Mobile Software Development for Android - I397

IT COLLEGE, ANDRES KÄVER, 2015-2016

EMAIL: AKAVER@ITCOLLEGE.EE

WEB: HTTP://ENOS.ITCOLLEGE.EE/~AKAVER/2015-2016/DISTANCE/ANDROID

SKYPE: AKAVER

Timetable – distance learners

- 2015
  - Oct 16 (1)
  - Nov 6 (2) & 7 (1)
  - Nov 29 (2)
  - Dec 18 (1) & 19 (1)
- 2016
  - Jan 9 – home project presentation
- Total 8 meetings (lecture/practice) + final

Requirements

- Development environment – latest Android Studio (java, IntelliJ)
  - http://developer.android.com/sdk/index.html
  - Base OS – free choice (MS Windows, OS X, Linux)
- Android based development device for testing – not required. School has some test equipment available (old devices – ca 2010).
- Personal Android device – (phone/tablet) strongly recommended
- If possible, use personal laptop for development
- Projects in GitHub

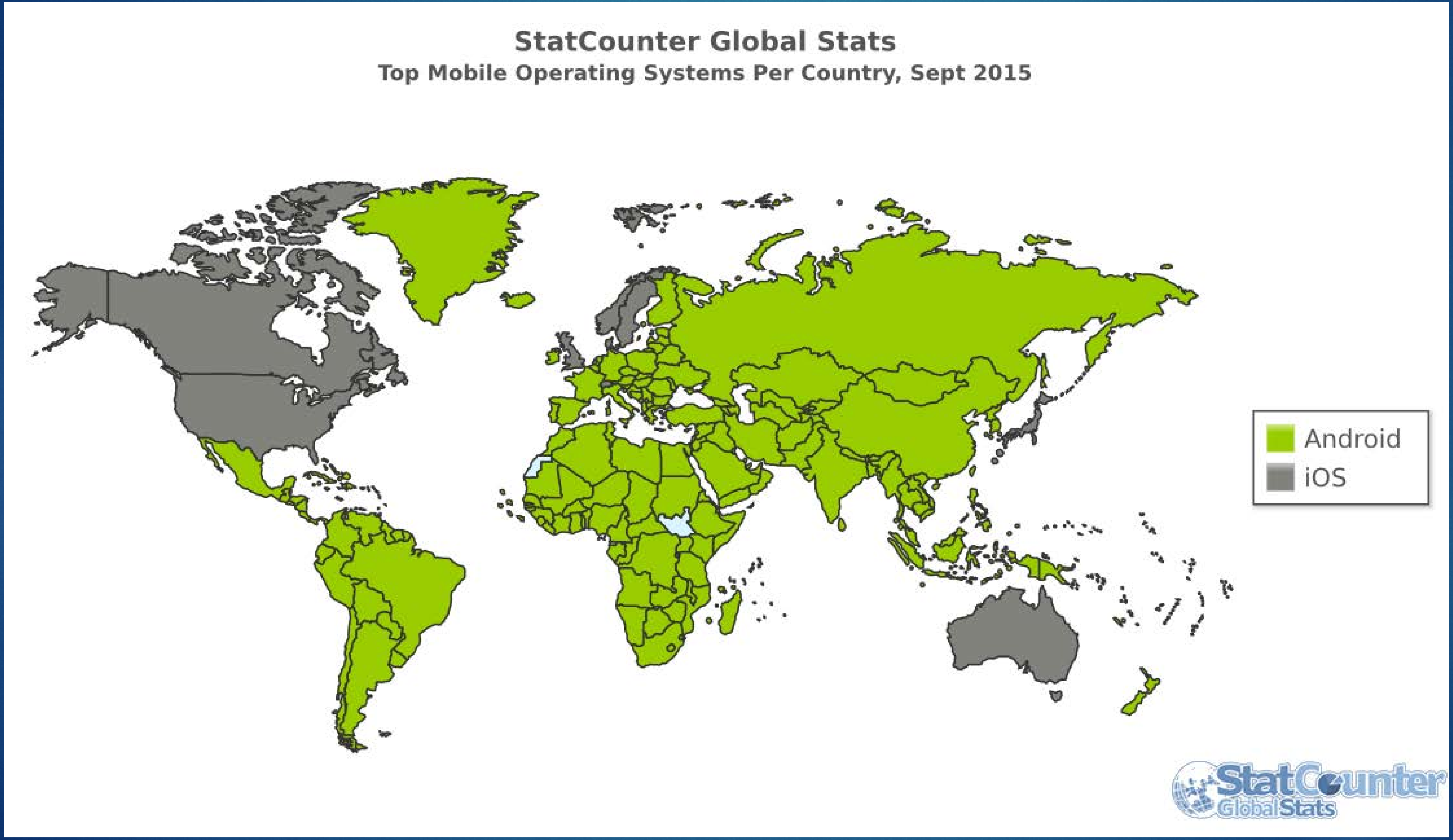
Topics

- Android overview
- Basic Android Studio usage
- UI creation
- Web services (REST API)
- Local storage and data access (SQLite)
- App lifecycle and state
- Sensors (proximity, geomagnetic, motion, GPS, ...)
- Google Play - publishing

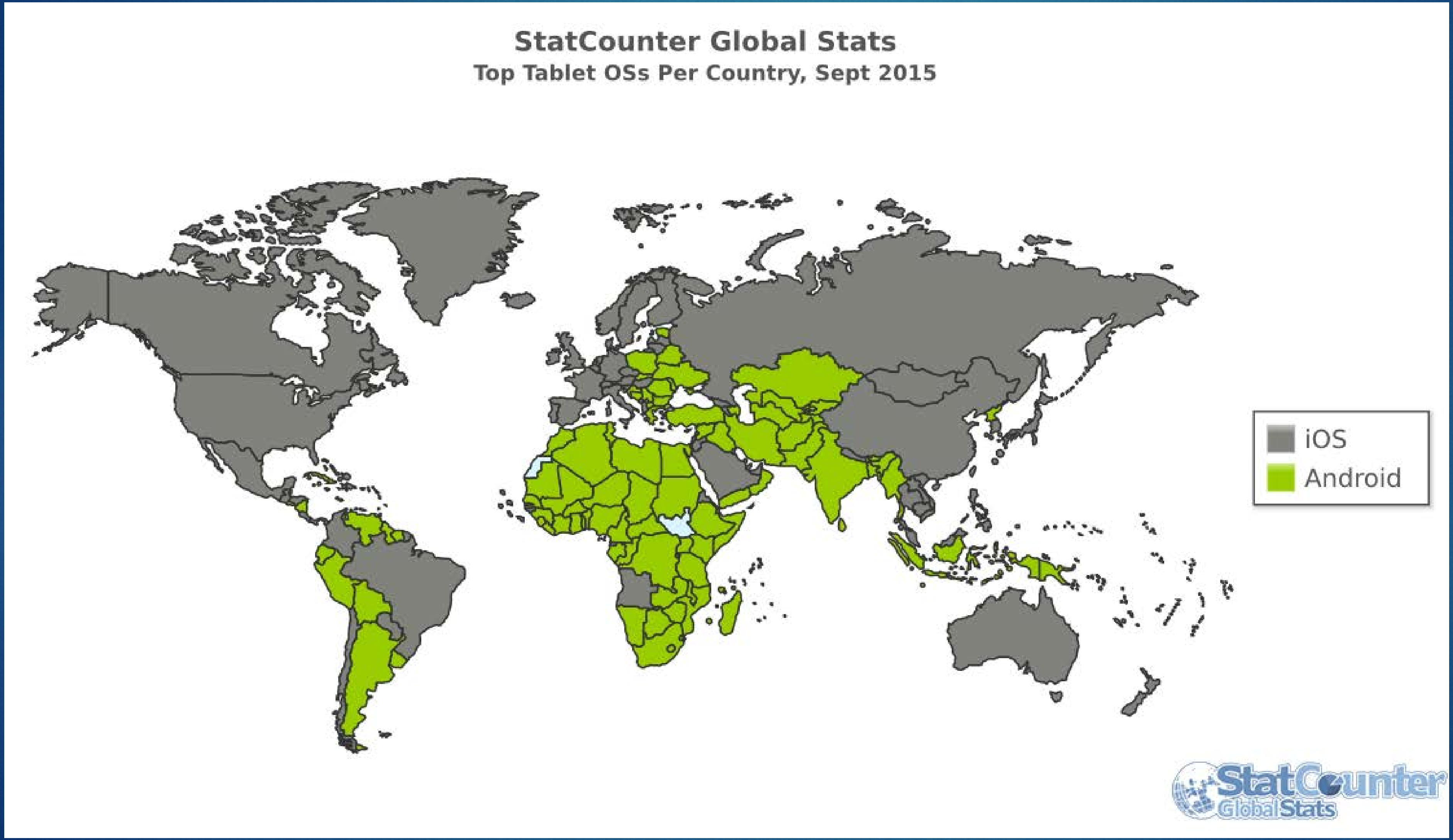
Android

- Operating system, devised for mobile equipment (mostly)
- Usage: phones, tablets, TV-s, watches, glasses, cars, laptops, cameras, game consoles, …
- Market share among smartphones – ca 82%
- Open source project
- Google apps are closed source (mail, map, etc.)

Android - mobile


StatCounter Global Stats
Top Mobile Operating Systems Per Country, Sept 2015

Android - tablet



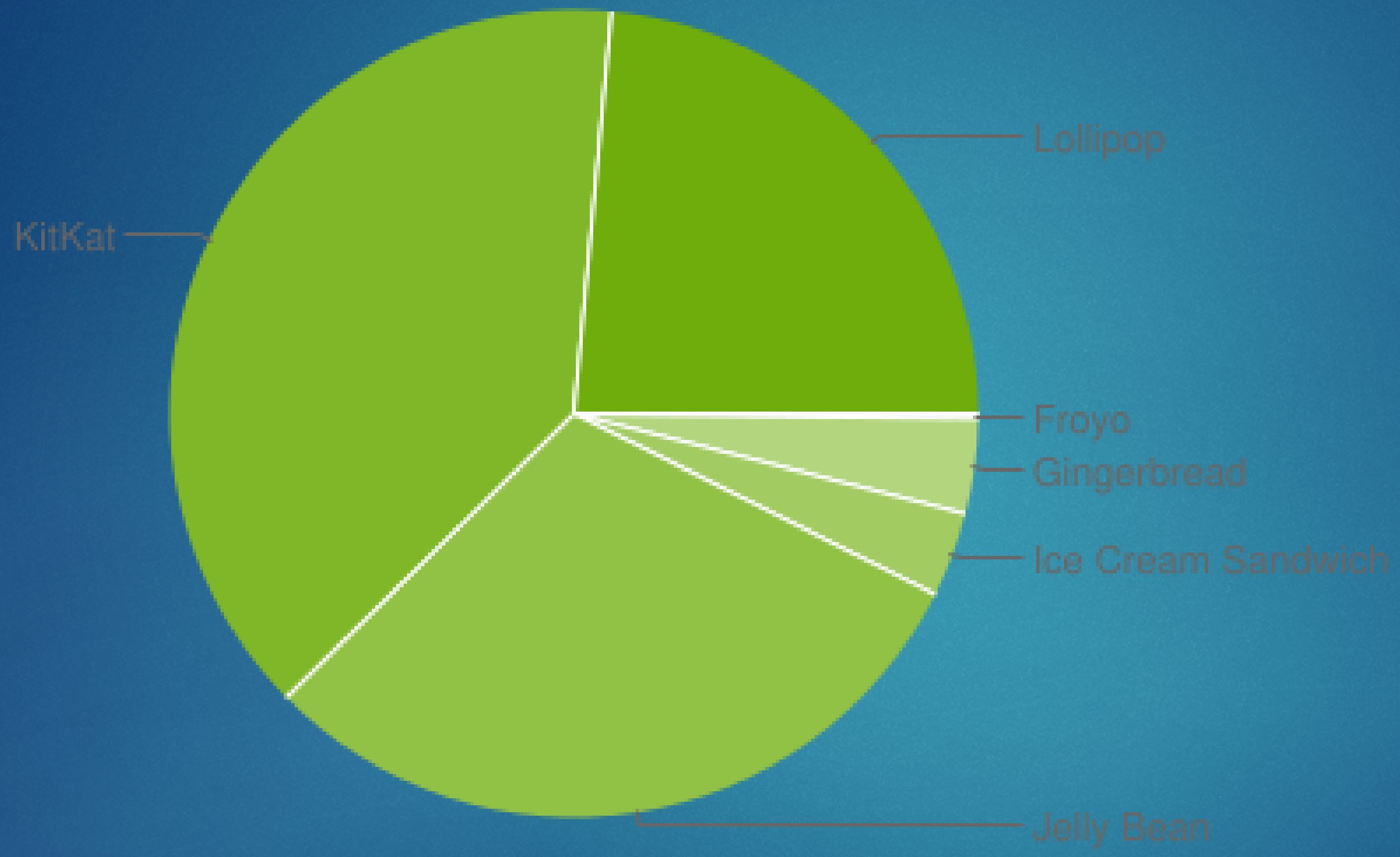
Short history

- 2003 – founded (lead: Andy Rubin)
    - Initial idea – OS for cameras
    - New plan – Mobile OS, (others: Symbian/Nokia and Win Mobile)
- 2005 – Google acquires the whole project
- 2007 – Open Handset Alliance
    - Google, HTC, Sony, Samsung, Dell, Motorola, LG, Qualcomm, Intel, etc…
- 2008 – Android 1.0 (HTC Dream, no touchscreen)
- 2009 – Android 1.5 Cupcake (iPhone 2007, iPhone 3G 2008)
- 2010 – Android 2.2 Froyo, 2.3 Gingerbread

