CS 528 Mobile and Ubiquitous Computing
Lecture 2: Android Introduction and Setup

Emmanuel Agu

What is Android?

- Android is world’s leading mobile operating system

- **Google:**
  - Owns Android, maintains it, extends it
  - Distributes Android OS, developer tools, free to use
  - Runs Android app market

Android is Multi-Platform

In-car console

Smartwatch

Android runs on all these devices

Tablet

Smartphone

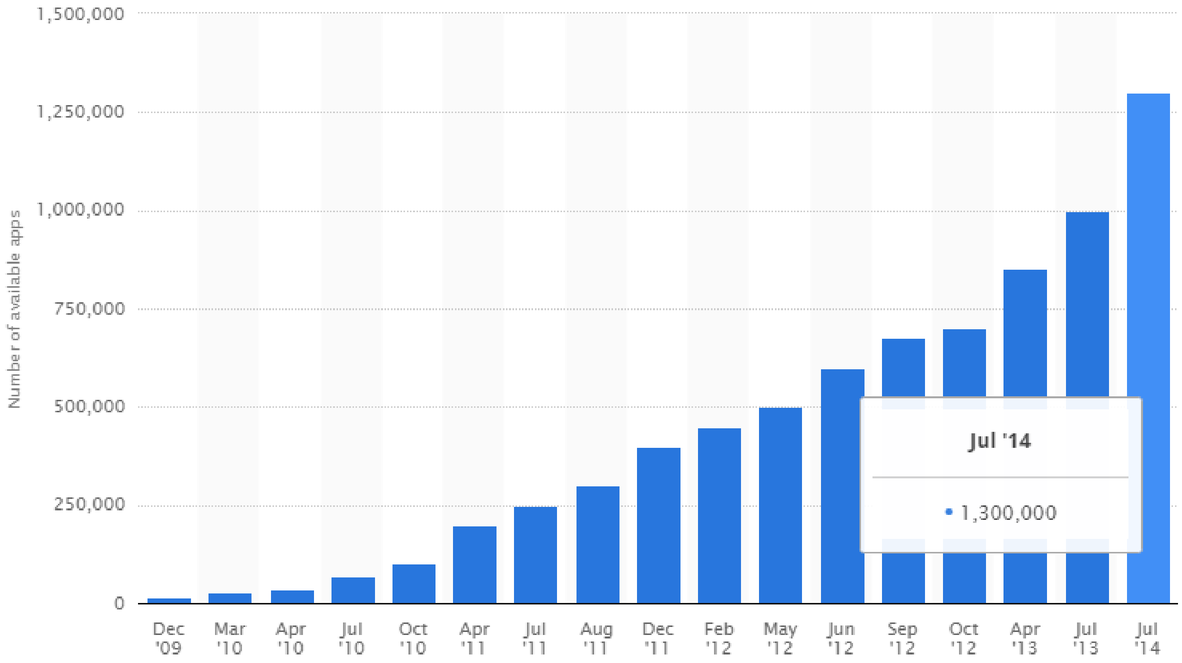
Television

This Class: Focuses Mostly on Smartphones!

Android Growth

- June 2014, 1 billion active Android users
- 1.25 million apps on the Android app market
  - Games, organizers, banking, entertainment, etc

