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CMSC436: Programming Handheld Systems
Application Fundamentals
Application Components

Activity
Service
BroadcastReceiver
ContentProvider
Applications

Apps are made from components
Android instantiates and runs them as needed
Each component has its own purpose and APIs
Apps can have multiple “entry points”
Activity

Primary class for user interaction
Usually implements a single, focused task that the user can do
Example App
Android Messages

Android Messages makes it easy to communicate with anyone by using SMS, MMS, and more. Stay in touch with friends and family, send group texts, and share your favorite pictures, videos, audio messages.

Key features:
I is hongry. Feed pleez.

No answer? SMH! Get my own bonz
ConversationActivity.java

package com.android.messaging.ui.conversation;

...

public class ConversationActivity extends BugleActionBarActivity implements ContactPickerFragmentHost, ConversationFragmentHost, ConversationActivityUiStateHost {

...

Android source code available at: https://source.android.com
Service

Runs in the background
to perform long-running operations
to support interaction with remote processes
I am hungry. Feed me.

11:18 PM

No answer? SMH! Get your own bone.

Now
package com.android.mms.service;

... 

/**
 * System service to process MMS API requests
 */

public class MmsService extends Service implements MmsRequest.RequestManager {

...
BroadcastReceiver

Component that listens for and responds to events
Acts as the subscriber in publish/subscribe pattern
Events are represented by an Intent and then broadcast by the platform. BroadcastReceivers can receive and respond to broadcast events.
I is hangry. Feed pleez.

No answer? SMH! Get my own bonz

Now
package com.android.messaging.receiver;
...
/**
 * Class that receives incoming SMS messages on KLP+ Devices.
 */

public final class SmsDeliverReceiver extends BroadcastReceiver {
    @Override
    public void onReceive(final Context context, final Intent intent) {
        SmsReceiver.deliverSmsIntent(context, intent);
    }
}
Content Providers

Store & share data across applications
- Uses database-style interface
- Handles interprocess communication
I am hungry. Feed me please.

No answer? SMH! Get your own bone.
SuggestionsProvider.java

package com.android.mms;
...
/**
 * Suggestions provider for mms.
 * Queries the "words" table to provide possible word suggestions.
 */

public class SuggestionsProvider extends android.content.ContentProvider {
    ...

MapLocation

User enters an address

App displays a map of area around the address
MapLocation
Simplified App Development Workflow

Android Project → Compilation & Packaging → Android Package .apk → .apk Signing → .apk Installed on Device
Creating an Android App

Define resources
Implement application classes
Package application
Install & run application
1. Defining Resources

Resources are non-source code entities

Many different resource types, e.g.,
  Layout, strings, images, menus, & animations

 Allows apps to be customized for different devices and users

See: https://developer.android.com/guide/topics/resources/overview.html
Strings

Types: String, String Array, Plurals
Strings

Types: String, String Array, Plurals

Typically stored in res/values/*.xml

Specified in XML, e.g.,

```xml
<string name="hello">Hello World!</string>
```

Can include formatting and styling codes
Strings

Accessed by other resources as:
   @string/string_name

Accessed in Kotlin as:
   R.string.string_name
MapLocation’s Strings Files

values/strings.xml

```xml
<resources>
  <string name="show_map_string">Show Map</string>
  <string name="location_string">Enter Location</string>
</resources>
```

values-it/strings/xml

```xml
<resources>
  <string name="show_map_string">Mostra la mappa</string>
  <string name="location_string">Digita l'indirizzo</string>
</resources>
```
Customized Strings at Runtime

If your default language is Italian, \texttt{@string/location_string} is

“Digita l’indirizzo”

Otherwise it’s,

“Enter Location”
User Interface Layout

UI layout specified in XML files

Some tools allow visual layout

XML files typically stored in res/layout/*.xml

Accessed in Kotlin as R.layout. layout_name

Accessed by other resources as: @layout/layout_name
Using Multiple Layout Files

Can specify different layout files based on your device’s orientation, screen size, etc.
Portrait Layout

```xml
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout
    xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:padding="@dimen/activity_margin">
```
Portrait Layout

