

MOBILE DEVELOPMENT

ANDROID DEVELOPMENT INTRODUCTION

(BASED ON CIS470 OF CLEVELAND STATE UNIVERSITY)

CONTENTS

Mobile phone evolution

Software: what is Android?

Android's software architecture

Android intents

Dissecting an Android application

Exercises

A solid green horizontal bar at the bottom of the slide.

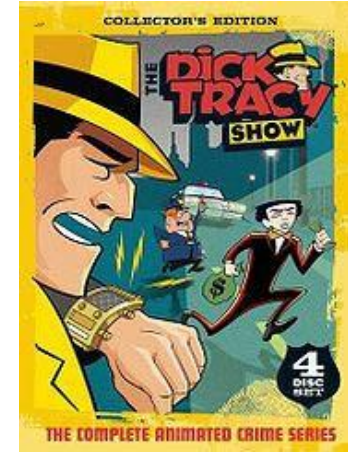
MOBILE PHONE EVOLUTION

In 1876, Alexander Graham Bell became the first to receive a patent for the electric phone

In 1936, Alfred Gross. Case Tech OH (Case Western Reserve University). Invented/Patented Walkie-talkie, CB radio, Telephone Pager

In 1975, Dr. Martin Cooper invented first commercial portable Motorola radio phone

In 2007, iPhone and Android appeared



MOBILE PHONE EVOLUTION

(What is inside a smart cellular phone?)

Smart cellular phone \geq radio + computer



Industries $\leftarrow \Sigma$ Software + telecom + semiconductor + marketing



MOBILE PHONE EVOLUTION

(Reusing cell phone frequencies)

The main idea behind cellular communications is the division of a large city into small areas called cells each hosting a Base-Station

Base-Stations operate with just enough power to reach only the users inside their individual cells

Each hexagonal cell covers approximate 10 square miles (26 km²)

Base stations use low-power transmitters, so the same frequencies can be reused in non-contiguous cells

SOFTWARE: WHAT IS ANDROID?



Android OS is an open-source Linux-based operating system for mobile devices

It is being developed by the Open Handset Alliance and Google Inc

The operating system has several native applications supporting telephony, messaging, etc.

3rd party Java developers can use Android API to extend functionality of the devices

Google provides an on-line electronic market for third-party developers to sell-distribute their applications

Open Handset Alliance is a consortium of 80+ technology and mobile business companies

Quoting from www.OpenHandsetAlliance.com site (2/25/2012)

Today, there are 1.5 billion television sets in use around the world. 1 billion people are on the Internet. But nearly 3 billion people have a mobile phone, making it one of the world's most successful consumer products. Building a better mobile phone would enrich the lives of countless people across the globe. The Open Handset Alliance™ is a group of mobile and technology leaders who share this vision for changing the mobile experience for consumers.

SOFTWARE: WHAT IS ANDROID?

(Open handset alliance members)

Mobile operators	Handset manufacturers	Semiconductor companies	Software companies	Commercialization companies
1. Bouygues Telecom China Mobile 2. Communications Corporation 3. China Telecommunications 4. China United Network Communications 5. KDDI 6. LG Uplus 7. NTT Docomo 8. Softbank mobile 9. Sprint Nextel 10. T-Mobile 11. Telecom Italia 12. Telefónica 13. Telus 14. Vodafone	1. Acer 2. Alcatel mobile phones 3. ASUSTeK Computer 4. CCI 5. Dell 6. Foxconn International Holdings Limited 7. Fujitsu limited 8. Garmin International 9. Haier Telecom (Qingdao) 10. HTC 11. Huawei Technologies 12. Kyocera 13. Lenovo Mobile Communication Technology 14. LG Electronics 15. Motorola 16. NEC 17. OPPO Mobile Telecommunications 18. Pantech 19. Samsung Electronics...	1. AKM 2. Audience 3. ARM 4. Atheros Communications 5. Broadcom Corporation 6. Cypress Semiconductor Corporation 7. Freescale Semiconductor 8. Gemalto 9. Imagination Technologies 10. Intel Corporation 11. Marvell Semiconductor 12. MediaTek 13. MIPS Technologies 14. NVIDIA Corporation 15. Qualcomm 16. Renesas Electronics Corporation 17. ST-Ericsson 18. Synaptics 19. Texas Instruments Incorporated 20. Via Telecom	1. Ándago Ingeniería S.L. 2. ACCESS 3. Ascender 4. Cooliris 5. eBay 6. Google 7. LivingImage 8. Myriad 9. MOTOYA 10. Nuance Communications 11. NXP Software 12. OMRON Software 13. PacketVideo 14. SkyPop 15. SONiVOX 16. SVOX 17. VisualOn	1. Accenture 2. Aplix Corporation 3. Borqs 4. Intrinsyc Software International 5. L&T Infotech 6. Noser Engineering 7. Sasken Communication Technologies 8. SQLStar International 9. The Astonishing Tribe AB 10. Teleca AB 11. Wind River 12. Wipro Technologies

SOFTWARE: WHAT IS ANDROID?