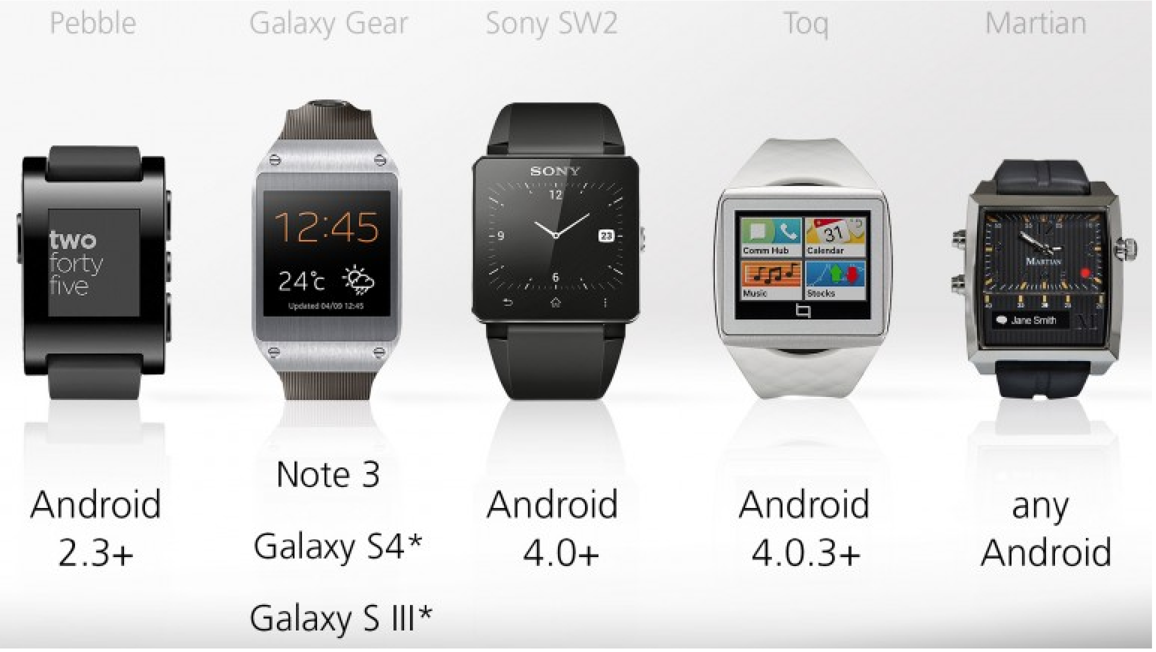
Number of available applications in the Google Play Store from December 2009 to July 2014



Other Types of Android Hardware (Apart from Smartphones)

Android Wearables: Smartwatches

- Minimal UI, at-a-glance
- Mostly notifications, Not full functionality
  - Voice Commands, phone calls
  - Directions, texts, run apps
  - Heart Rate monitor
  - Count Steps
  - Wireless charging



Android Wearables: Google Glass

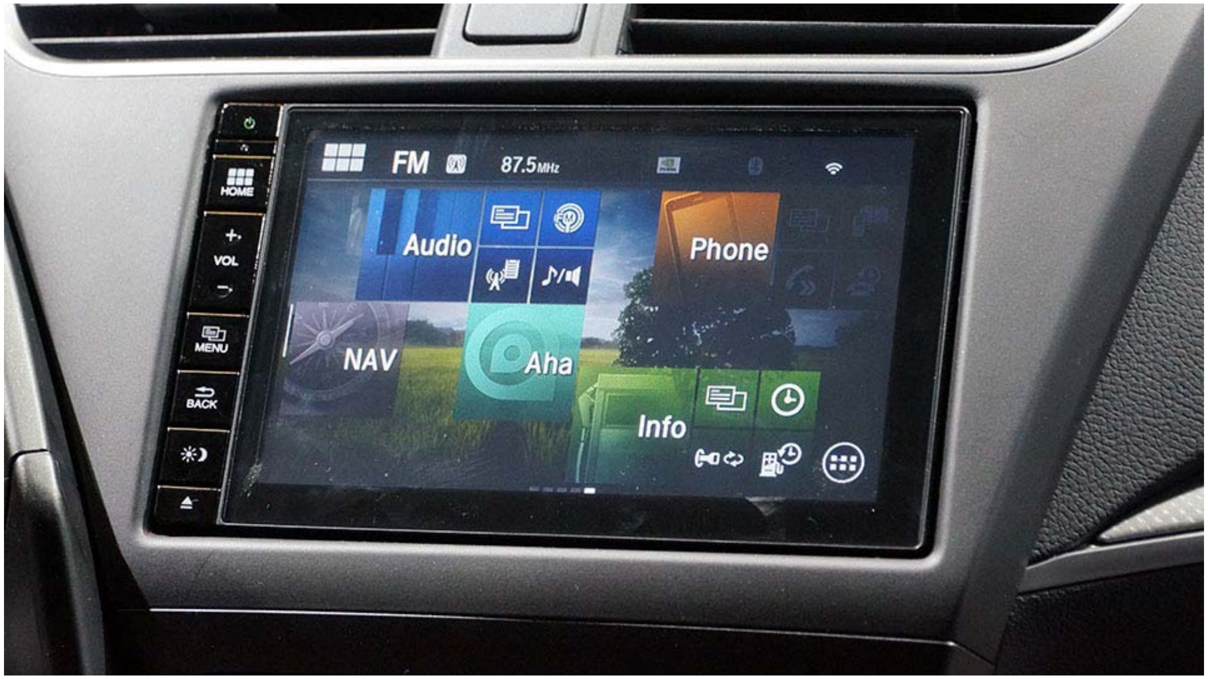
- Head-mounted display, displays information, touch-free
- Example application: Records babies life steps
- Features:
  - Touchpad (on side), camera for photoes video, display, voice commands
- Google recently announced discontinuing Google Glass

