Mobile Application Development - Android

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Mobile Cloud Lab

tiigriülikool

Programm IKT toetuseks kõrghariduses

Tiigriülikool on riiklik info- ja kommunikatsioonitehnoloogia-alane kõrghariduse toetusprogramm

Goal

- Give you an idea of how to start developing Android applications
- Introduce major Android application concepts
- Walk you through some sample applications in the development environment

References & Books

- Android developers

  http://developer.android.com/
- Books
  - "Professional Android 4 Application Development", By Reto Meier

Dealing with problems & Help

- Have created a mailing list
  - mclab DOT mad AT lists DOT ut DOT ee
- Post your question to mailing list
- Practicals assistants:
  - Mohan Liyanage (liyanage AT ut DOT ee)
  - Jakob Mass (jaks AT ut DOT ee)
- Also created a Google group https://groups.google.com/forum/#!forum/mob-app-dev--mtat03262-ut
  - Post your questions there
  - Keep answering your friends

What is Android?

- Android is not a device or a product
  - It's not even limited to phones - you could build a handheld GPS, an MP3 player, TV, Watch etc.
- A free, open source mobile platform
- Open Handset Alliance
  - 100+ technology companies
  - Commitment to openness, shared vision, and concrete plans
- A Linux-based, multiprocess, multithreaded OS
  - The Android operating system is a multi-user Linux system in which each application is a different user

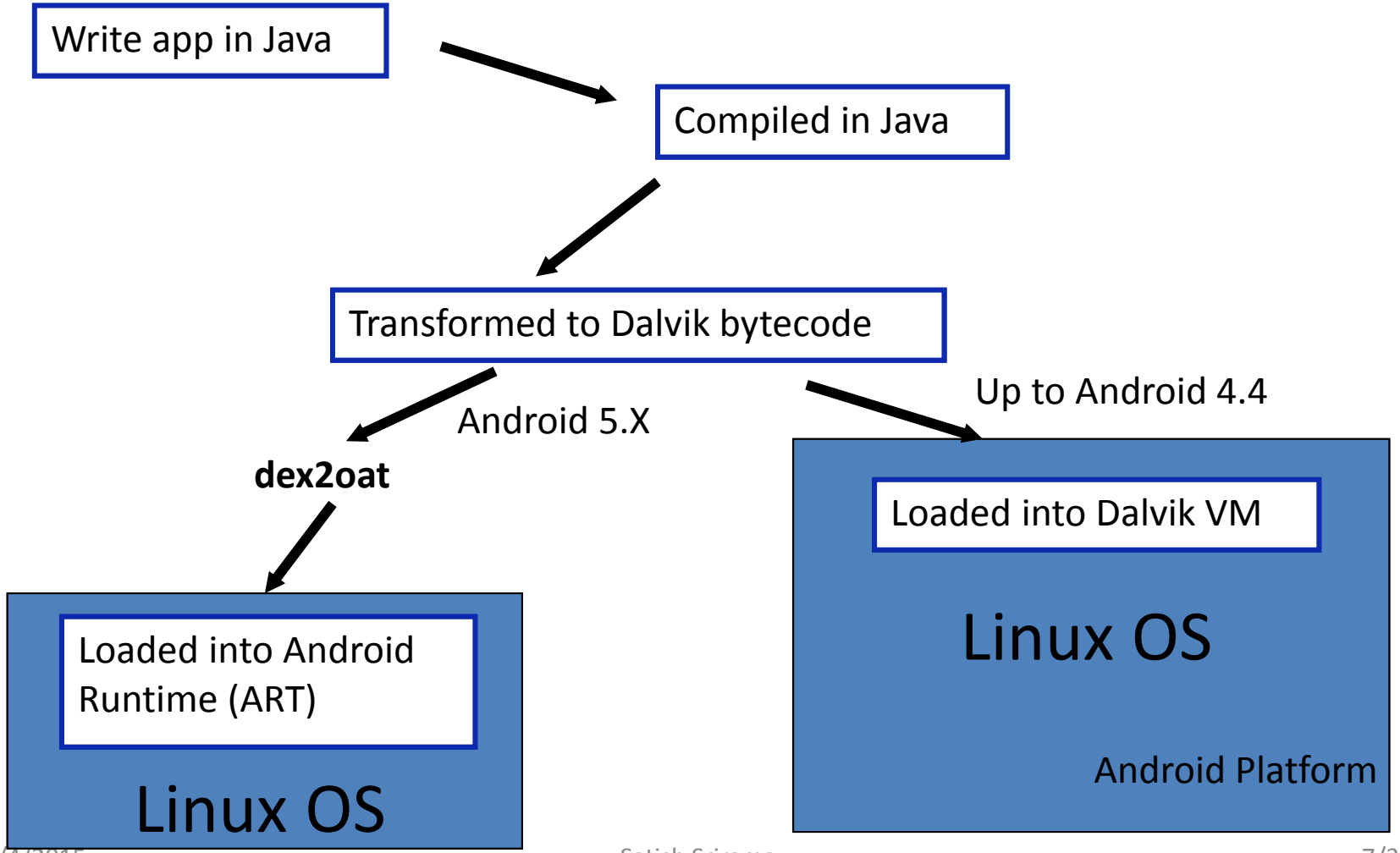
Android applications are written in Java

```
package com.google.android.helloactivity;

import android.app.Activity;
import android.os.Bundle;

public class HelloActivity extends Activity {
    public HelloActivity() {
    }
@Override
    public void onCreate(Bundle icicle) {
        super.onCreate(icicle);
        setContentView(R.layout.hello_activity);
    }
}
```