(The mobile revolution)

Electronic tools commonly carried by a typical business warrior

Not so long ago ...	Today
<ol style="list-style-type: none">1. Phone2. Pager3. PDA Organizer4. Laptop5. MP3 Portable music player6. Wired modem7. No internet access / limited access	<ol style="list-style-type: none">1. Smartphone2. Laptop

Tomorrow?

I want my 2015 Smartphone to be: Phone, Pager, PDA Organizer, high quality camera, laptop, cash, ...

SOFTWARE: WHAT IS ANDROID?

(Android vs. OS competitors)

1. Apple
2. Microsoft
3. Nokia Symbian
4. Palm & webOS
5. Research in motion

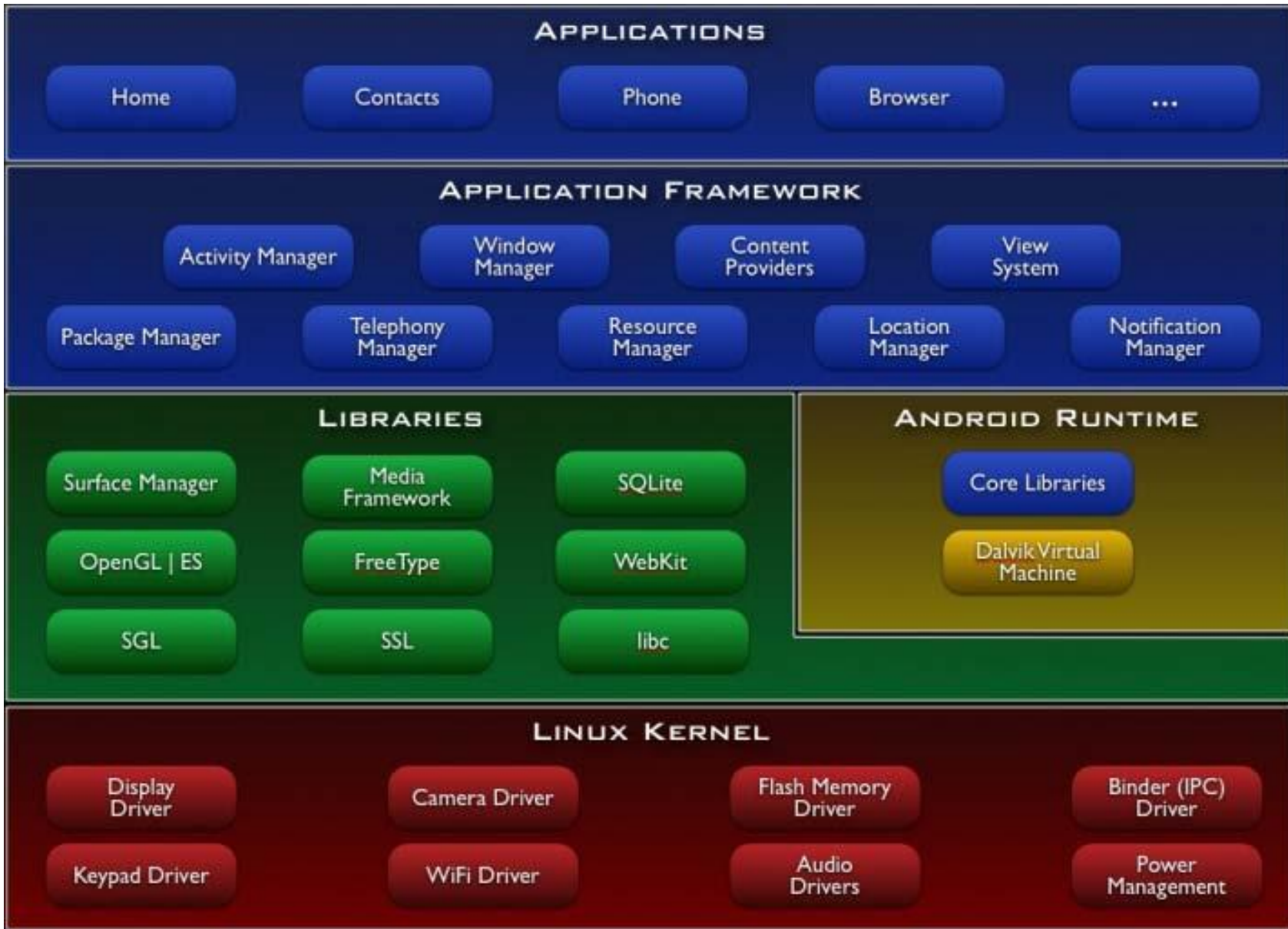


SOFTWARE: WHAT IS ANDROID?

(The mobile revolution)

Android Software/Hardware Components

- Dalvik virtual machine (soon to be replaced by ART)
- Integrated browser (WebKit)
- Graphic Capabilities (hardware acceleration)
- SQLite for structured data storage
- Media support (audio/video)
- GSM Telephony (hardware dependent)
- Bluetooth, EDGE, 3G, 4G, NFC, and Wi-Fi (hardware manufacturer dependent)
- Camera, GPS, compass, accelerometer, gyroscope, proximity/ambient light, barometric pressure, fingerprint reader, heart rate sensor (hardware dependent)
- Software Development Tools & Application framework (device emulator, debugging, profiling, plugin for the Eclipse IDE, resource managers, Android Studio)



ANDROID'S SOFTWARE ARCHITECTURE

1. Software Layers: <https://www.youtube.com/watch?v=QBGfUs9mQYY>

2. Application's Life Cycle: <https://www.youtube.com/watch?v=fL6gSd4ugSI&feature=channel>

3. Android's API: <https://www.youtube.com/watch?v=MPukbH6D-IY&feature=channel>