Android Hardware: TV programming

- Smart, interactive TV platform (Android 5.0) featuring:
  - Viewing recommendations based on watching habits
  - Media apps downloadable from Google Play. E.g. Netflix streaming app
  - Games
  - Voice Search to answer questions. E.g. which movies were nominated for academy awards

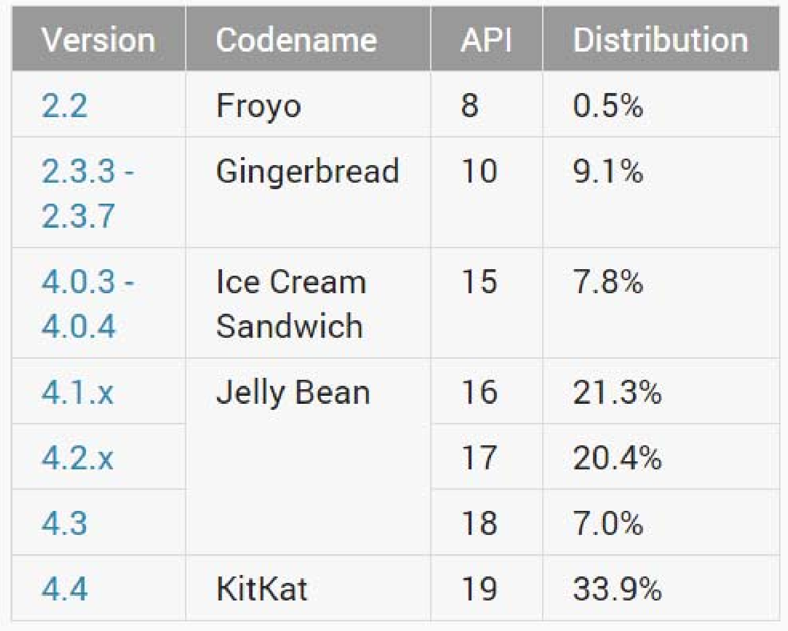
Android Hardware: in-Car Entertainment and Navigation System

- Example: Honda Connect system
- Integrated audio, phone, navigation, information system
- Runs Android 4.0.4
- Android Auto announced by automotive alliance in Jan 2014

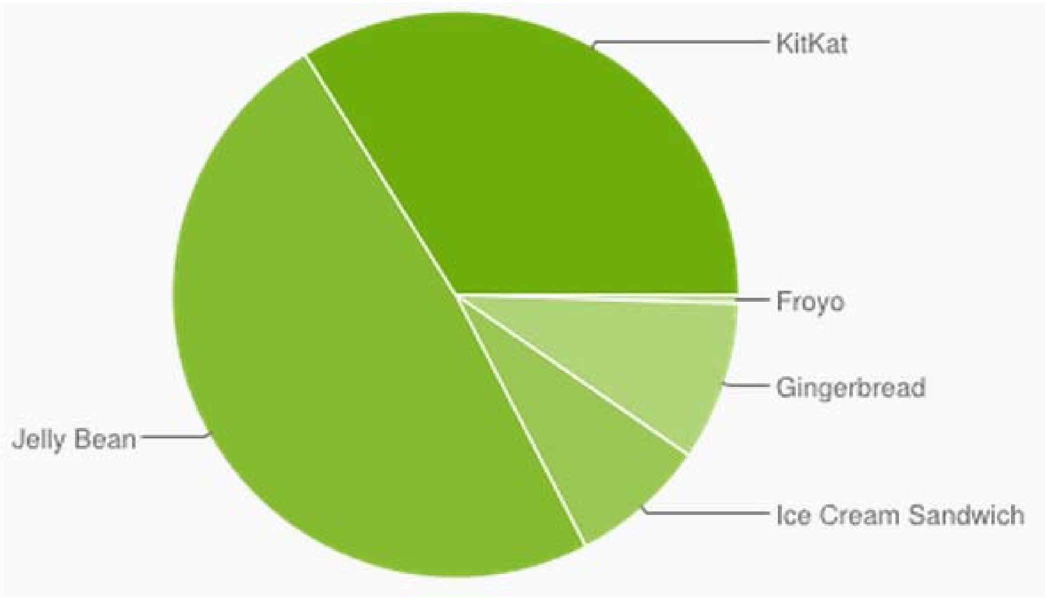


Android Versions

- Most recent Android version is Android L (5.0) or “Lollipop”
- Distribution as at Dec 1, 2014

