APK
The Emulator

• Running the Package starts the Android Emulator
  ♦ Normal
  ♦ With debug support
• Can configure the screen size and properties
• Runs the app via a mouse and keyboard
  ♦ Change screen orientation
  ♦ Long and Short presses
  ♦ Menu and Back buttons (external to device)
• Vital in development
  ♦ catches runtime exceptions
IPv4andIPv6Free

IP address

Check IP address

Return Code

Reason Code

Type

IPv6 compressed

IPv6 native

IPv4 native

IPv4 compatible

IPv4 mapped

Hint
Display (Layout) elements

- Common GUI elements
  - Literal and Input text
  - Buttons (Press, Radio, Check)
  - Icons

- Layout options
  - Scrolling (Vertical - sometimes default - Horizontal)
  - Linear
  - Table
  - List

- All specified as a Layout in XML
  - name of layout = name of the file
All items have an id:
@+id/xx generates a Java constant used to access it in code
@string/thing refers to a literal defined in another XML file
Positioning on the screen

• Cannot use screen co-ordinates
  - Screen size unknown
  - Orientation unknown
    - Android recommends both portrait and landscape
  - EditText sizes are dynamic

• Linear Layout
  - Align elements in a fixed direction (Vertical or Horizontal)
  - Can expand into blank areas (weight)

• Relative Layout
  - Align elements in a position relative to each other
  - Below, toLeftOf an earlier element (gravity)
Table Layout

• Forces elements into cells to ensure correct alignment in device independent fashion
• Columns can expand or contract as needed
• Put inside Vertical and Horizontal scrollers
  - So get bigger display area than the viewport
• Table structure should be maintained over device orientation change
  - Can manipulate cells, rows or columns via API
  - Dynamically insert rows containing cells with other views (Text, EditText)
  - Some APIs don't work until the screen is built
Altering Display Properties

Control Corner Shapes, Fills, Colours

Create <shape> in XML file in the res/drawable folder

```xml
<shape xmlns:android="http://schemas.android.com/apk/res/android"
       android:shape="rectangle"
       android:padding="10dp"
>
  <solid android:color="#FFFFFF"/>
  <corners
    android:bottomRightRadius="15dp"
    android:bottomLeftRadius="15dp"
    android:topLeftRadius="15dp"
    android:topRightRadius="15dp"
  />
</shape>
```

Use via @drawable/file_name in the layout

```xml
<EditText
    android:layout_width="fill_parent"
    android:layout_height="wrap_content"
    android:padding="5dp"
    android:background="@drawable/rounded_edittext"/>
```
Create your own contents

• Create Java Class with the required methods
  - onCreate for initialisation
  - onDraw to display it
  - onMeasure to calculate the size
  - onLayout to compute rendering bounds
  - onSaveInstanceState for orientation change
  - onPause, onResume for visibility change

• Use in a layout XML file
  - <dfhexpert.myclass ….. />
Apps are not programs

• Android is in control
  - Apps are rather like exits in mainframe environment
    ▪ Apps implement methods which get called
  - You do not get to control things
    ▪ Install and Uninstall
    ▪ Lifecycle
    ▪ When the screen is updated

• Multi-thread support
  - Locking and race conditions
  - Runaway task

• Only the Main thread can update the screen
  - Some APIs don't work until the screen is updated
Application Lifecycle states

- **Start**
  - **onCreate()**
  - **onStart()**
  - **onResume()**
    - App runs in the foreground
    - Something else comes in front of the screen (not foreground any more)
    - Other thing ends and this has restored screen visibility (come to foreground)
  - **onPause()**
    - Still running, but invisible
  - **onStop()**
  - **onDestroy()**
    - Not there

- **Not there**
  - Blocking app ended whilst this app was ending (come to foreground)

App temporarily killed by Android (?memory?) and the user navigates back to it.
The main methods to implement

• `onCreate(Bundle)` – the first method called
  - Set the screen layout
  - Initialise variables
  - Recover state (Android is stateless) from Bundle
    - Android does not save method state
• `onSaveInstanceState` – save current state
  - Screen orientation change
  - Save state in a Bundle `{K=V}`
    - On exit Android has cleared state and calls `onCreate(Bundle)`
• `onClick`, `onLongClick` – Button or something clicked
  - Do action
• `selfDestruct` – end of instance
The contents of an App Class

• App extends Android classes
  - Method callbacks to run the app
  - usually extend Activity
  - implement onClickListener, onLongClickListener

• Generally no enforcement of
  - @Override
  - private, public, protected, final

• Have your own methods in there for usage in this

• Package name has to be unique in the Android Marketplace

• All exported in a signed .APK file
package dfhexpert.IPv4andIPv6;
import java.util.*;
import android.app.Activity;

final public class main extends Activity
        implements OnClickListner, OnLongClickListner
{

    @Override
    public void onCreate(Bundle inBundle)

    public void onClick(View inview)

    @Override
    protected void onActivityResult(int requestCode, int resultCode, Intent intent)

    final public boolean onLongClick(View v)

    @Override
    final public boolean onCreateOptionsMenu(Menu menu)