Android applications are compiled to Dalvik bytecode



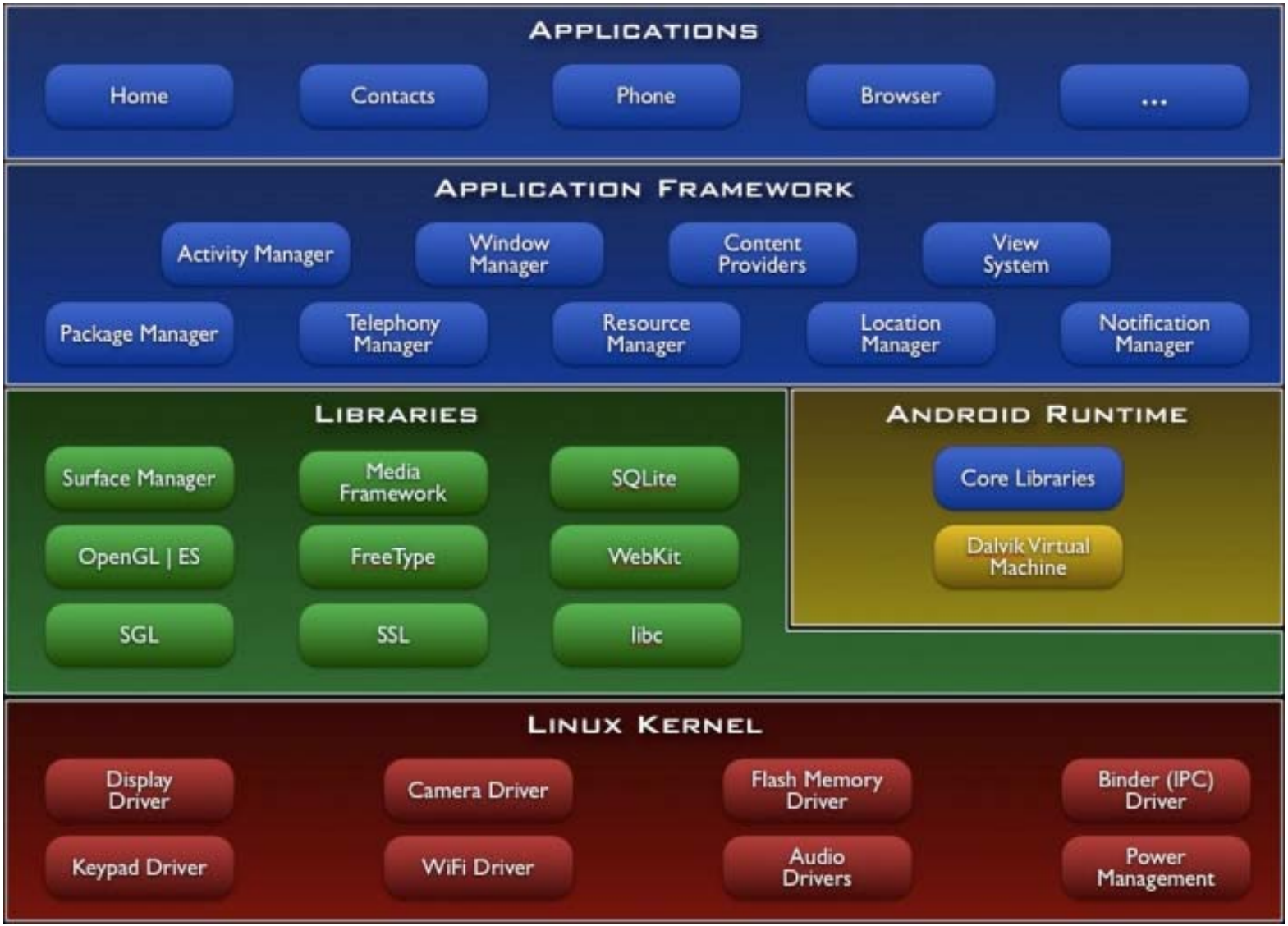
Android's ART vs Dalvik

- ART and Dalvik are compatible runtimes running Dex bytecode
- Dalvik is based on JIT (just in time) compilation
  - Each time an app is run, the part of the code required for its execution is going to be translated (compiled) to machine code
  - It has a smaller memory footprint and uses less physical space on the device
- ART compiles the intermediate language, Dalvik bytecode, into a system-dependent binary
  - Whole code of the app will be pre-compiled during install (once)
    - Ahead-of-Time compiler (AOT)
    - Installation process takes a bit longer
  - Code executes much faster
  - Less CPU usage as no more compilation required and this also results in less battery drain