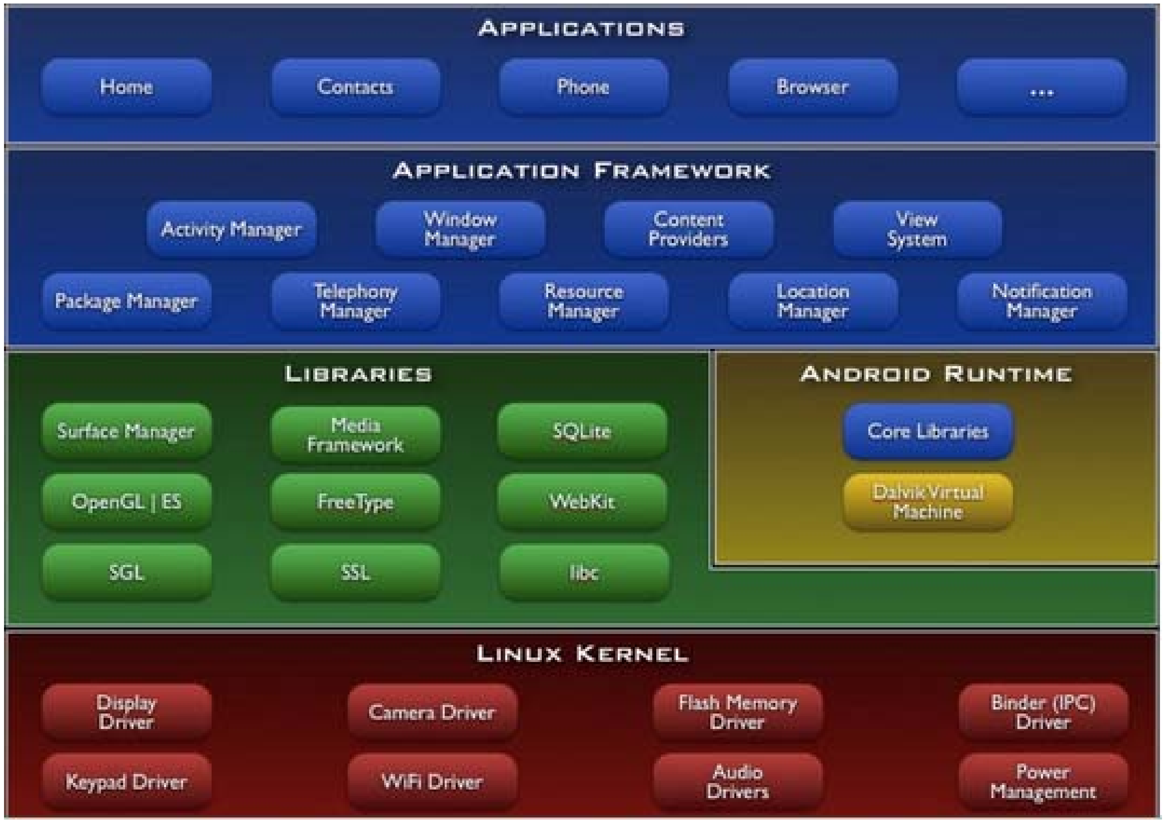


Version	Codename	API	Distribution
2.2	Froyo	8	0.5%
2.3.3 - 2.3.7	Gingerbread	10	9.1%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	7.8%
4.1.x	Jelly Bean	16	21.3%
4.2.x		17	20.4%
4.3		18	7.0%
4.4	KitKat	19	33.9%