<EditText
    android:id="@+id/location"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:layout_alignParentStart="true"
    android:hint="@string/location_string"
    android:inputType="textPostalAddress"
    android:textAppearance="@android:style/TextAppearance.Material.Subhead"
    android:importantForAutofill="no" />

Portrait Layout

```
<Button
    android:id="@+id/mapButton"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_below="@+id/location"
    android:layout_centerHorizontal="true"
    android:text="@string/show_map_string"
    android:textAppearance="
        @android:style/TextAppearance.Material.Button"
    android:textColor="@color/primary_light"
/>
</RelativeLayout>
```
Landscape Layout

<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout
    xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:padding="@dimen/activity_margin">

</RelativeLayout>
Landscape Layout

<pre><code>&lt;EditText
    android:id="@+id/location"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:layout_alignParentTop="true"
    android:layout_toStartOf="@+id/mapButton"
    android:ems="10"
    android:hint="@string/location_string"
    android:inputType="textPostalAddress"
    android:textAppearance="
        @android:style/TextAppearance.Material.Subhead"
    android:importantForAutofill="no" />
</code></pre>
Landscape Layout

<Button
    android:id="@+id/mapButton"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_alignParentEnd="true"
    android:layout_alignTop="@+id/location"
    android:text="@string/show_map_string"
    android:textAppearance="@android:style/TextAppearance.Material.Button"
    android:textColor="@color/primary_light" />

</RelativeLayout>
At compilation time, resources are used to generate the R.java class
App code uses the R class to access resources
package course.examples.maplocation;

public final class R {
    public static final class color {
        public static final int accent=0x7f010000;
        public static final int edit_text=0x7f010001;
        public static final int primary=0x7f010002;
        public static final int primary_dark=0x7f010003;
        public static final int primary_light=0x7f010004;
        public static final int primary_text=0x7f010005;
        public static final int secondary_text=0x7f010006;
    }
}
public static final class dimen {
    public static final int activity_margin=0x7f020000;
}
public static final class id {
    public static final int location=0x7f030000;
    public static final int mapButton=0x7f030001;
}
public static final class layout {
    public static final int main=0x7f040000;
}
public static final class mipmap {
    public static final int ic_launcher=0x7f050000;
}
public static final class string {
    public static final int location_string=0x7f060000;
    public static final int show_map_string=0x7f060001;
}

public static final class style {
    public static final int MaterialTheme=0x7f070000;
}

2. Implement Classes

Usually involves at least one Activity
Activity initialization code usually in onCreate()
2. Implement Classes

Typical onCreate() workflow

- Restore saved state, if necessary
- Set content view
- Initialize UI elements
- Link UI elements to code actions
class MapLocation : Activity() {
    companion object {
        const val TAG = "MapLocation"
    }
    // UI elements
    private lateinit var addrText: EditText
    private lateinit var button: Button
override fun onCreate(savedInstanceState: Bundle?) {

    /*
     * Required call through to Activity.onCreate()
     * Restore any saved instance state, if necessary
     */
    super.onCreate(savedInstanceState)

    // Set content view
    setContentView(R.layout.main)
MapLocation.kt

// Initialize UI elements
addrText = findViewById(R.id.location)
button = findViewById(R.id.mapButton)

// Link UI elements to actions in code
button.setOnClickListener { processClick() }

// Called when user clicks the Show Map button
private fun processClick() {
    try {
        // Process text for network transmission
        var address = addrText.text.toString()
        address = address.replace(' ', '+')
        // Create Intent object for starting Google Maps application
        val geoIntent = Intent(Intent.ACTION_VIEW, Uri.parse("geo:0,0?q=${address}"))
        if (packageManager.resolveActivity(geoIntent, 0) != null) {
            // Use the Intent to start Google Maps application using
            // Activity.startActivity()
            startActivity(geoIntent)
        }
    } catch (e: Exception) {
        Log.e(TAG, e.toString()) // Log error messages to LogCat
    }
}
3. Package Application

System packages application components & resources into a .apk file

Developers specify required application information in a file called AndroidManifest.xml
AndroidManifest.xml

Information includes:
Application name
Application components
Other
  Required permissions
  Application features
  etc.
4. Install & Run

From IDE run app in the emulator or device

From command line

   Enable USB Debugging on the device


   %adb install <path_to_apk>
Next

The Activity Class
Example Applications

MapLocation