- ART optimized the garbage collector (GC)

Why Android/Dalvik Runtime?

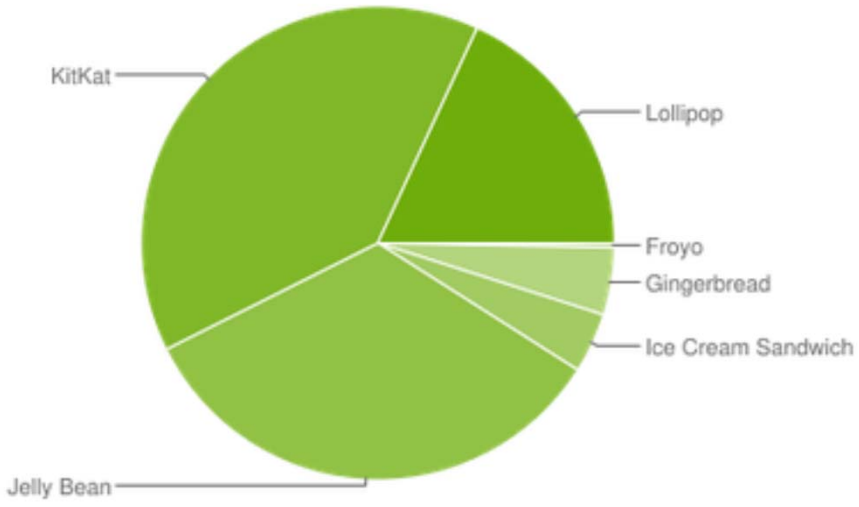
- The Android/Dalvik runtime is optimized for mobile applications
- Runs multiple VMs efficiently
- Each application has its own VM
- Minimal memory footprint
- Relies on Linux kernel for threading and low-level memory management

Android software stack



Can assume that most devices have android 4.x or 5.x

Version	Codename	API	Distribution
2.2	Froyo	8	0.3%
2.3.3 - 2.3.7	Gingerbread	10	4.6%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	4.1%
4.1.x	Jelly Bean	16	13.0%
4.2.x		17	15.9%
4.3		18	4.7%
4.4	KitKat	19	39.3%
5.0	Lollipop	21	15.5%
5.1		22	2.6%



http://developer.android.com/about/dashboards/index.html http://en.wikipedia.org/wiki/Android_version_history