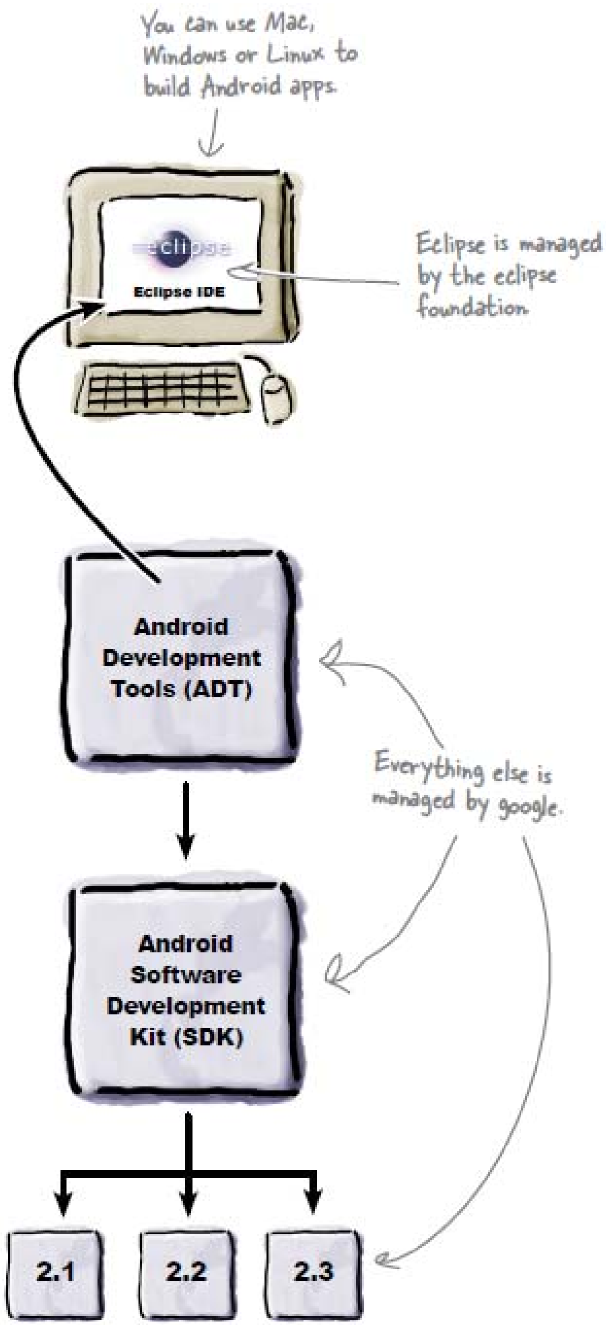


Android Software Framework

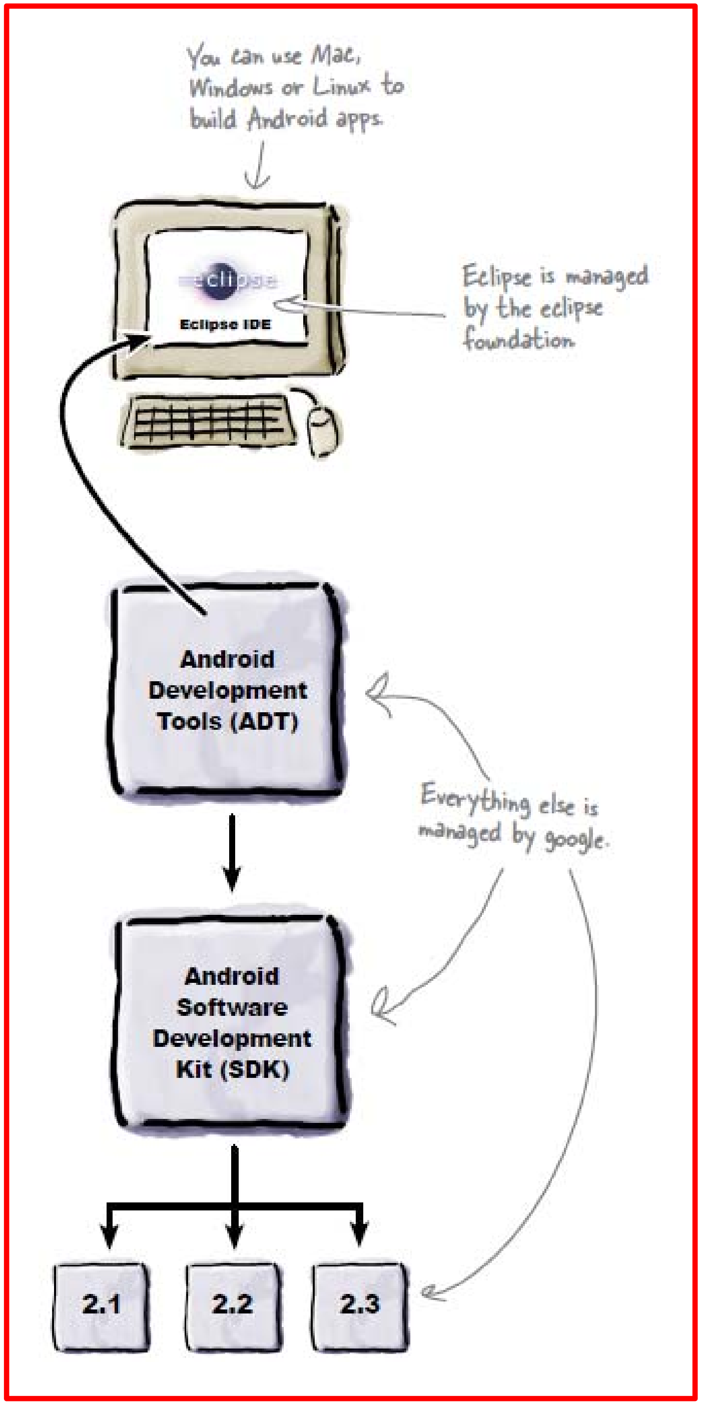
- Android OS has Linux kernel, drivers
- Android Applications: Programmed in Java
- Android Libraries: OpenGL ES (graphics), SQLite (database), etc