Short history

- 2011 – Android 3.0 Honeycomb (tablets only)
- 2011 - Android 4.0 Ice Cream Sandwich
  - HOLO UI
- 2014 - Android 5 Lollipop
  - Material design
  - Dalvik vs ART (Android Runtime) (JIT or precompile, garbage collection)
- 2015 - Android 6 Marshmallow

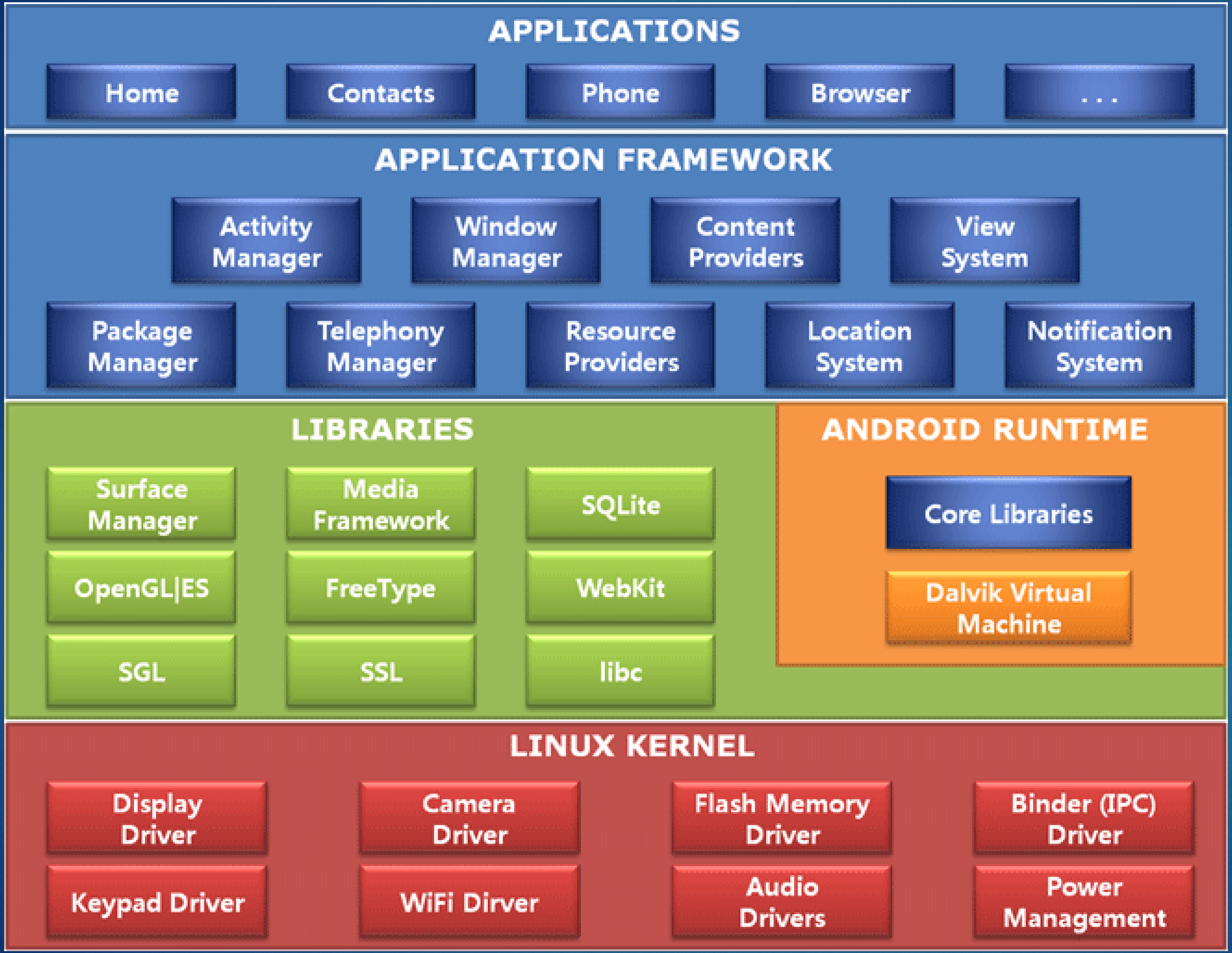
Version distribution



Lollipop - 5.X – 23%
KitKat, Jelly Bean, Ice Cream Sandwich - 4.X - 73%

- Source: http://developer.android.com/about/dashboards/index.html

Android architecture



APPLICATIONS

Home

Contacts

Phone

Browser

. . .

APPLICATION FRAMEWORK

Activity Manager

Window Manager

Content Providers

View System

Package Manager

Telephony Manager

Resource Providers

Location System

Notification System

LIBRARIES

Surface Manager

Media Framework

SQLite

OpenGL|ES

FreeType

WebKit

SGL

SSL

libc

ANDROID RUNTIME

Core Libraries

Dalvik Virtual Machine

LINUX KERNEL

Display Driver

Camera Driver

Flash Memory Driver

Binder (IPC) Driver

Keypad Driver

WiFi Dirver

Audio Drivers

Power Management

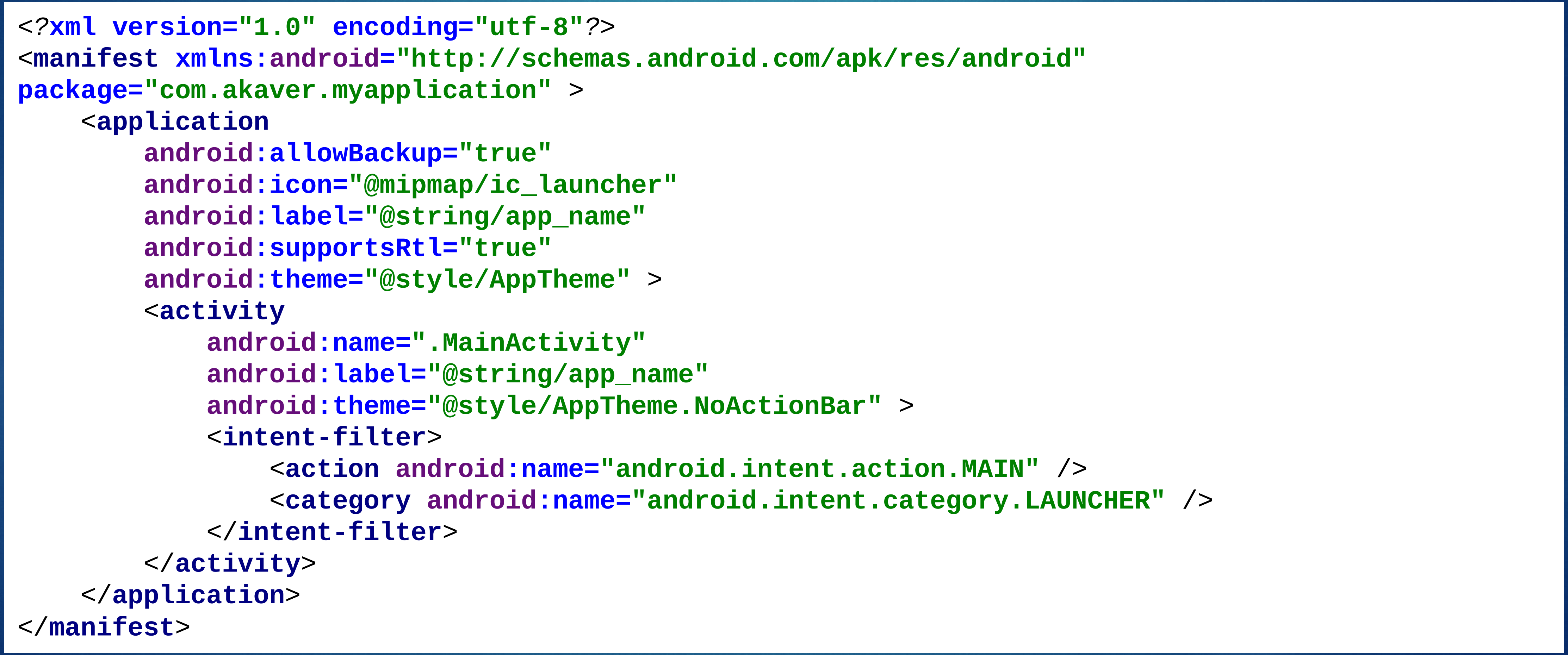
Android - App types

- NDK - C/C++
  - Close to hardware and opsys
- SDK - Native <- this course!!!!
  - Java (ART/Dalvik), using system libraries
- Crossplatform – Xamarin (C#), etc
- Html
  - One codebase/layout for different platforms
  - Problems with UI, weak access to hardware

Android – App architecture AndroidManifest.xml

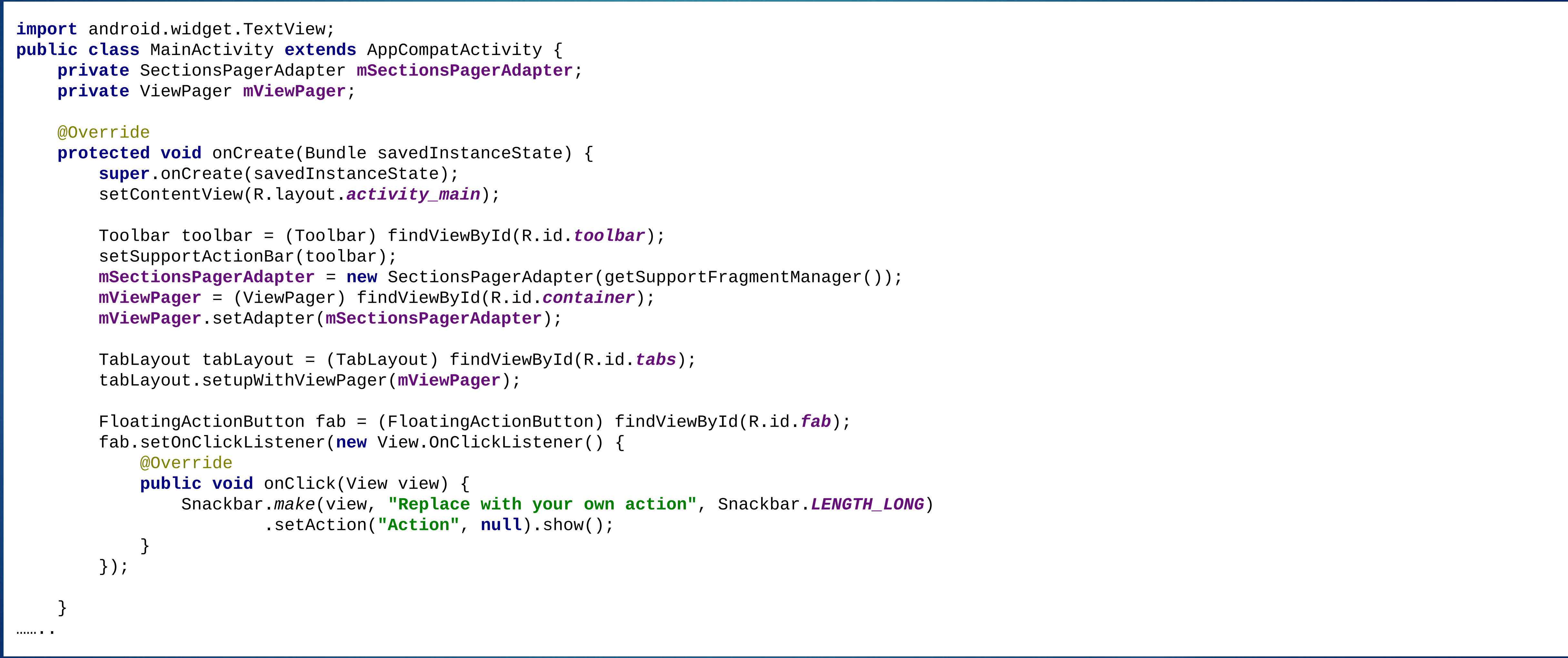
- The manifest file presents essential information about your app to the Android system, information the system must have before it can run any of the app's code.
- Describes the components of the application — the activities, services, broadcast receivers, and content providers that the application is composed of.
- Declares which permissions the application must have in order to access protected parts of the API and interact with other applications.
- Declares the minimum level of the Android API that the application requires.