4. Android Application Framework: <https://sites.google.com/site/io/inside-the-android-application-framework>

5. Introduction to Android: https://www.youtube.com/watch?v=x1ZZ-R3p_w8

6. Dalvik Virtual Machine Internals: <https://www.youtube.com/watch?v=ptjedOZEXPM>

ANDROID INTENTS

An Intent is a request for services offered by an Android based device

An Intent is made up of various pieces including:

- desired action or service
- data
- category of component that should handle the intent and instructions on how to launch a target activity

Action	Data
The general action to be performed, such as: ACTION_VIEW, ACTION_EDIT, ACTION_MAIN, etc.	The data to operate on, such as a person record in the contacts database, expressed as a Uri

ANDROID INTENTS (Some examples)

Some examples of Intent's action/data pairs are:

- ACTION_VIEW content://contacts/1 -- Display information about the person whose identifier is "1".
- ACTION_DIAL content://contacts/1 -- Display the phone dialer with the person filled in.
- ACTION_VIEW tel:123 -- Display the phone dialer with the given number filled in
- ACTION_DIAL tel:123 -- Display the phone dialer with the given number filled in.
- ACTION_EDIT content://contacts/1 -- Edit information about the person whose identifier is "1".
- ACTION_VIEW content://contacts/ -- Display a list of people, which the user can browse through.

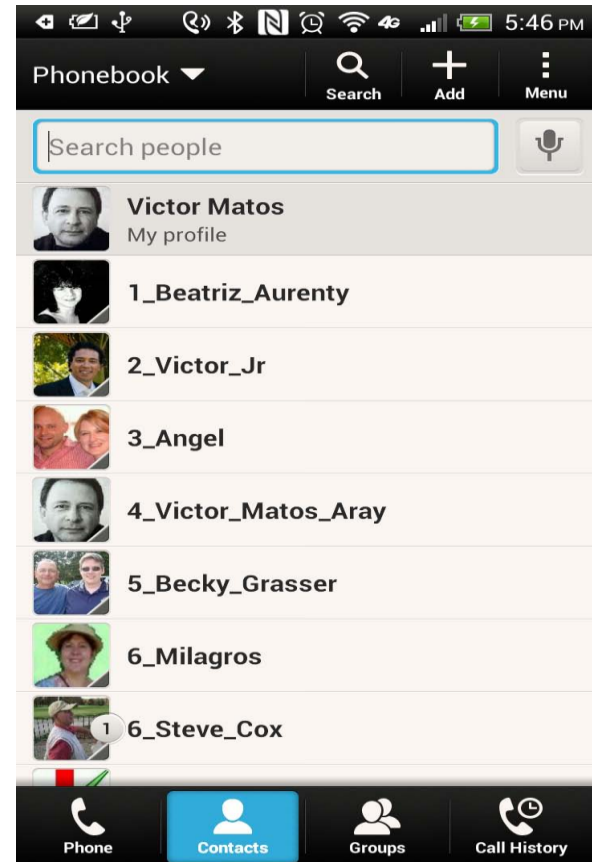
The following code fragment calls an Intent whose job is to invoke a built-in task (ACTION_VIEW) and explore the Contacts available in the phone.