    @Override
    final public boolean onPrepareOptionsMenu(Menu menu)

    @Override
    final public boolean onOptionsItemSelected(MenuItem item) {

        public boolean willIntentRun(Context context, Intent intent)

} // end of main class
@Override
public void onCreate(Bundle inBundle)
{
    super.onCreate(inBundle);
    setContentView(R.layout.byobject);

    /* Grab hold of the XML Resources */
    Resources res = getResources();

    /* Set the base global text size from the initial object layout */
    if (gTextSize == 0)
    {
        TextView v = (TextView) findViewById(R.id.byObjectC1);
        gTextSize = v.getTextSize();
    }

    /* Reload the pre-rotation state if around */
    if (inBundle != null)
    {
        gColourObject = inBundle.getInt("gColourObject");
        gColourCN = inBundle.getInt("gColourCN");
        gColourPy = inBundle.getInt("gColourPy");
        gOrderBy = inBundle.getInt("gOrderBy");
        gTextSize = inBundle.getFloat("gTextSize");
    }

    /* Load the Object and Collective Nouns */
    boolean rc = doBuildItems(res);

    /* Build the columns */
    if (rc == true) doBuildTable(res);

    /* End of onCreate method */
```java
final public boolean onLongClick(View v) {
    // Get handle to the clipboard service
    ClipboardManager clipboard =
        (ClipboardManager) getSystemService(Context.CLIPBOARD_SERVICE);
    /* Grab the item id clicked and its text */
    Context context = getApplicationContext();
    TextView vv = (TextView) v;
    String vt = vv.getText().toString();
    int vi = vv.getId();
    switch (vi) {
        case R.id.in_tsc :
            /* Long click on the ac runs the examples screen */
            /* with those IP showing the ac backlit */
            Intent iniperi1 = new Intent(this, iperrors.class);
            iniperi1.putExtra("ac", vt);
            startActivity(iniperi1);
            break;
        case R.id.in_t6c :
        case R.id.in_t6n :
        case R.id.in_t4n :
        case R.id.in_t4m :
            /* Long click on the IPv4/5 returns copies */
            /* that data value to the clipboard */
            clipboard.setText(vt);
            String tt = "\n" + vt + "\n" copied to clipboard";
            Toast.makeText(context, tt, Toast.LENGTH_SHORT).show();
            break;
    }
    default : break;
} // End of select
return true;
} /* End of OnlongClick callback method */
```

Callback method when something was Long Clicked (v is the id of the item clicked)

- Decide who was clicked
- Click to show another screen
- Which View was clicked
- Use API to access services

Control returns back to Android. A class method is not called again until something happens on the screen.
Menus

• Menus are built in – special layouts for them
  • Options (Application) Menu
    ▪ Access via icon on device
    ▪ Used for settings (email address, font size)
    ▪ Data should be preserved over application instance
    ▪ Overlays app screen
  • Context Menu
    ▪ Under your control by press of something on the screen
    ▪ Do something specific to the item being clicked
    ▪ Not really a Button substitute
  • Processed by observing the id of the menu item clicked
<!-- Application Menu layout -->

<menu xmlns:android="http://schemas.android.com/apk/res/android">
  <!-- Show Samples -->
  <item android:id="@+id/mSamples"
        android:title="@string/mia_Samples"
        android:enabled="true"
        android:visible="true" />

  <!-- Show the reason code samples -->
  <item android:id="@+id/mShowRCs"
        android:enabled="true"
        android:title="@string/mia_ShowRCs"
        android:visible="true" />

  <!-- Show the Coding tabs -->
  <item android:id="@+id/nCoding"
        android:enabled="true"
        android:title="@string/mia_Coding"
        android:visible="true" />

  <!-- general About tabs -->
  <item android:id="@+id/mAbout"
        android:enabled="true"
        android:title="@string/mia_About"
        android:visible="true" />
</menu>

<!-- IPv4 and IPv6 -->

IP address

Check IP address

Return Code

Reason Code

Type

IPv6 compressed

IPv6 native

IPv4 native

IPv4 compatible

<table>
<thead>
<tr>
<th>IPv4</th>
<th>Examples</th>
<th>Reason Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IPv4 compatible</th>
<th>Intent Coding</th>
<th>About</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Showing a different screen

- You start the App in a class which manages a screen/layout
- When a Button is pressed, you want to show another screen
  - onPause method gets invoked to show being obscured
- New Screen
  - has it's own class
  - overlays (higher Z order) current screen
  - exits using the standard device back button
    - returns to previous screen/layout
    - control returns to the class which owns the previous screen
    - usually previous screen is active (with data)
- Initial screen now visible again
  - onResume method run before device's screen updated
Running another class

• Run another class in the same App (one of yours)
  - Screen and methods local to it
  - Stacked on top of current class
    - which is still running but obscured
  - Go back (down the Z order) by the back key

• Run someone else’s App

• Run an Android built-in service
  - Telephony
  - Database (mySQL builtin)
  - Mobile data access (web pages)
Intents

• Intents run something else
  - Another class (=screen) in your app
  - Android built-in service
    - telephony
    - read web page
• Intents contain the indireced name of something to run
  - Maps to a package.class in AndroidManifest.xml
    - Scan of all installed apps to find it if not yours
• Used both to invoke (with data) and return (+data)
  - Contains user data as input
• Start via API, get returns in onActivityResult callback
• A running Intent is an Activity
Manifest Android Control

- AndroidManifest.xml is key to running an App
  - Versioning indication (Android Marketplace)
  - Launcher information
  - What is the minimum Android release required
  - What device it will run on
    - Physical keyboard? Camera?
  - Definition of the App and it's first class
  - Other classes (screens) that run
  - Service provided by your app to others
  - What parts of Android are used
    - IP access? Camera?