Android has a working emulator

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Getting started

- I hope all of you have Android Studio installed
- Downloaded the latest SDK tools and platforms (version 22) using the SDK Manager

http://developer.android.com/training/basics/firstapp/index.html

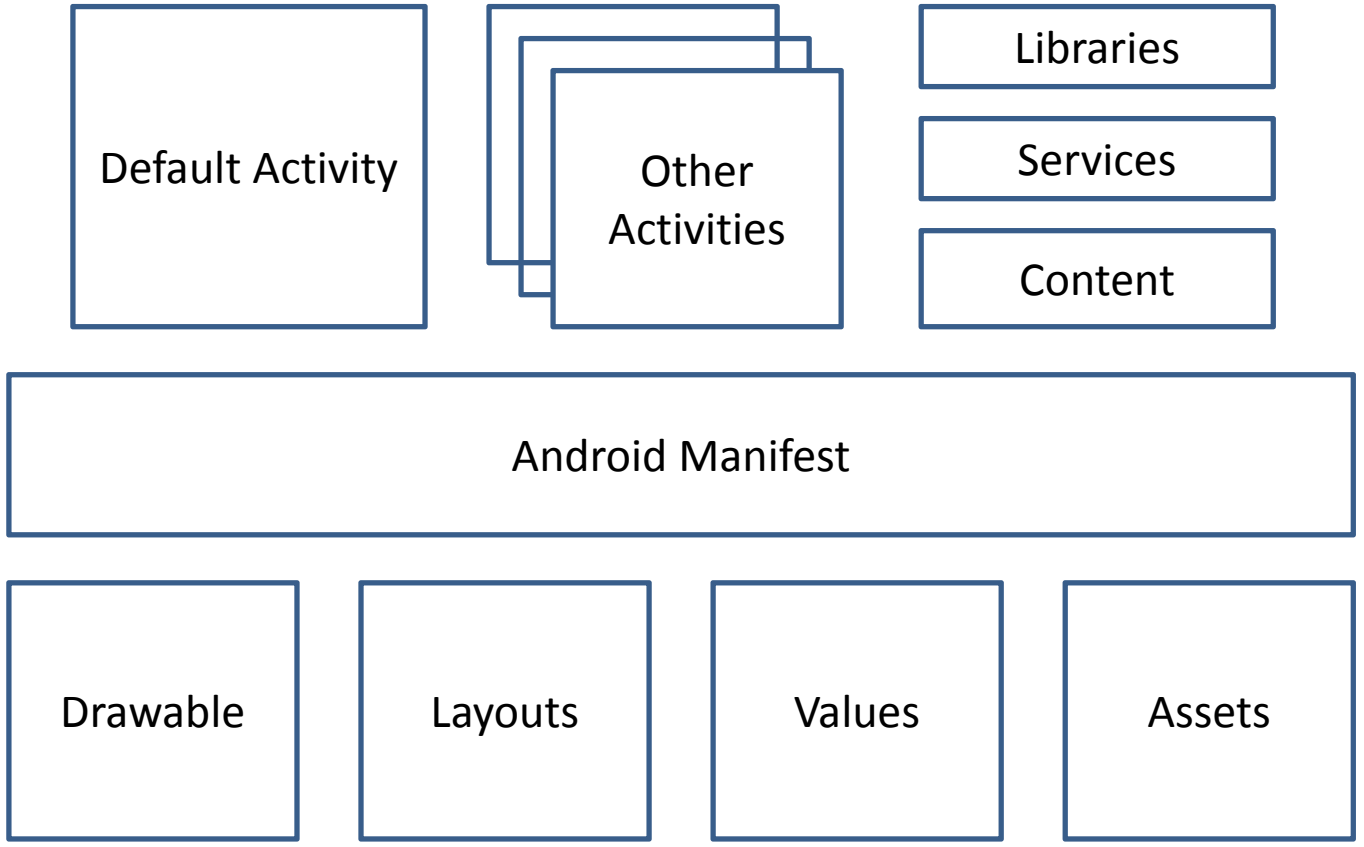
Exercise: Hello World

- Let us create an AVD (Android virtual device)
- Create a New Android Project
- Construct the UI
- Run the Application
- Upgrade the UI to an XML Layout
- Let us debug