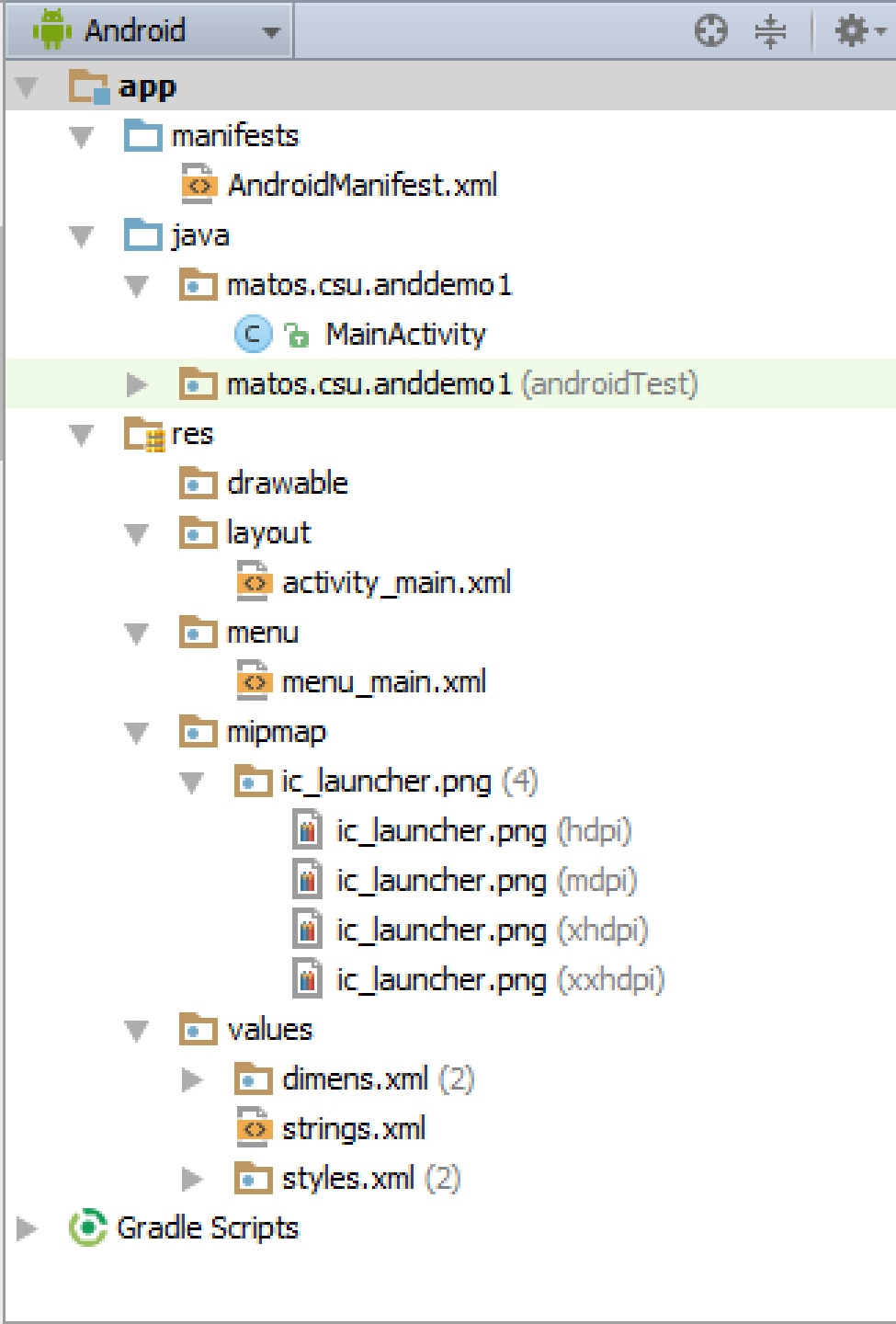
```
Intent myIntent = new Intent(Intent.ACTION_VIEW, Uri.parse("content://contacts/people"));
startActivity(myIntent);
```