Android – AndroidManifest.xml Example -



```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
package="com.akaver.myapplication" >
    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:supportsRtl="true"
        android:theme="@style/AppTheme" >
        <activity
            android:name=".MainActivity"
            android:label="@string/app_name"
            android:theme="@style/AppTheme.NoActionBar" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>
</manifest>
```

Android – Java code MainActivity.java

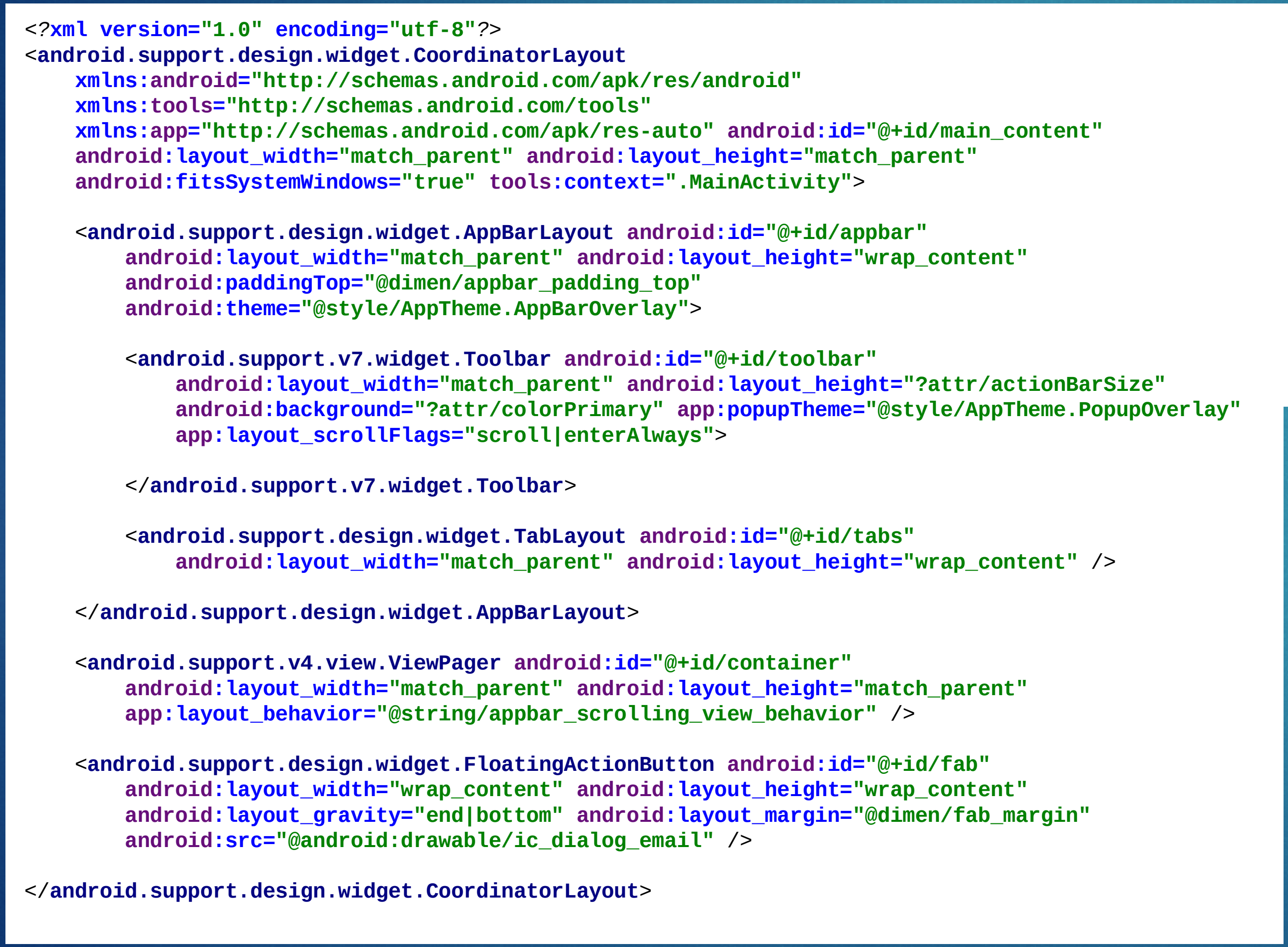


```
import android.widget.TextView;
public class MainActivity extends AppCompatActivity {
    private SectionsPagerAdapter mSectionsPagerAdapter;
    private ViewPager mViewPager;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        Toolbar toolbar = (Toolbar) findViewById(R.id.toolbar);
        setSupportActionBar(toolbar);
        mSectionsPagerAdapter = new SectionsPagerAdapter(getSupportFragmentManager());
        mViewPager = (ViewPager) findViewById(R.id.container);
        mViewPager.setAdapter(mSectionsPagerAdapter);

        TabLayout tabLayout = (TabLayout) findViewById(R.id.tabs);
        tabLayout.setupWithViewPager(mViewPager);

        FloatingActionButton fab = (FloatingActionButton) findViewById(R.id.fab);
        fab.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View view) {
                Snackbar.make(view, "Replace with your own action", Snackbar.LENGTH_LONG)
                        .setAction("Action", null).show();
            }
        });

    }
……..
```

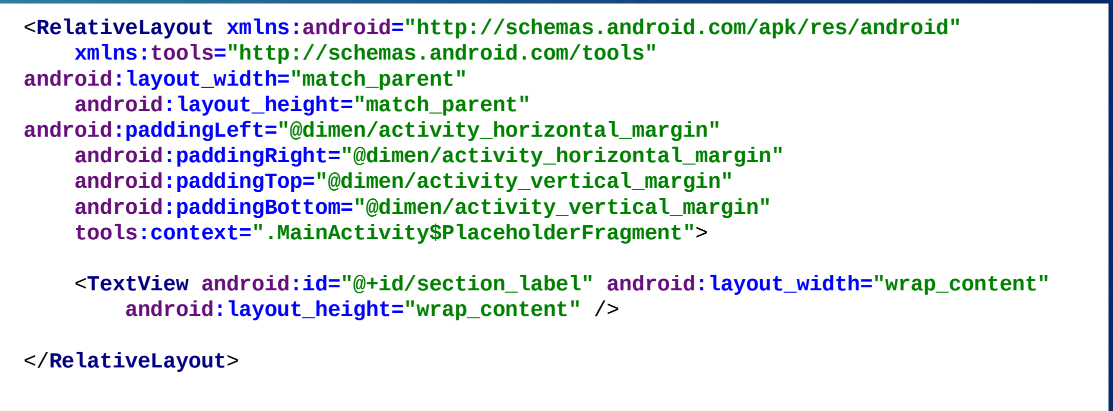
Android – Layout - Resource files

activity_main.xml

fragment_main.xml



```
<?xml version="1.0" encoding="utf-8"?>
<android.support.design.widget.CoordinatorLayout
    xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    xmlns:app="http://schemas.android.com/apk/res-auto" android:id="@+id/main_content"
    android:layout_width="match_parent" android:layout_height="match_parent"
    android:fitsSystemWindows="true" tools:context=".MainActivity">

    <android.support.design.widget.AppBarLayout android:id="@+id/appbar"
        android:layout_width="match_parent" android:layout_height="wrap_content"
        android:paddingTop="@dimen/appbar_padding_top"
        android:theme="@style/AppTheme.AppBarOverlay">

        <android.support.v7.widget.Toolbar android:id="@+id/toolbar"
            android:layout_width="match_parent" android:layout_height="?attr/actionBarSize"
            android:background="?attr/colorPrimary" app:popupTheme="@style/AppTheme.PopupOverlay"
            app:layout_scrollFlags="scroll|enterAlways">

        </android.support.v7.widget.Toolbar>

        <android.support.design.widget.TabLayout android:id="@+id/tabs"
            android:layout_width="match_parent" android:layout_height="wrap_content" />

    </android.support.design.widget.AppBarLayout>

    <android.support.v4.view.ViewPager android:id="@+id/container"
        android:layout_width="match_parent" android:layout_height="match_parent"
        app:layout_behavior="@string/appbar_scrolling_view_behavior" />

    <android.support.design.widget.FloatingActionButton android:id="@+id/fab"
        android:layout_width="wrap_content" android:layout_height="wrap_content"
        android:layout_gravity="end|bottom" android:layout_margin="@dimen/fab_margin"
        android:src="@android:drawable/ic_dialog_email" />

</android.support.design.widget.CoordinatorLayout>
```



```
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
android:layout_width="match_parent"
    android:layout_height="match_parent"
android:paddingLeft="@dimen/activity_horizontal_margin"
    android:paddingRight="@dimen/activity_horizontal_margin"
    android:paddingTop="@dimen/activity_vertical_margin"
    android:paddingBottom="@dimen/activity_vertical_margin"
    tools:context=".MainActivity$PlaceholderFragment">

    <TextView android:id="@+id/section_label" android:layout_width="wrap_content"
        android:layout_height="wrap_content" />

</RelativeLayout>
```

Android – Other resources

- Images
- Animations
- Menu
- Strings
- Misc files

Android - apk

- Android Application Package
- ZIP file, combines all the resources and java bytecode
- Signed with developer key
- Developer key must be the same from version to next version
- Don’t lose your keys (passwords)
- Android Studio takes care of APK creation
- APK-s can be downloaded from store, using 3-rd party utilities
- Resources can be used as is
- Most elements/code can be decompiled/recompiled

Android – Google Play - appstore

- No review process
- Problems are dealt with afterwards
- App hijacking, etc. are real problems

Android – App security

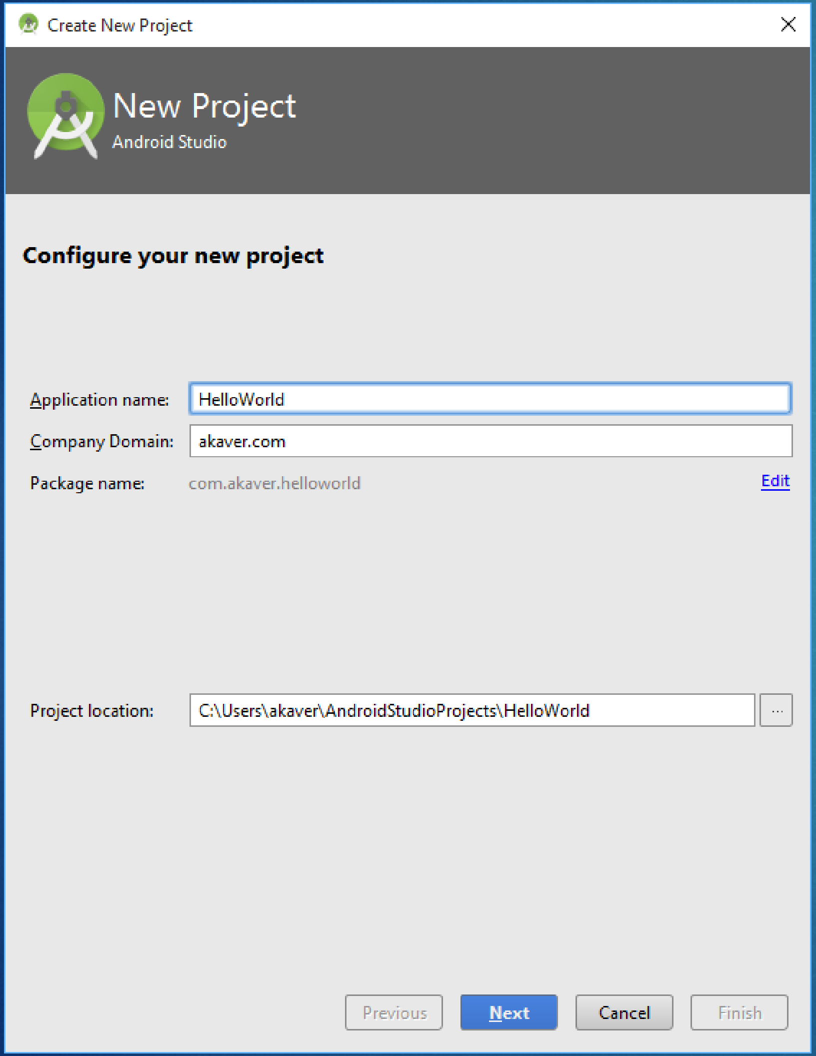
- Every app works in its own private virtual machine (Zygote)
- Need permission for system resources (confirmed on app install)
- Data is private, no other app can access directly other app data
- Everything is possible on rooted device
- End user is the weakest link