- Vital to get right
Manifest control

```xml
<manifest
    xmlns:android="http://schemas.android.com/apk/res/android"
    package="dfhexpert.IPv4andIPv6"
    android:versionCode="100"
    android:versionName="1.0.0">

    <uses-sdk android:minSdkVersion="7"
        android:targetSdkVersion="7"/>

    <uses-conversion android:reqKeyboardType="undefined"
        android:reqHardKeyboard="false"
        android:reqNavigation="undefined"
        android:reqFiveWayNav="true"/>

    <uses-conversion android:reqKeyboardType="undefined"
        android:reqHardKeyboard="false"
        android:reqNavigation="nonav"
        android:reqFiveWayNav="false"/>

</manifest>
```

- **Version Control**
- **Min Android level**
- **What hardware is needed to run**

Google's Android Marketplace shows the devices on which the app will run
Manifest defines the App

<!-- The Main application -->

<application android:icon="@drawable/icon"
    android:label="@string/app_name"
    android:allowTaskReparenting="false"
    android:description="@string/app_description"
    android:persistent="false"
>
</application>

<!-- The main screen -->

<activity android:name="dfhexpert.IPv4andIPv6.main"
    android:label="@string/app_name"
    android:alwaysRetainTaskState="false"
    android:enabled="true"
    android:launchMode="standard"
    android:screenOrientation="unspecified"
    android:stateNotNeeded="true"
    android:windowSoftInputMode="stateAlwaysHidden"
>
    <intent-filter>
        <action android:name="android.intent.action.MAIN" />
        <category android:name="android.intent.category.LAUNCHER" />
    </intent-filter>
</activity>

Class to run
First class for the App
Can be user invoked from the Launcher
Manifest for another screen in the App

<!-- Activity for the About screen -->

<activity android:name="dfhexpert.IPv4andIPv6.about"
android:label="@string/ab_about"
android:alwaysRetainTaskState="false"
android:enabled="true"
android:launchMode="standard"
android:screenOrientation="unspecified"
android:stateNotNeeded="true"
android:windowSoftInputMode="stateAlwaysHidden"
>

<intent-filter>
  <action android:name="android.intent.action.VIEW" />
  <category android:name="android.intent.category.LAUNCHER" />
</intent-filter>

</activity>
Manifest for running function by request from someone else

```xml
<!-- Intent receiving processing, no screen, background -->
<activity android:name="dfhexpert.IPv4andIPv6.byIntent"
    android:label="@string/app_name"
    android:alwaysRetainTaskState="false"
    android:enabled="true"
    android:launchMode="standard"
    android:screenOrientation="unspecified"
    android:stateNotNeeded="true"
    android:windowSoftInputMode="stateAlwaysHidden"
>
    <intent-filter>
        <action android:name="dfhexpert.IPv4andIPv6.action.CHECKIP" />
        <category android:name="android.intent.category.DEFAULT" />
        <data android:scheme="ip" android:host="dfhexpert" />
    </intent-filter>
</activity>
```

Data for Intent is in URI format of `scheme://host/data`
Creating and running an Intent

For local class

```java
Intent insam = new Intent(this, iperrors.class);
insam.putExtra("max", "4");
startActivity(insam);
```

For remote class

```java
Intent ipintent = new Intent();
ipintent.setAction("dfhexpert.IPV4andIPv6.action.CHECKIP");
ipintent.addCategory("android.intent.category.DEFAULT");

Uri ipuri = Uri.parse("ip://dfhexpert/"+ip+"/");
ipintent.setData(ipuri);

// Schedule the Intent to do the checking

int iprc = 100
startActivityForResult(ipintent, iprc);

// Processing continues in the onActivityResult method
```
Conclusion

- Android has a significant learning curve
- Good integration with Eclipse
- Development running in emulator and real device
- Layout is complex and sometimes unintuitive
- AndroidManifest.xml is critical and difficult to get right
- Strangely both alien and familiar to mainframe transaction processing developers
- Lots of good advice and examples on the web
- Mainframe 3270/LU2 applications can be refaced for Android mobile usage quite directly
Thank You

dfhexpert thanks you for coming to this talk

Contact Robert Harris on dfhexpert@gmail.com

Connect via www.linkedin.com/in/dfhexpert

Admire his android apps by searching in the Google app market for 'pub:dfhexpert'

谢谢 再见