ANDROID INTENTS (Java + Built-in intent)

Java class including invocation to an Intent to display Contacts

```
public class AndDemo1 extends Activity {  
    /** show contact list */  
    @Override  
    public void onCreate(Bundle savedInstanceState) {  
        super.onCreate(savedInstanceState);  
        setContentView(R.layout.main);  
        Intent myIntent = new Intent(Intent.ACTION_VIEW, Uri.parse("content://contacts/people"));  
        startActivity(myIntent);  
    }  
}
```





DISSECTING AN ANDROID APPLICATION

Structure of a typical Android application (Android studio)

Every application must have an AndroidManifest.xml file in its root directory.

The manifest presents essential information about the application to Android system, for instance it has an entry for each activity, library request, and special permissions needed to assemble the app.

DISSECTING AN ANDROID APPLICATION

This is a list of the <XML-elements> allowed in the Manifest file

1. <action>
2. <activity>
3. <activity-alias>
4. <application>
5. <category>
6. <data>
7. <grant-uri-permission>
8. <instrumentation>
9. <intent-filter>
10. <manifest>
11. <meta-data>
12. <permission>
13. <permission-group>
14. <permission-tree>
15. <provider>
16. <receiver>
17. <service>
18. <uses-configuration>
19. <uses-library>
20. <uses-permission>
21. <uses-sdk>

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android" package="matos.earthquake" android:versionCode="1" android:versionName="1.0.0">
  <application android:icon="@drawable/yellow_circle" android:label="@string/app_name">
    <activity android:name=".AndQuake" 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=".SatelliteMapping"> </activity>
    <service android:name="AndQuakeService" android:enabled="true" ></service>
    <receiver android:name="AndQuakeAlarmReceiver" >
      <intent-filter>
        <action android:name = "ALARM_TO_REFRESH_QUAKE_LIST"/>
      </intent-filter>
    </receiver>
  </application>
  <uses-library android:name="com.google.android.maps" />
  <uses-permission android:name="android.permission.INTERNET" />
</manifest>
```

US Dollars 100

Euros €74.07

Colon CR ₡52,631.58

Clear

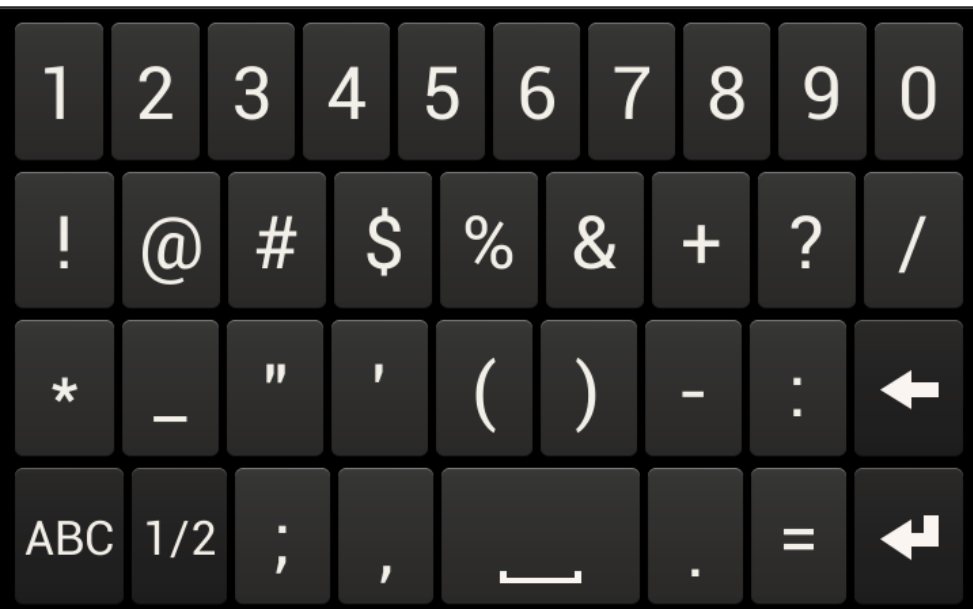
Convert

EXAMPLES (Currency converter)

Implementing a currency converter: USD \rightarrow Euro \rightarrow Colon (CR)

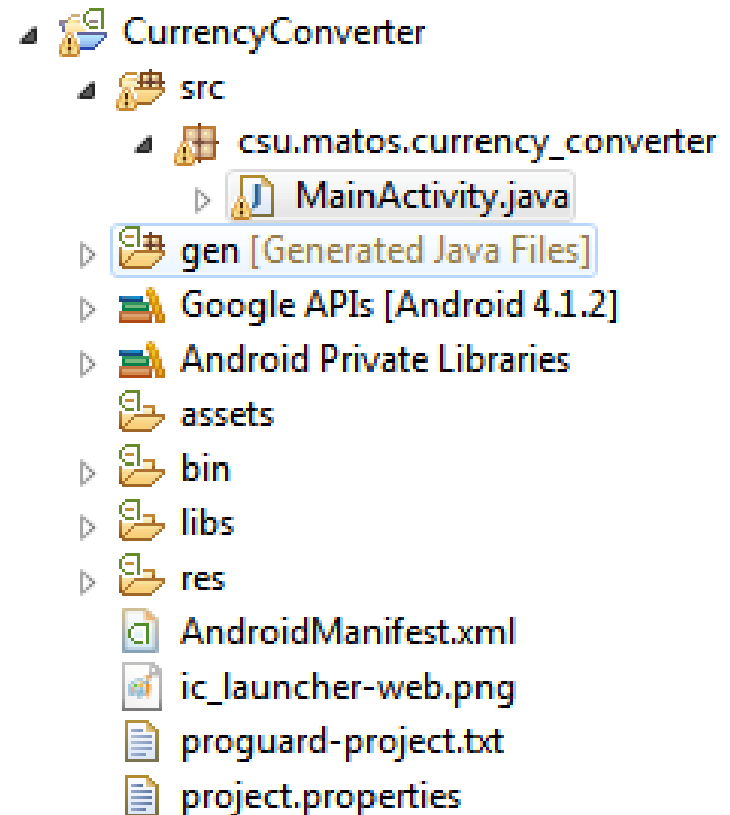
Note:

- Naive implementation using a fixed
- Exchange rate:
 - 1 Costa Rican Colon = 0.0019 U.S. dollars
 - 1 Euro = 1.35 U.S. dollars



EXAMPLES (Currency converter)