Old Developer Android Environment


You can use Mac, Windows or Linux to build Android apps.
eclipse
Eclipse IDE
Eclipse is managed by the eclipse foundation
Android Development Tools (ADT)
Everything else is managed by google.
Android Software Development Kit (SDK)
2.1
2.2
2.3

- **Eclipse IDE:** type code in, compile, not Android-specific
- **Android Dev Tools (ADT):** Eclipse plugin, adds Android functionality
- **Android Software Dev Kit (SDK):** Tools to build, test and run apps
- **Packages:** Enables developing for various Android versions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2.1
2.2
2.3

New Developer Android Environment

- Google developed it's own IDE called **Android Studio**
- Combines tools in old development environment into 1
- Cleaner interface specifically for Android Development (e.g. drag and drop app design)
- In December 2014, Google announced it will stop supporting Eclipse IDE

Android Studio

Installing Android Studio

- **Step 1:** Install Java (at least version 1.7)
  - **Note:** You may already have Java installed. Check first

- **Step 2:** Set JAVA_HOME system variable
  - This variable tells applications that need Java where it is installed

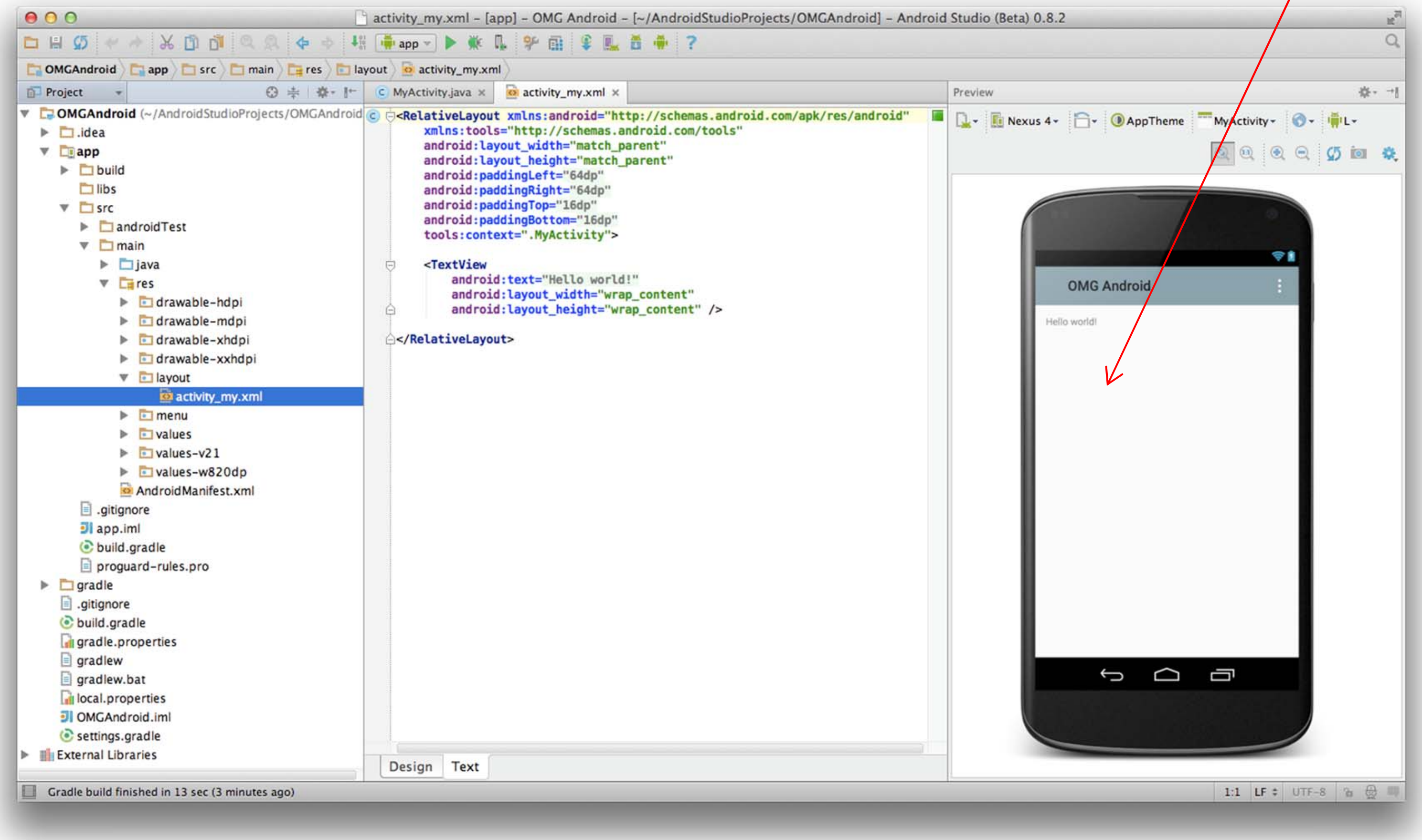
- **Step 3:** Install Android Studio (version 1.1 is the latest)