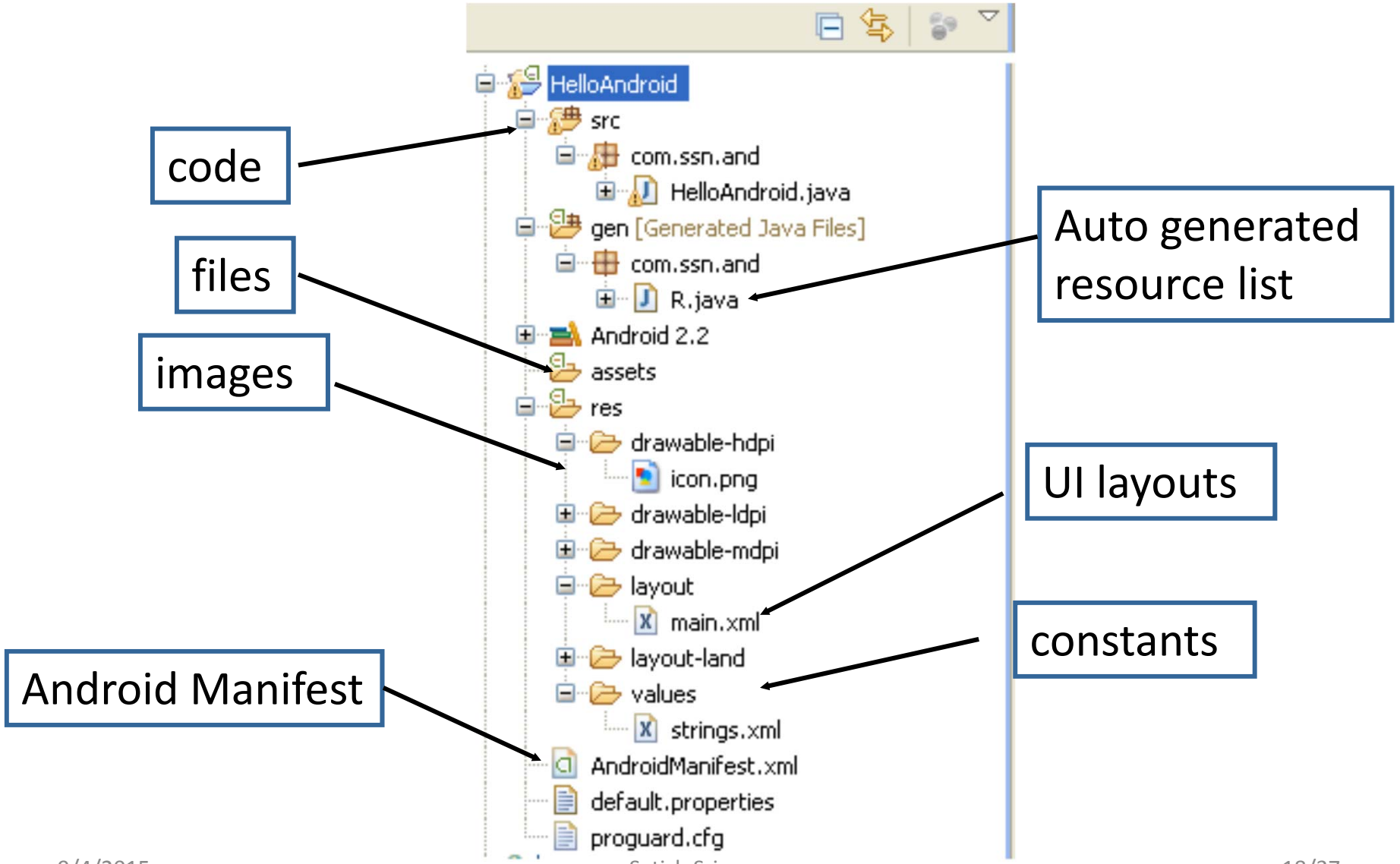
Debugging in Android

- Traditional `System.out.println` is not available in the Android system
- We can debug through the app user interface
  - Errors crash and close app
- Instead use Logging mechanisms
  - `Log.v(String tag, String message);`
  - *tag -> app name*
  - *Message -> debug message.*
- Requires importing `android.util.Log`
- Log messages appear in the LogCat component of the Android Studio interface

What's in an Application?