```
package csu.matos.currencyconverter;
import android.app.Activity;
import android.os.Bundle;
import android.view.View;
import android.view.View.OnClickListener;
import android.widget.Button;
import android.widget.EditText;
public class Currency1 extends Activity {
    //USA money format (12 digits, 2 decimals)
    DecimalFormat usaDf = new DecimalFormat("###,###,###,###.##");
    // naive currency converter (USD to Euros & Colones)
    private final double EURO2USD = 1.35;
    private final char EUROSYM = '\u20AC';
    private final double COLON2USD = 0.0019;
    private final char COLONSYM = '\u20A1';
    // GUI widgets
    Button btnConvert, btnClear;
    EditText txtUSDollars, txtEuros, txtColones;
```



EXAMPLES (Currency converter)

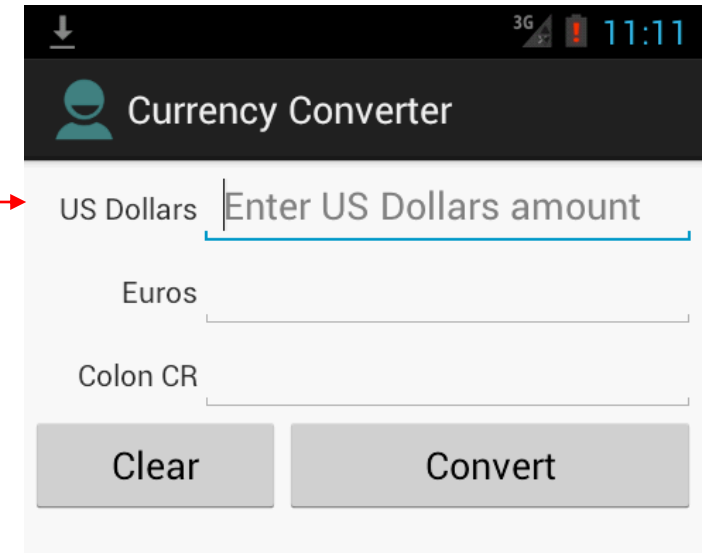
```
@Override
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_main_linear);
    // bind local controls to GUI widgets
    txtUSDollars = (EditText)findViewById(R.id.txtUSDollars);
    // make 'Euros' box not-editable (no user input)
    txtEuros = (EditText)findViewById(R.id.txtEuros);
    txtEuros.setInputType(EditorInfo.TYPE_NULL);
    // No user input. See layout: android:editable="false"
    txtColones = (EditText)findViewById(R.id.txtColones);
    // attach click behavior to buttons
    btnClear = (Button)findViewById(R.id.btnClear);
    btnClear.setOnClickListener(new OnClickListener() {
        // clear the text boxes
        @Override
        public void onClick(View v) {
            txtColones.setText(""); txtEuros.setText(""); txtUSDollars.setText("");
        }
    }); // setOnClick...
```