- Bucky Roberts (thenewboston): nice youtube Android tutorials
  - **Tutorial 1:** Install Java [Watch it]
  - **Tutorial 2:** Install Android Studio [Watch it]

Where to Run Android App

- Android app can run on:
  - Real phone (or device)
  - Emulator (software version of phone)

Emulated phone
in Android Studio


activity_my.xml – [app] – OMG Android – [~/AndroidStudioProjects/OMGAndroid] – Android Studio (Beta) 0.8.2
app
OMGAndroid › app › src › main › res › layout › activity_my.xml
Project
MyActivity.java
activity_my.xml
Preview
Nexus 4
AppTheme
MyActivity
L
OMG Android
Hello world!
Design
Text
1:1
LF
UTF-8

```
OMGAndroid (~/AndroidStudioProjects/OMGAndroid)
  .idea
  app
    build
    libs
    src
      androidTest
      main
        java
        res
          drawable-hdpi
          drawable-mdpi
          drawable-xhdpi
          drawable-xxhdpi
          layout
            activity_my.xml
          menu
          values
          values-v21
          values-w820dp
        AndroidManifest.xml
    .gitignore
    app.iml
    build.gradle
    proguard-rules.pro
  gradle
  .gitignore
  build.gradle
  gradle.properties
  gradlew
  gradlew.bat
  local.properties
  OMGAndroid.iml
  settings.gradle
External Libraries
```

```xml
<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="64dp"
    android:paddingRight="64dp"
    android:paddingTop="16dp"
    android:paddingBottom="16dp"
    tools:context=".MyActivity">

    <TextView
        android:text="Hello world!"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content" />

</RelativeLayout>
```

Gradle build finished in 13 sec (3 minutes ago)

Running Android App on Real Phone

- Need USB cord to copy app over from development PC to phone

Emulator Pros and Cons

- Pros:
  - Conveniently test app on basic hardware by clicking in software
  - Easy to test app on various devices (phones, tablets, TVs, etc), various screen sizes

- Cons:
  - Some hardware missing, especially hardware for sensing environment
  - E.g. GPS, camera, video recording, etc