File structure of applications



Application Manifest

- Each Android project has a manifest file
- Defines the structure and metadata of the application
- Includes nodes for each of the application components (Activities, Services, Intents etc.)
- Also includes security permissions

Application Manifest - continued

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.ssn.and.ch5" android:versionCode="1" android:versionName="1.0">
    <uses-sdk android:minSdkVersion="8" />

    <application android:icon="@drawable/icon" android:label="@string/app_name">
        <activity android:name=".ContactPickerActivity"
            android:label="@string/app_name">
            <!--
                <intent-filter> <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
                </intent-filter>
            -->
            <intent-filter>
                <action android:name="android.intent.action.PICK" />
                <category android:name="android.intent.category.DEFAULT" />
                <data android:path="contacts" android:scheme="content" />
            </intent-filter>
        </activity>
        <activity android:name=".ContentPickerTesterActivity" android:label="Content Picker Test">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>
    <uses-permission android:name="android.permission.READ_CONTACTS"/>
</manifest>
```

Security in Android

- Follows standard Linux guidelines
- Each application runs in its own process
- Process permissions are enforced at user and group IDs assigned to processes
- Finer grained permissions are then granted (revoked) per operations
- Apps declare permissions in manifest
  - `<uses-permission id="android.permission.RECEIVE_SMS" />`

Android Design Philosophy