```
// do the conversion from USD to Euros and Colones
btnConvert = (Button) findViewById(R.id.btnConvert);
btnConvert.setOnClickListener(new OnClickListener() {
    @Override
    public void onClick(View v) {
        try {
            String usdStr = txtUSDollars.getText().toString();
            double usd = Double.parseDouble(usdStr);
            String euros = EUROS_SYM + String.valueOf(usaDf.format(usd / EURO2USD));
            String colones = COLONS_SYM + String.valueOf(usaDf.format(usd / COLON2USD));
            txtEuros.setText(euros);
            txtColones.setText(colones);
        }
        catch (NumberFormatException e) { /*ignore errors*/ }
    }
}); // setOnClick...
// onCreate
// class
```

EXAMPLES (Currency converter – layouts)

LAYOUT: res/layout/activity_main_linear.xml

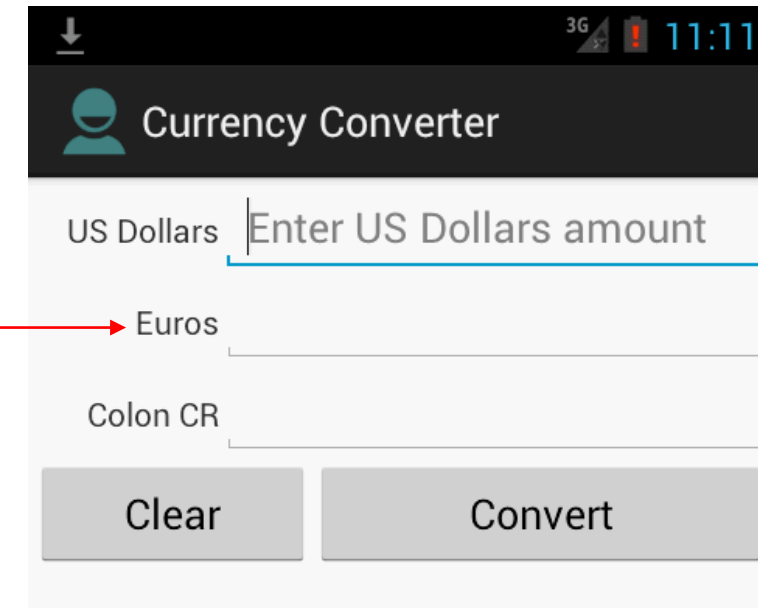
```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent" android:layout_height="match_parent"
    android:orientation="vertical" android:padding="2dp" >
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        <TextView android:id="@+id/textView2" android:layout_width="wrap_content"
            android:layout_height="wrap_content" android:ems="5"
            android:gravity="right" android:text="US Dollars" />
        <EditText android:id="@+id/txtUSDollars" android:layout_width="wrap_content"
            android:layout_height="wrap_content" android:layout_weight="2"
            android:hint="Enter US Dollars amount" android:inputType="numberDecimal" />
    </LinearLayout>
    <requestFocus />
</LinearLayout>
...
```



EXAMPLES (Currency converter – layouts)

LAYOUT: res/layout/activity_main_linear.xml

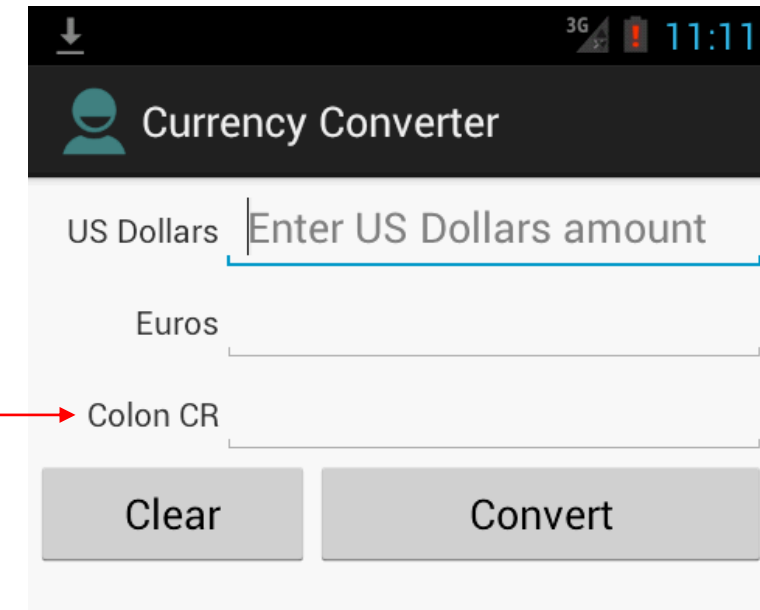
```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent" android:layout_height="match_parent"
    android:orientation="vertical" android:padding="2dp" >
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        ...
    </LinearLayout>
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        <TextView android:id="@+id/textView3" android:layout_width="wrap_content"
            android:layout_height="wrap_content" android:ems="5"
            android:gravity="right" android:text="Euros" />
        <EditText android:id="@+id/txtEuros" android:layout_width="wrap_content"
            android:layout_height="wrap_content" android:layout_weight="2" />