Android – dev problems

- Gazillion different hardware devices and capabilities
- Lots of different Android implementations
  - Samsung TouchWiz
  - HTC Sense
  - CyanogenMod
  - …..
- Migration to newer versions very slow (or not done at all)
- Rooted phones
- Ca 2X time spent on development compared to iOS
- Ca 60% better income on iOS

Android – testing on devices

Android – HelloWorld



Create New Project

New Project
Android Studio

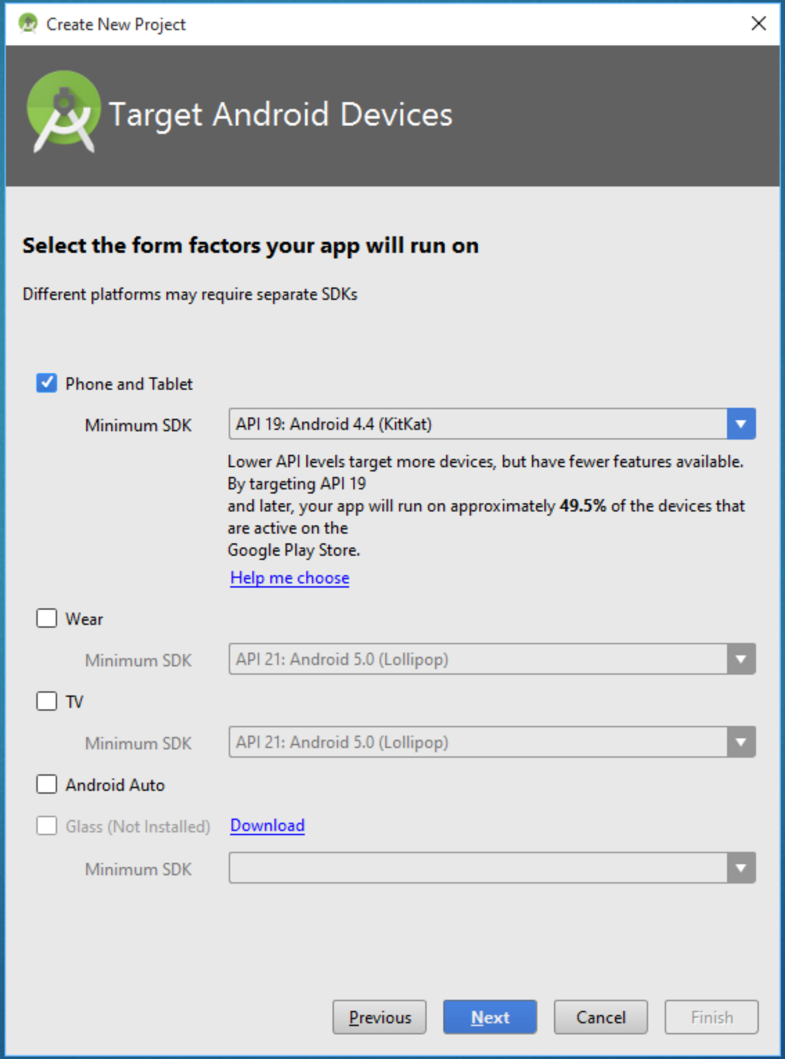
Configure your new project

Application name: HelloWorld

Company Domain: akaver.com

Package name: com.akaver.helloworld Edit

Project location: C:\Users\akaver\AndroidStudioProjects\HelloWorld



Create New Project

Target Android Devices

Select the form factors your app will run on

Different platforms may require separate SDKs

☑ Phone and Tablet

Minimum SDK: API 19: Android 4.4 (KitKat)

Lower API levels target more devices, but have fewer features available. By targeting API 19
and later, your app will run on approximately **49.5%** of the devices that are active on the
Google Play Store.

Help me choose

☐ Wear

Minimum SDK: API 21: Android 5.0 (Lollipop)

☐ TV

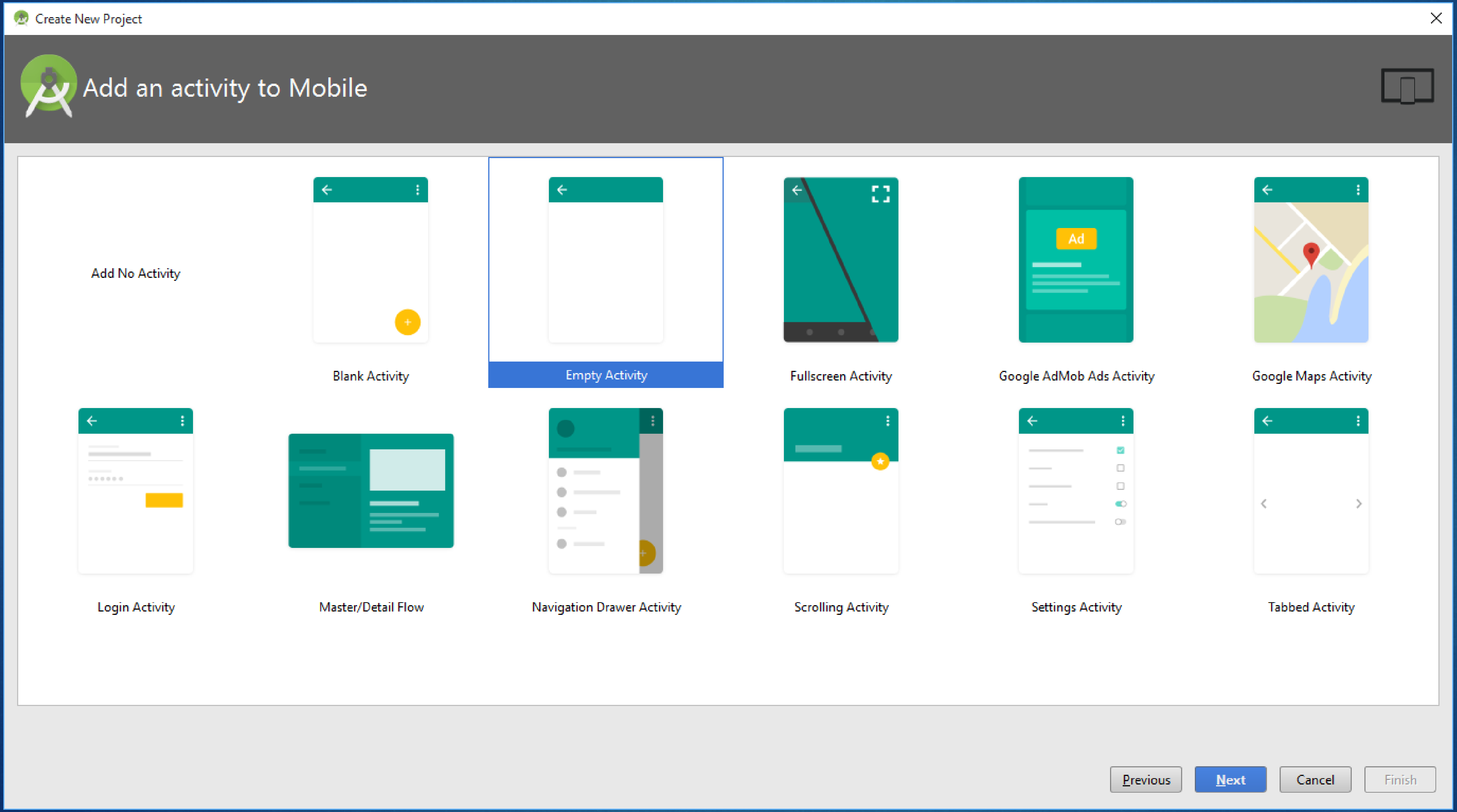
Minimum SDK: API 21: Android 5.0 (Lollipop)

☐ Android Auto

☐ Glass (Not Installed) Download

Minimum SDK:

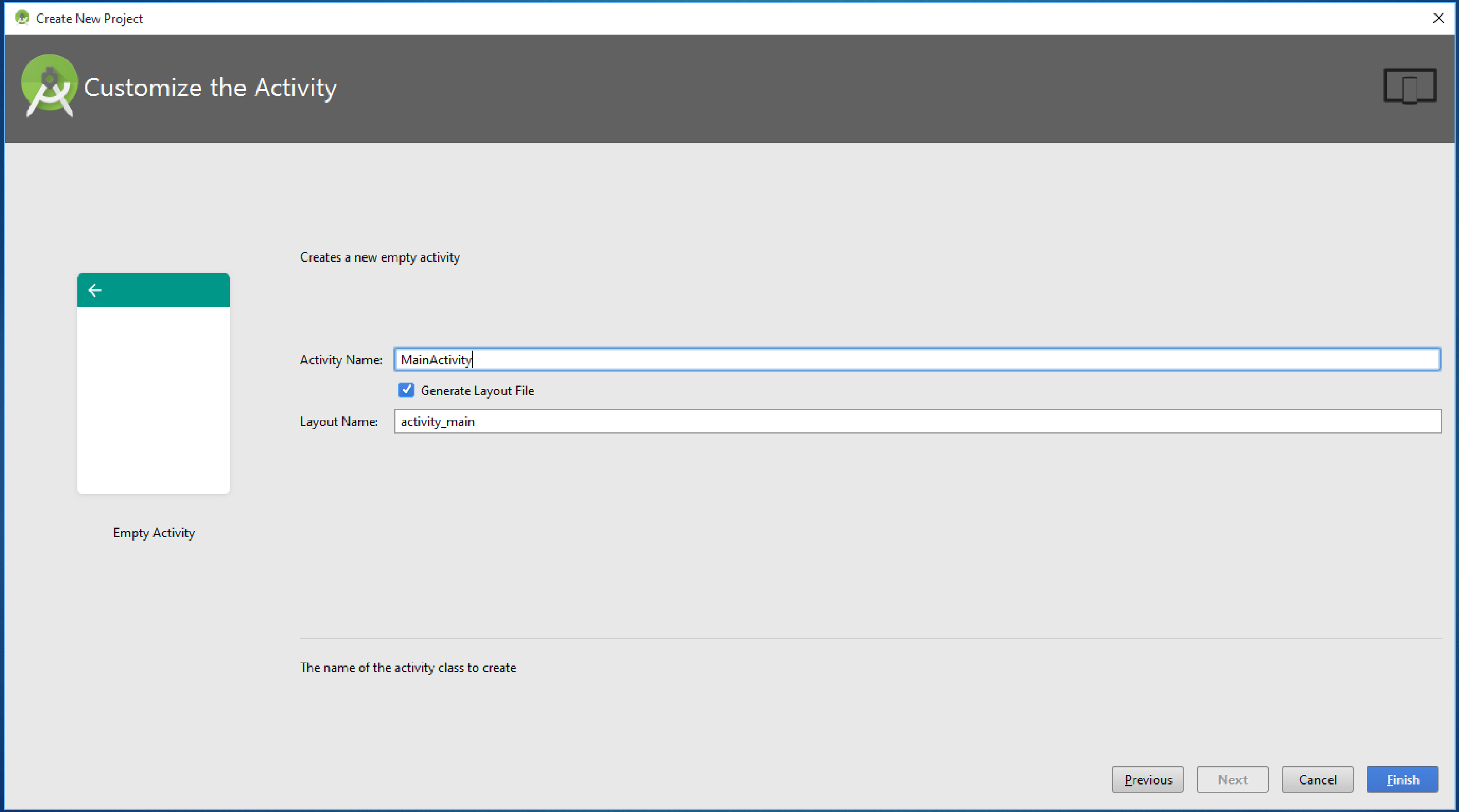
Android - HelloWorld



Create New Project

Add an activity to Mobile

Android - HelloWorld



Create New Project

Customize the Activity

Creates a new empty activity

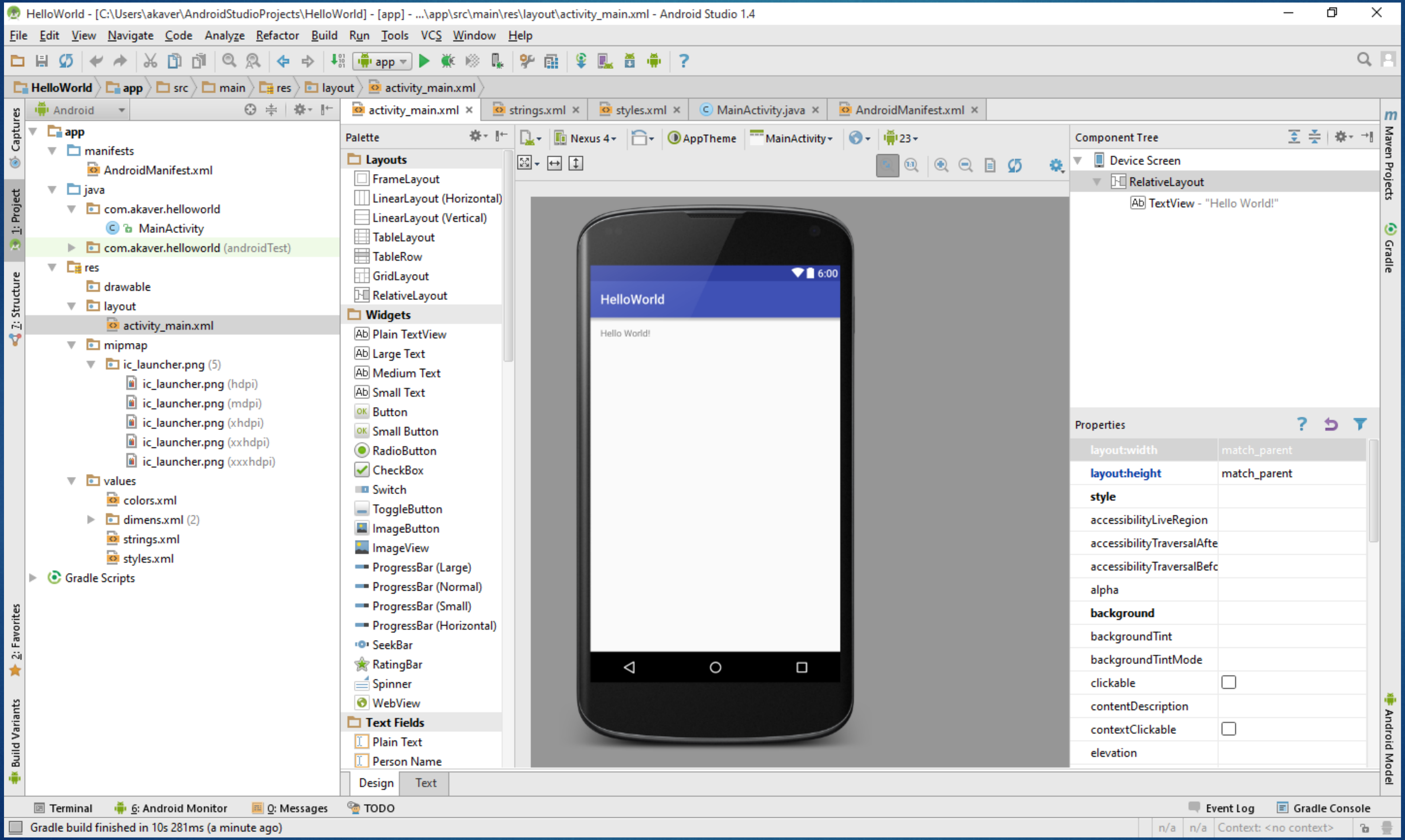
Activity Name: MainActivity

☑ Generate Layout File

Layout Name: activity_main

The name of the activity class to create

Android - HelloWorld

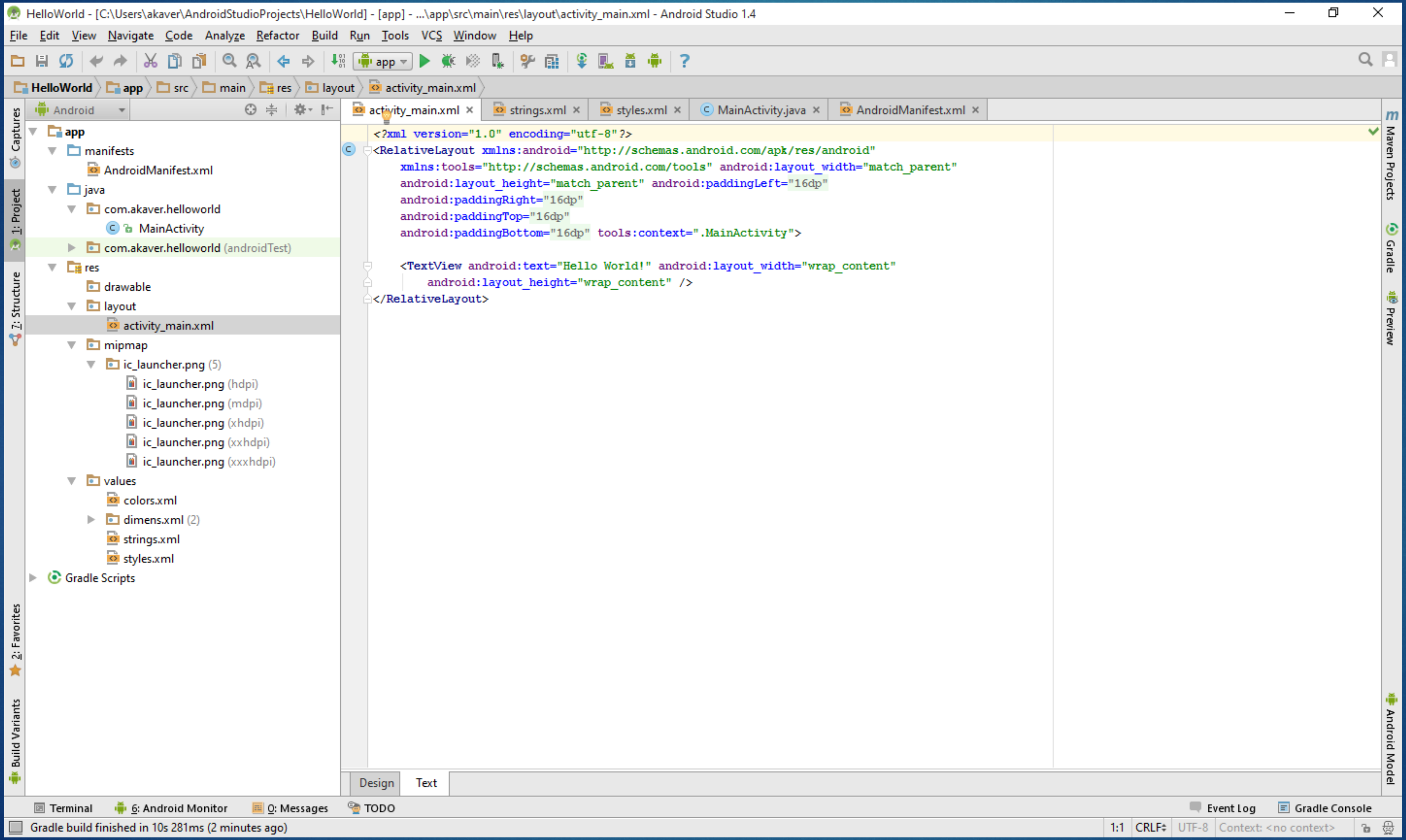


HelloWorld - [C:\Users\akaver\AndroidStudioProjects\HelloWorld] - [app] - ...\app\src\main\res\layout\activity_main.xml - Android Studio 1.4

Properties	
layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveRegion	
accessibilityTraversalAfte	
accessibilityTraversalBefc	
alpha	
background	
backgroundTint	
backgroundTintMode	
clickable	□
contentDescription	
contextClickable	□
elevation	

Gradle build finished in 10s 281ms (a minute ago)

Android - HelloWorld

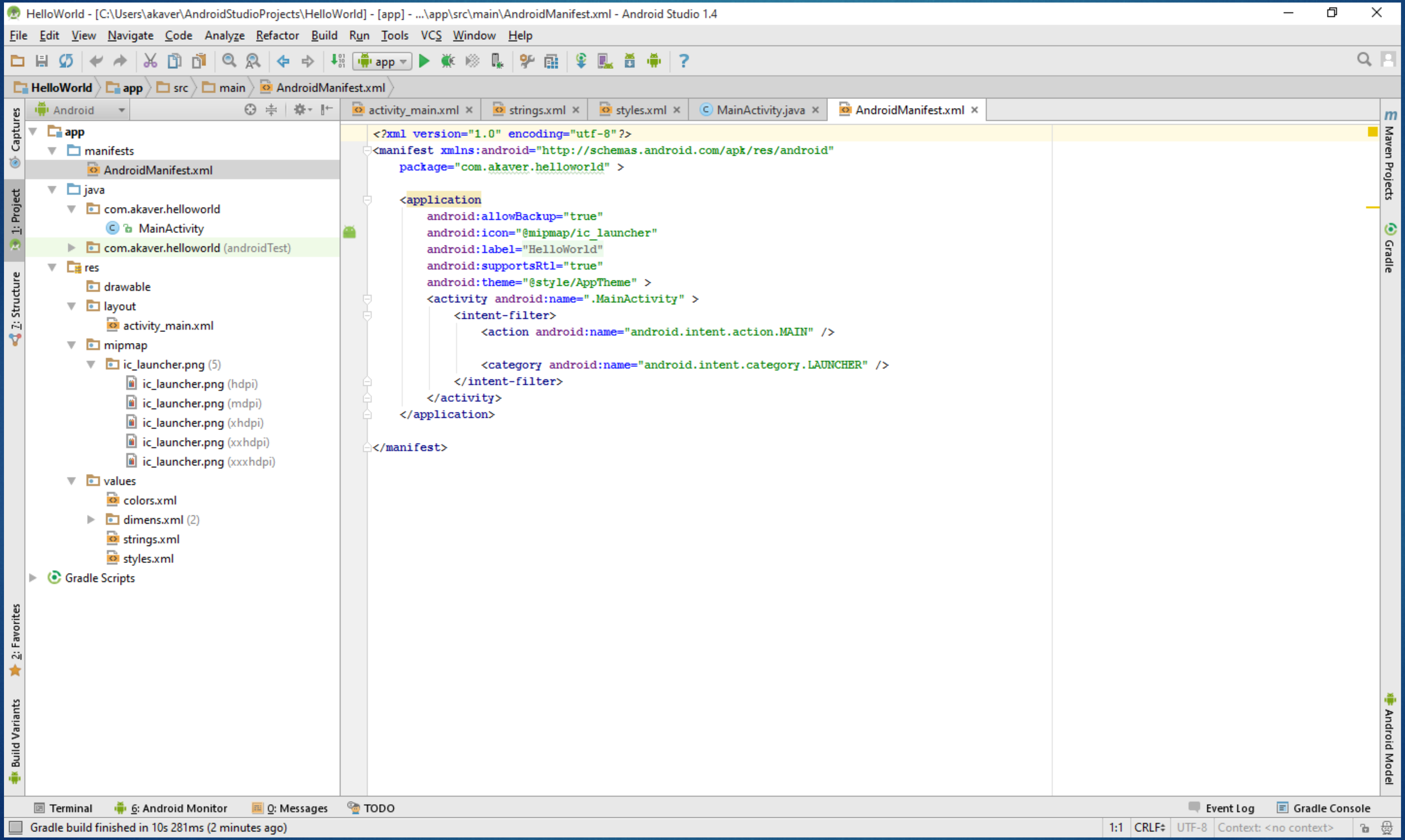


HelloWorld - [C:\Users\akaver\AndroidStudioProjects\HelloWorld] - [app] - ...\app\src\main\res\layout\activity_main.xml - Android Studio 1.4

```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools" android:layout_width="match_parent"
    android:layout_height="match_parent" android:paddingLeft="16dp"
    android:paddingRight="16dp"
    android:paddingTop="16dp"
    android:paddingBottom="16dp" tools:context=".MainActivity">

    <TextView android:text="Hello World!" android:layout_width="wrap_content"
        android:layout_height="wrap_content" />
</RelativeLayout>
```