- Applications should be:
  - Fast
    - Resource constraints: <200MB RAM, slow processor
  - Responsive
    - Apps must respond to user actions within 5 seconds
  - Secure
    - Apps declare permissions in manifest
  - Seamless
    - Usability is key, persist data, suspend services
    - Android kills processes in background as needed

Application priority and process states

- Android applications have limited control over their life cycles
- Each application runs in its own process
  - Each process is running a separate instance of Dalvik/ART
- Memory and process management is handled by runtime
  - Runtime may kill some services in the background
  - Application priority is critical

Application priority

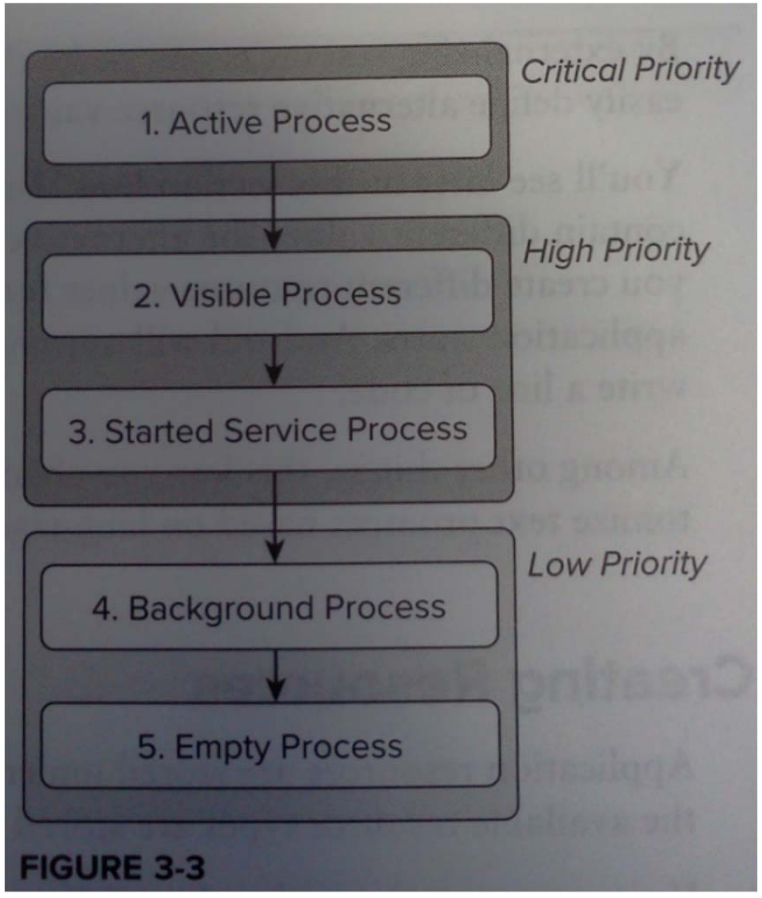


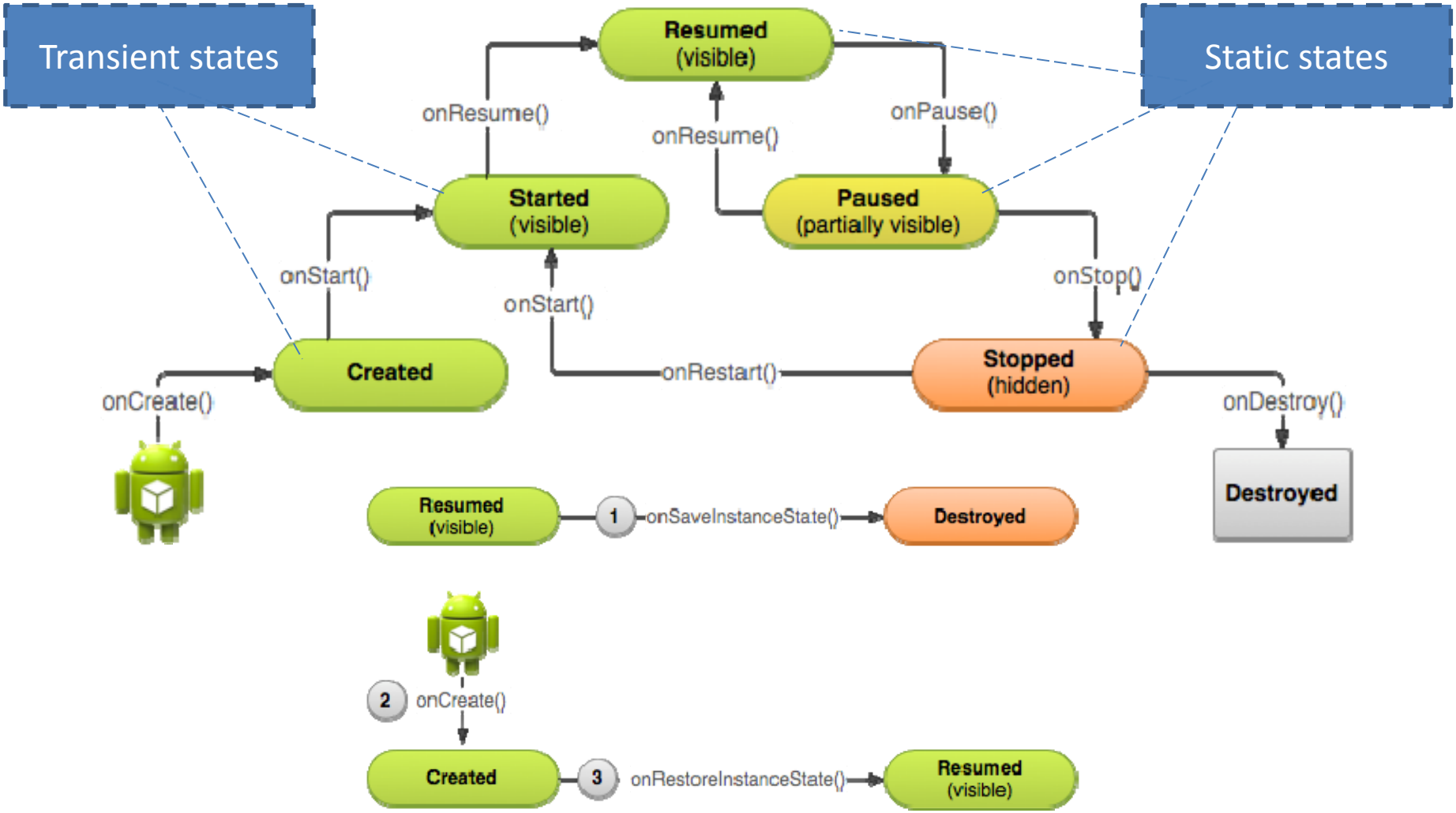
FIGURE 3-3

Reto Meier, Professional Android 2 Application Development, p 59

Android application lifecycle

- Apps move through states during lifecycle
- Understanding app lifecycle is necessary, so that apps:
  - Does not crash if the user receives a phone call or switches to another app while using your app
  - Does not consume valuable system resources when the user is not actively using it
  - Does not lose the user's progress if they leave your app and return to it at a later time
  - Does not crash or lose the user's progress when the screen rotates between landscape and portrait orientation

Android application lifecycle - continued



http://developer.android.com/training/basics/activity-lifecycle/starting.html

The History of GUIs

- Hardcoded to the screen
- Hardcoded to the window
- Hardcoded within a view hierarchy
- Dynamic layout within a view hierarchy

Generating GUIs in Android

- Two ways to create GUIs: in XML or in code