    </LinearLayout>
    ...
</LinearLayout>
```



EXAMPLES (Currency converter – layouts)

LAYOUT: res/layout/activity_main_linear.xml

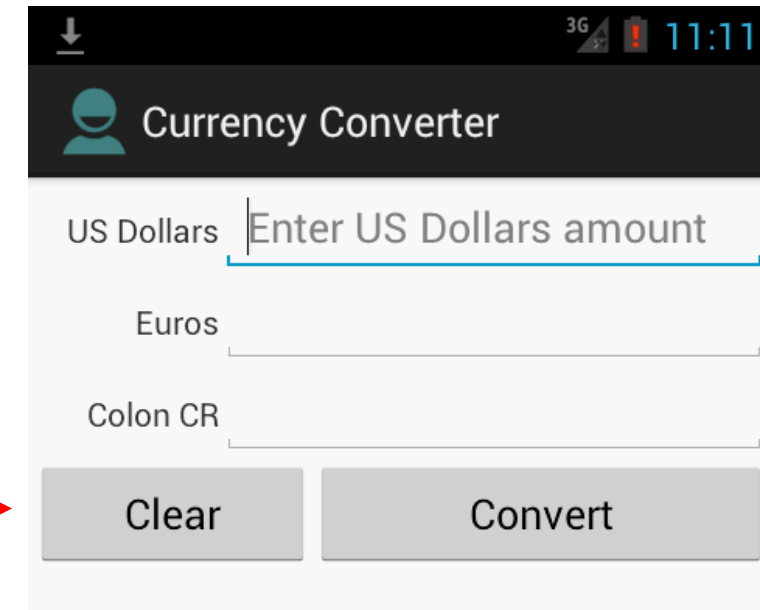
```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent" android:layout_height="match_parent"
    android:orientation="vertical" android:padding="2dp" >
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        ...
    </LinearLayout>
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        ...
    </LinearLayout>
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        <TextView android:id="@+id/textView4" android:layout_width="wrap_content"
            android:layout_height="wrap_content" android:ems="5"
            android:gravity="right" android:text="Colon CR" />
        <EditText android:id="@+id/txtColones" android:layout_width="wrap_content"
            android:layout_height="wrap_content" android:layout_weight="2" android:editable="false" />
    </LinearLayout>
    ...
</LinearLayout>
```



EXAMPLES (Currency converter – layouts)

LAYOUT: res/layout/activity_main_linear.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent" android:layout_height="match_parent"
    android:orientation="vertical" android:padding="2dp" >
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        ...
    </LinearLayout>
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        ...
    </LinearLayout>
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        ...
    </LinearLayout>
    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content" >
        <Button android:id="@+id/btnClear" android:layout_width="wrap_content"
            android:layout_height="wrap_content" android:layout_weight="1" android:text="Clear" />
        <Button android:id="@+id/btnConvert" android:layout_width="wrap_content"
            android:layout_height="wrap_content" android:layout_weight="2" android:text="Convert" />
    </LinearLayout>
</LinearLayout>
```



EXERCISES

Survey and **analyze** the size of market year...

- Mobile search market
- Content accessed from smartphone
- Mobile market compared to other technologies, such as papers, internet or TV
- Mobile operating system market share
- Some new products-ideas for 2020...
- Cell-Phone diffusion

Some references:

- <https://techcrunch.com/>
- <https://www.openautoalliance.net/>
- <http://gizmodo.com/>
- ...