Gradle build finished in 10s 281ms (2 minutes ago)

Android - HelloWorld

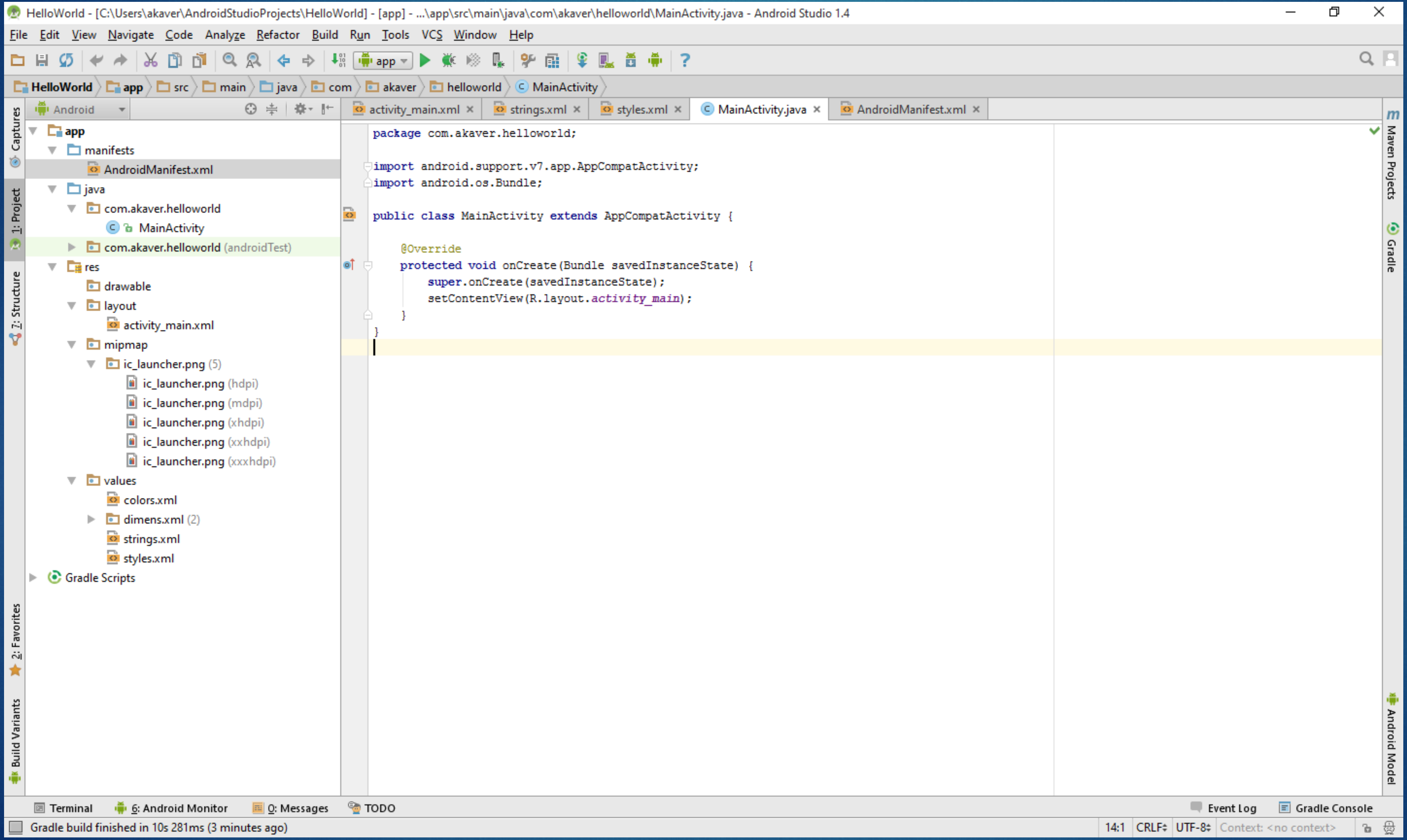


HelloWorld - [C:\Users\akaver\AndroidStudioProjects\HelloWorld] - [app] - ...\app\src\main\AndroidManifest.xml - Android Studio 1.4

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.akaver.helloworld" >

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="HelloWorld"
        android:supportsRtl="true"
        android:theme="@style/AppTheme" >
        <activity android:name=".MainActivity" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />

                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>

</manifest>
```

Gradle build finished in 10s 281ms (2 minutes ago)

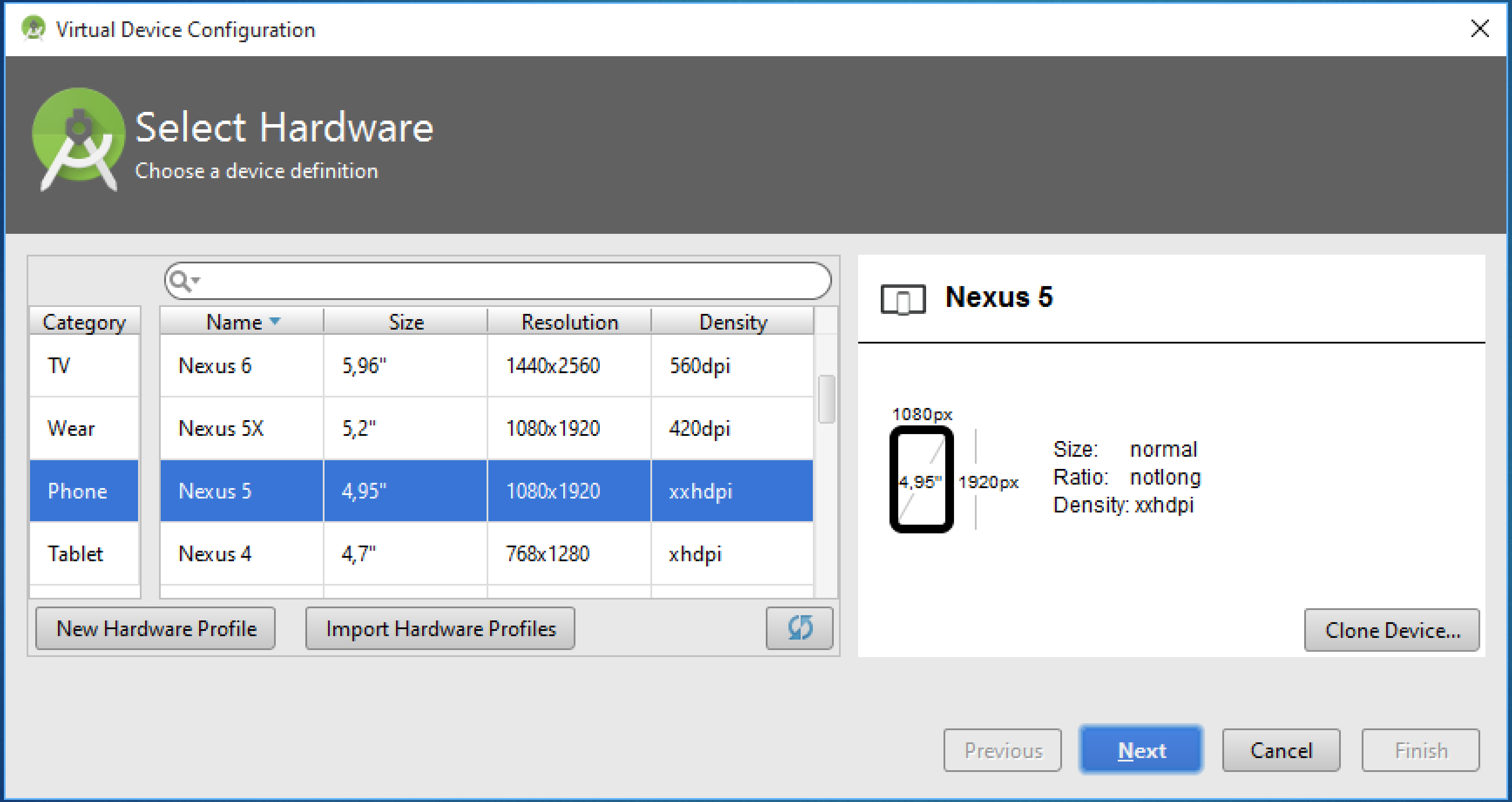
Android - HelloWorld



```java
package com.akaver.helloworld;

import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;