```java
public class LayoutExamplesActivity extends Activity {
    /** Called when the activity is first created. */
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);

        Button buttonOne = new Button(this);
        Button buttonTwo = new Button(this);
        buttonOne.setText("Press Me!");
        buttonTwo.setText("Press Me Two!");

        LinearLayout linearLayout = new LinearLayout(this);
        linearLayout.setOrientation(LinearLayout.VERTICAL);
        linearLayout.addView(buttonOne);
        linearLayout.addView(buttonTwo);

        setContentView(linearLayout);
    }
}
```

```xml
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent"
    >
<Button
    android:layout_width="fill_parent"
    android:layout_height="wrap_content"
    android:text="Press Me!"
    >
    </Button>
    <Button
    android:layout_width="fill_parent"
    android:layout_height="wrap_content"
    android:text="Press Me Two!"
   >
   </Button>
</LinearLayout>
```

Advantages of Declarative route via XML

- Separation of appearance (presentation) from actual meaningful state-changing code
- Can change interface without having to completely recompile Java code
  - Can just recompile XML
  - View Resource is inflated at runtime

Generating GUIs in Android - continued

- A lot of your GUI-related work will take place in:
  - `res/layout`
  - `res/values`
- `@+id/name_for_component` gives you handle for referencing XML declarations in code

```
Button button = (Button) findViewById(R.id.button1);
```

```
<Button
    android:layout_width="fill_parent"
    android:layout_height="wrap_content"
    android:layout_weight="1"
    android:text="Record Time"
    android:id="@+id/button1"
    ></Button>
```

Working with resources

- Application resources are stored under `res/`
- There are different types of resources
- String resources
  - Saved in `res/values/` and accessed from the `R.string`

XML file saved at **res/values/strings.xml**:

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="hello">Hello!</string>
</resources>
```

This layout XML applies a string to a View:

```
<TextView
    android:layout_width="fill_parent"
    android:layout_height="wrap_content"
    android:text="@string/hello" />
```

This application code retrieves a string:

```
String string = getString(R.string.hello);
```

```
<resources>
    <string-array name="planets_array">
        <item>Mercury</item>
        <item>Venus</item>
        <item>Earth</item>
        <item>Mars</item>
    </string-array>
</resources>
```

This application code retrieves a string array:

```
Resources res = getResources();
String[] planets = res.getStringArray(R.array.planets_array);
```


http://developer.android.com/guide/topics/resources/available-resources.html

Working with resources - continued

- Color resources
  - Saved in `res/color/` and accessed from the `R.color` class

XML file saved at **res/values/colors.xml**:

```
<resources>
   <color name="opaque_red">#f00</color>
   <color name="translucent_red">#80ff0000</color>
</resources>
```

```
Resources res = getResources();
int color = res.getColor(R.color.opaque_red);
```

```
<TextView
    android:textColor="@color/translucent red"
```

- Style resources
  - Saved in `res/values/` and accessed from the `R.style` class
- Layout resources

http://developer.android.com/guide/topics/resources/available-resources.html

Advantages of structured resources

- One can maintain resources independently and can group based on types
- Android selects which alternative resource to use at runtime
  - Depending on the current device configuration
- Help in providing alternative resources based on device types
- Localizing the applications

Supporting different screens

- Four generalized sizes
  - small, normal, large, xlarge
- Four generalized densities
  - low (ldpi), medium (mdpi), high (hdpi), extra high (xhdpi)
  - `res/layout`
  - `res/layout-large`
  - `res/layout-land-large`
  - `res/drawable-ldpi`
  - `res/drawable-hdpi`

http://developer.android.com/training/basics/supporting-devices/screens.html

Localizing the applications

- Supporting different languages
  - `res/values`
  - `res/values-en`
  - `res/values-fr`
- Help in localizing the applications
  - `res/drawable-de-rDE/`
  - `res/drawable-fr-rCA/`

http://developer.android.com/training/basics/supporting-devices/languages.html

Homework

- Play with life cycle methods
  - Have a layout with 2 EditTexts and 2 TextViews and try to manage the input under different conditions like application paused, resumed, stopped, destroyed.
- Have the same application dealing with language, localization and landscape movement issues
- Upload the project to course tasks
- Deadline: A day before the next lecture. So 10th September 2015.