public class MainActivity extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }
}
```

Gradle build finished in 10s 281ms (3 minutes ago)

Android - HelloWorld



Virtual Device Configuration

Select Hardware

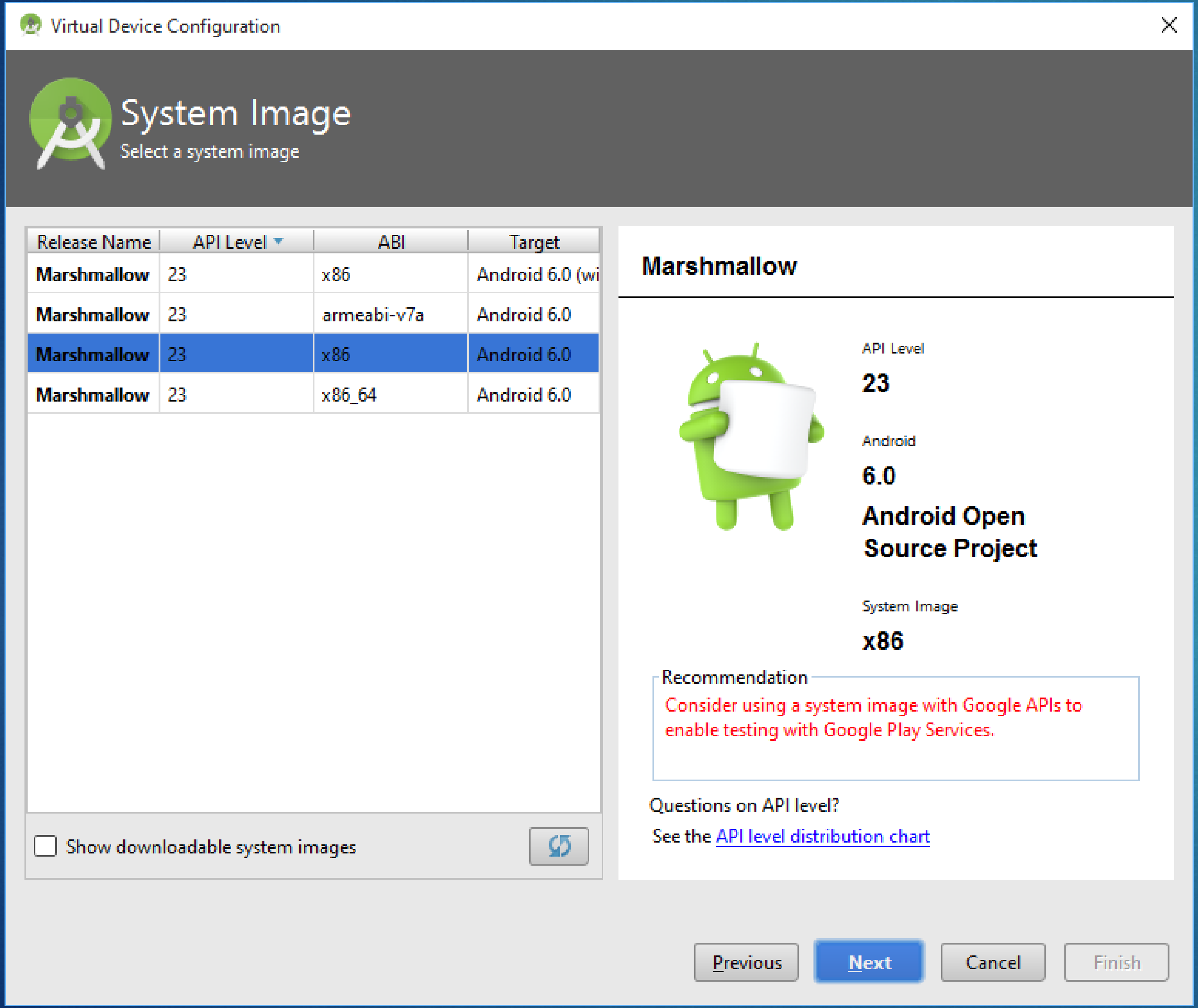
Choose a device definition

Category	Name	Size	Resolution	Density
TV	Nexus 6	5,96"	1440x2560	560dpi
Wear	Nexus 5X	5,2"	1080x1920	420dpi
Phone	Nexus 5	4,95"	1080x1920	xxhdpi
Tablet	Nexus 4	4,7"	768x1280	xhdpi

Nexus 5

Size: normal
Ratio: notlong
Density: xxhdpi

Android - HelloWorld



Virtual Device Configuration

System Image

Select a system image

Release Name	API Level	ABI	Target
Marshmallow	23	x86	Android 6.0 (wi
Marshmallow	23	armeabi-v7a	Android 6.0
Marshmallow	23	x86	Android 6.0
Marshmallow	23	x86_64	Android 6.0

□ Show downloadable system images

Marshmallow

API Level

23

Android

6.0

Android Open Source Project

System Image

x86

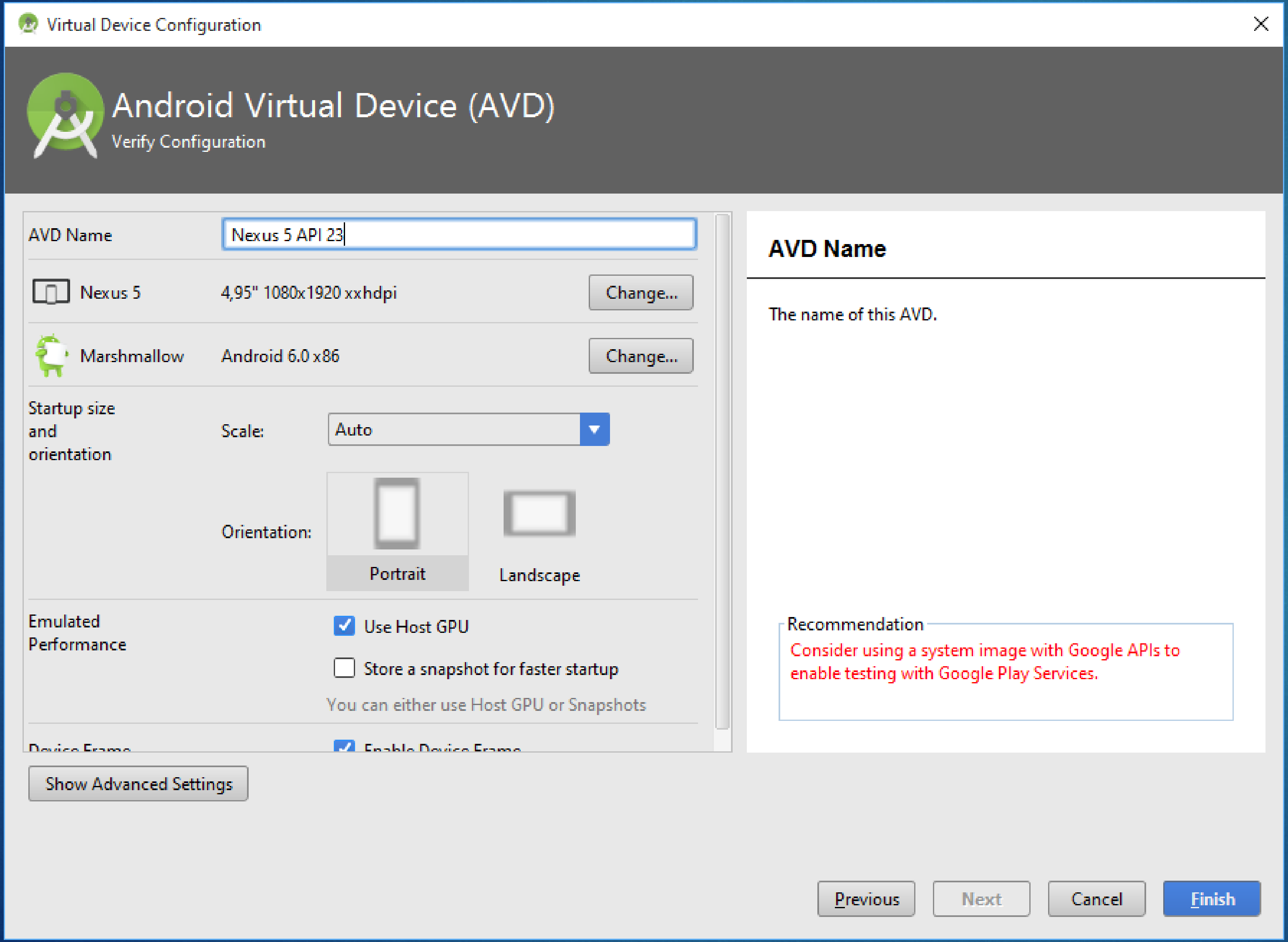
Recommendation

Consider using a system image with Google APIs to enable testing with Google Play Services.

Questions on API level?

See the API level distribution chart

Android - HelloWorld



Virtual Device Configuration

Android Virtual Device (AVD)

Verify Configuration

AVD Name: Nexus 5 API 23

Nexus 5 — 4,95" 1080x1920 xxhdpi — Change...

Marshmallow — Android 6.0 x86 — Change...

Startup size and orientation — Scale: Auto

Orientation: Portrait Landscape

Emulated Performance — ☑ Use Host GPU

□ Store a snapshot for faster startup

You can either use Host GPU or Snapshots

Device Frame — ☑ Enable Device Frame

Show Advanced Settings

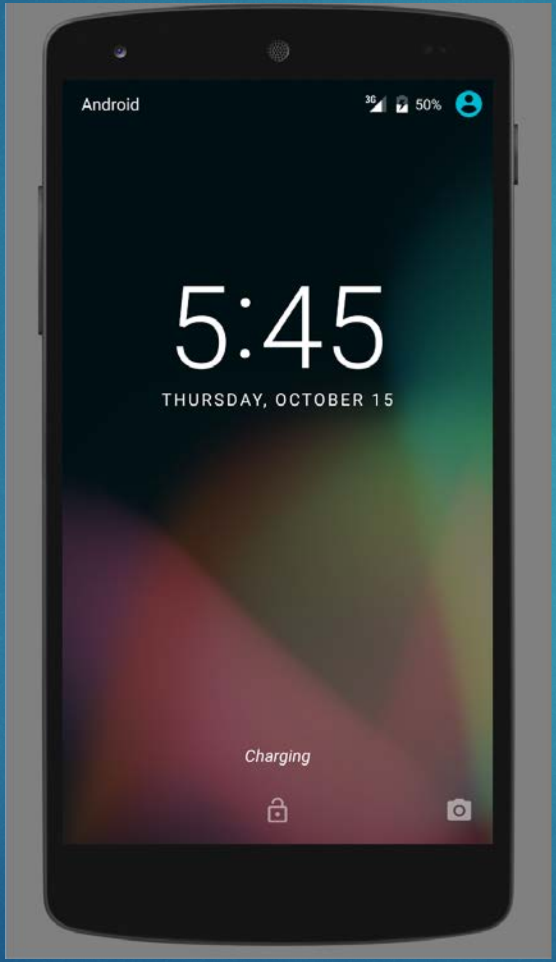
AVD Name

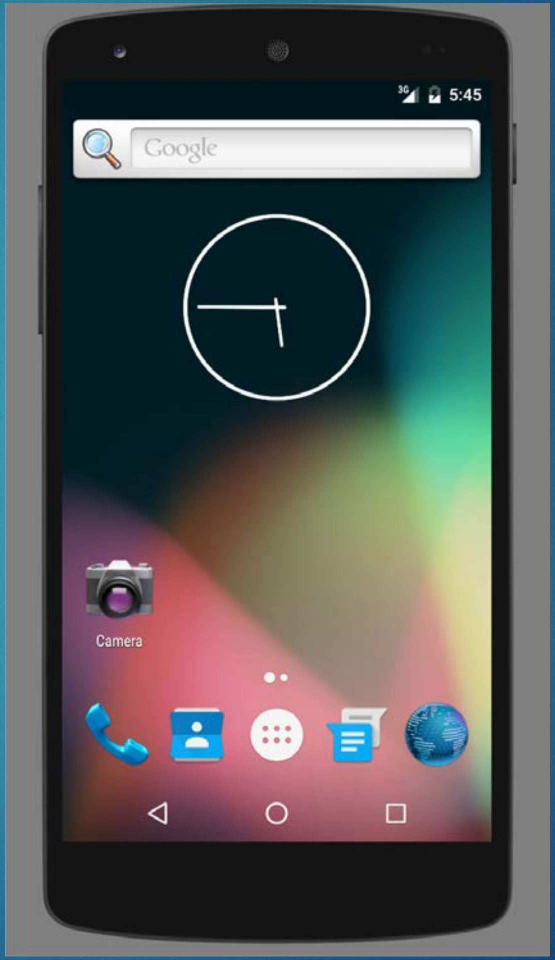
The name of this AVD.

Recommendation

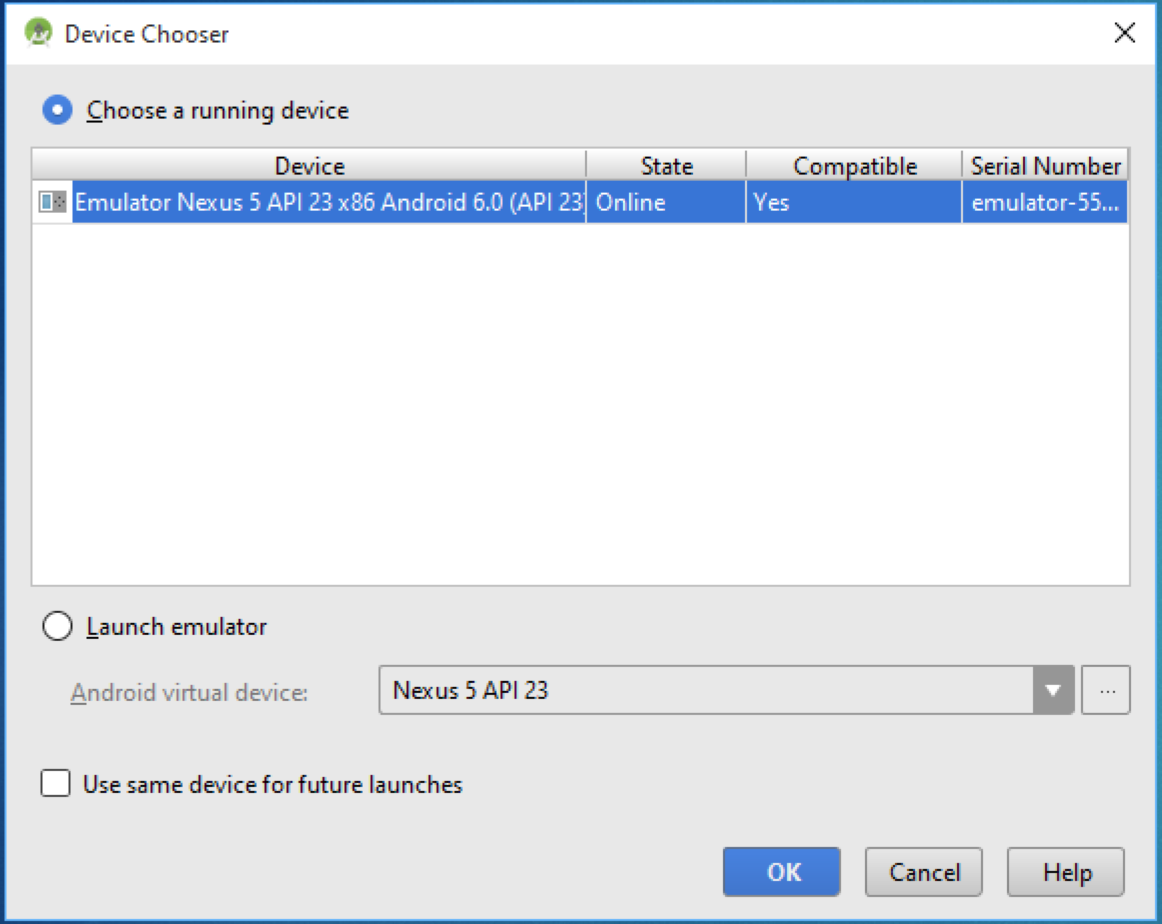
Consider using a system image with Google APIs to enable testing with Google Play Services.

Android - HelloWorld





Android - HelloWorld



Device Chooser

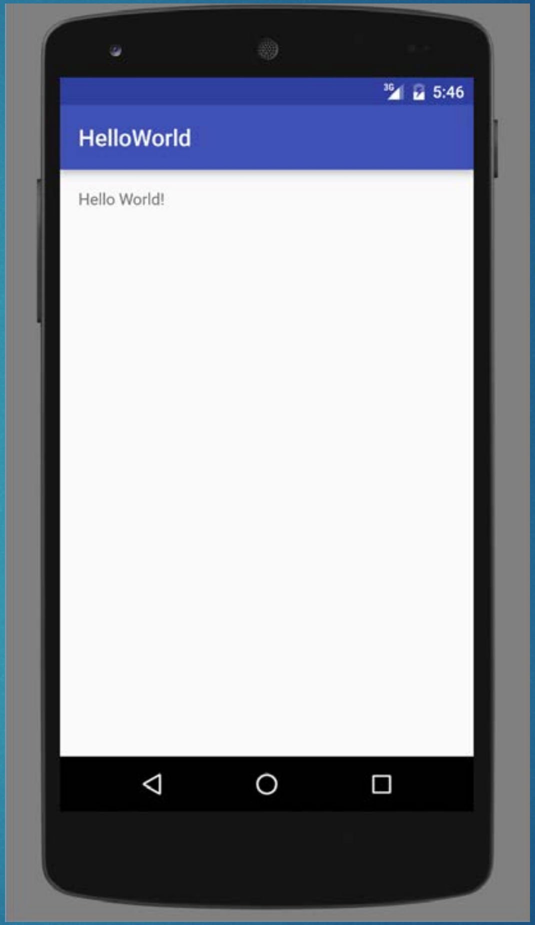
● Choose a running device

Device	State	Compatible	Serial Number
Emulator Nexus 5 API 23 x86 Android 6.0 (API 23)	Online	Yes	emulator-55...

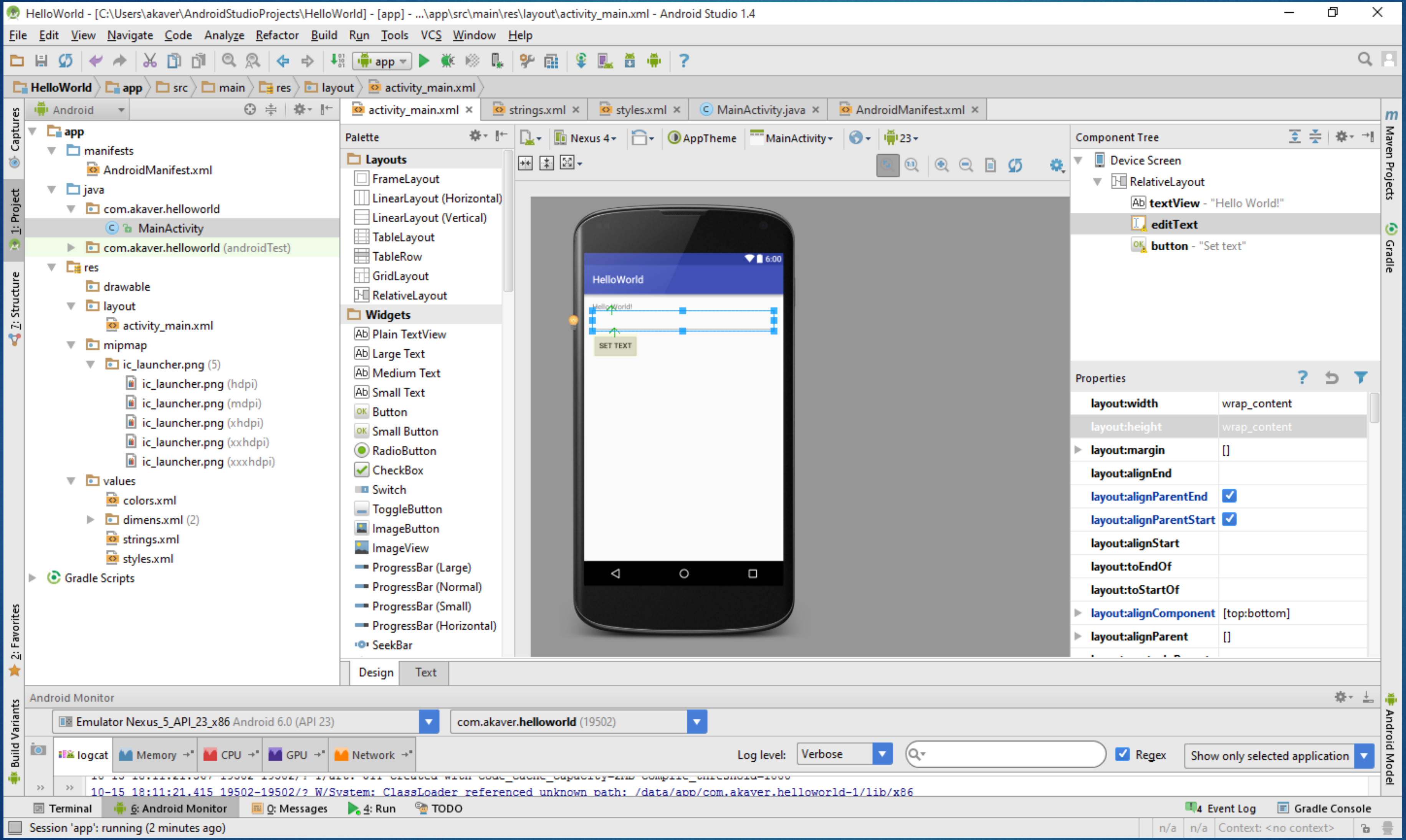
○ Launch emulator

Android virtual device: Nexus 5 API 23

□ Use same device for future launches



Android – HelloWorld – add TextBox



HelloWorld - [C:\Users\akaver\AndroidStudioProjects\HelloWorld] - [app] - ...\app\src\main\res\layout\activity_main.xml - Android Studio 1.4

Component Tree

- Device Screen
  - RelativeLayout
    - textView - "Hello World!"
    - editText
    - button - "Set text"

Properties

layout:width	wrap_content
layout:height	wrap_content
layout:margin	[]
layout:alignEnd	
layout:alignParentEnd	☑
layout:alignParentStart	☑
layout:alignStart	
layout:toEndOf	
layout:toStartOf	
layout:alignComponent	[top:bottom]
layout:alignParent	[]

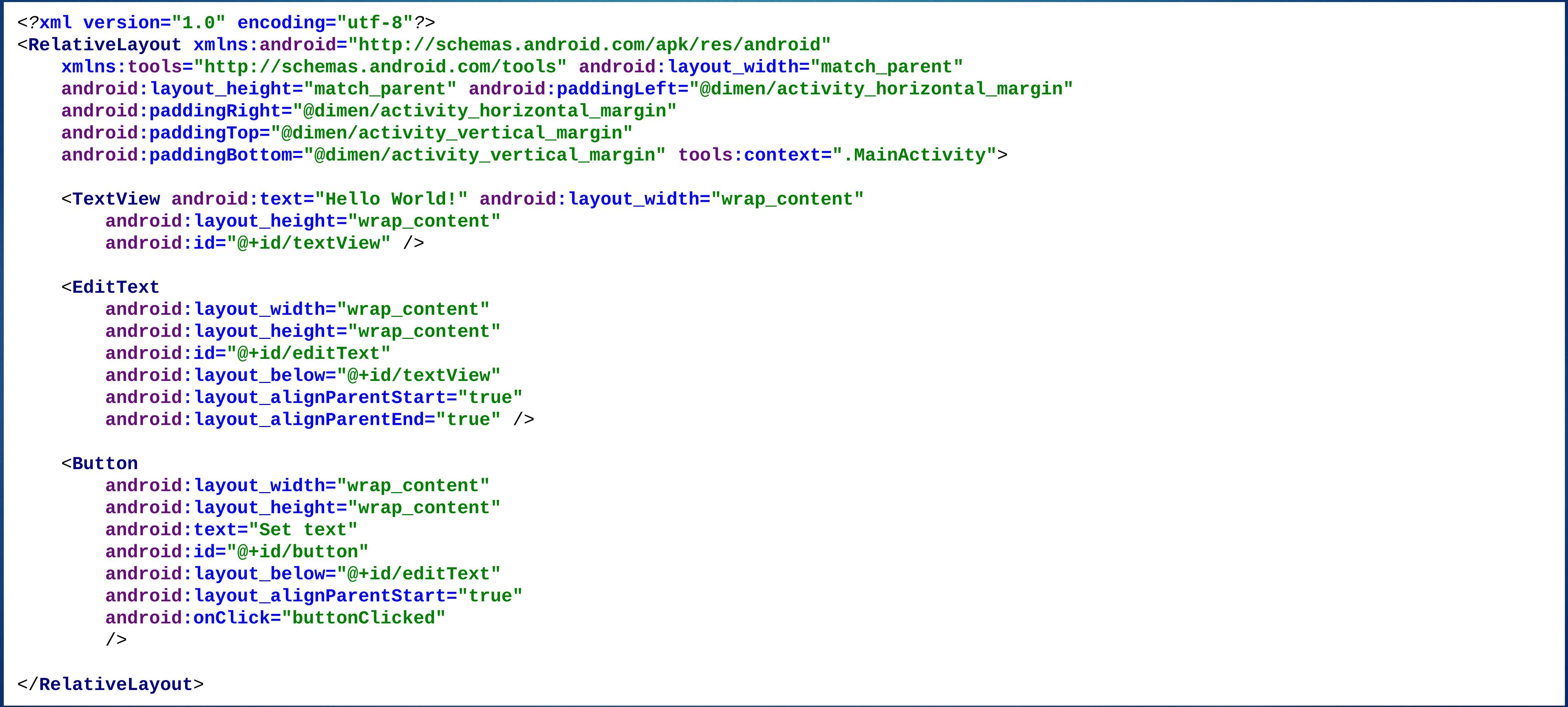
Android Monitor: Emulator Nexus_5_API_23_x86 Android 6.0 (API 23) — com.akaver.helloworld (19502)

Log level: Verbose — ☑ Regex — Show only selected application

```
10-15 18:11:21.415 19502-19502/? W/System: ClassLoader referenced unknown path: /data/app/com.akaver.helloworld-1/lib/x86
```

Session 'app': running (2 minutes ago)

Android – HelloWorld – activity_main.xml



```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools" android:layout_width="match_parent"
    android:layout_height="match_parent" android:paddingLeft="@dimen/activity_horizontal_margin"
    android:paddingRight="@dimen/activity_horizontal_margin"
    android:paddingTop="@dimen/activity_vertical_margin"
    android:paddingBottom="@dimen/activity_vertical_margin" tools:context=".MainActivity">

    <TextView android:text="Hello World!" android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:id="@+id/textView" />

    <EditText
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:id="@+id/editText"
        android:layout_below="@+id/textView"
        android:layout_alignParentStart="true"
        android:layout_alignParentEnd="true" />

    <Button
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Set text"
        android:id="@+id/button"
        android:layout_below="@+id/editText"
        android:layout_alignParentStart="true"
        android:onClick="buttonClicked"
        />

</RelativeLayout>
```

Android – HelloWorld – MainActivity.java

```java
package com.akaver.helloworld;

import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;
import android.view.View;
import android.view.inputmethod.InputMethodManager;
import android.widget.EditText;
import android.widget.TextView;

public class MainActivity extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }

    public void buttonClicked(View view) {
        TextView textView = (TextView) findViewById(R.id.textView);
        EditText editText = (EditText) findViewById(R.id.editText);
        textView.setText("Hello "+editText.getText()+"!");
        editText.setText("");

        InputMethodManager imm = (InputMethodManager) getSystemService(INPUT_METHOD_SERVICE);
        imm.hideSoftInputFromWindow(getCurrentFocus().getWindowToken(), 0);
    }
}
```