Emulator Limitations

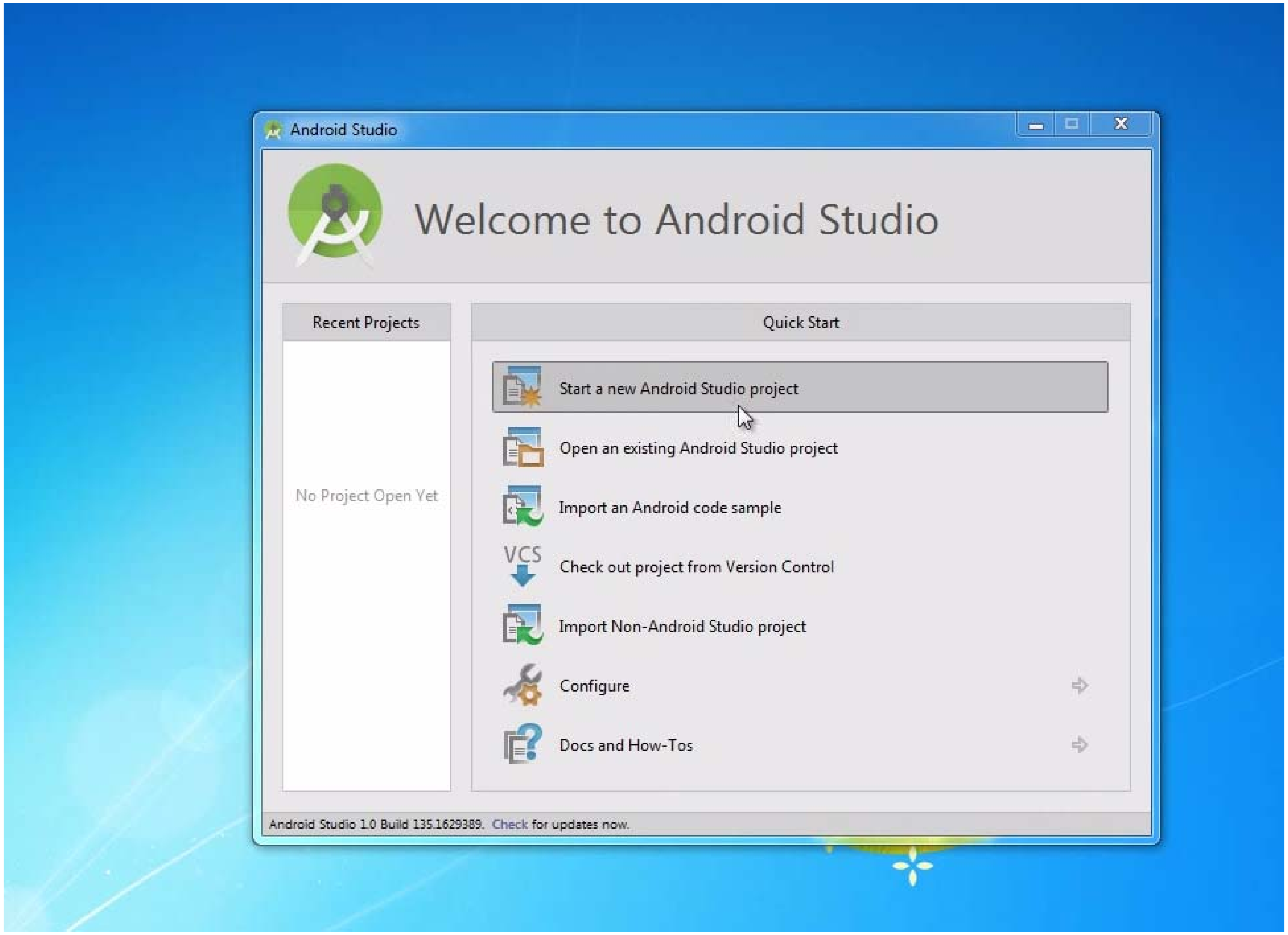
- No support for placing or receiving actual phone calls
  - Simulate phone calls (placed and received) through the emulator console
- No support for USB connections
- No support for camera/video capture (input)
- No support for device-attached headphones
- No support for determining connected state
- No support for determining battery charge level and AC charging state
- No support for determining SD card insert/eject
- No support for Bluetooth
- No support for simulating the accelerometer
  - Use OpenIntents's Sensor Simulator
- Slow!!!

Setting up your Project

- After installing Android Studio, need to set up your project
- Tutorial: Android App Development for Beginners - 3
  - – Setting up your project by Bucky Roberts (thenewboston)
    - https://www.youtube.com/watch?v=r4oIez0sfvY

- Main steps to set up Android Project
  - Start a new Android Project
  - Configure new Android Project (select app name, domain name, etc)
  - Set platform and minimum SDK
  - Add an Activity

Start a new Android Project



Android Studio

Welcome to Android Studio

Recent Projects

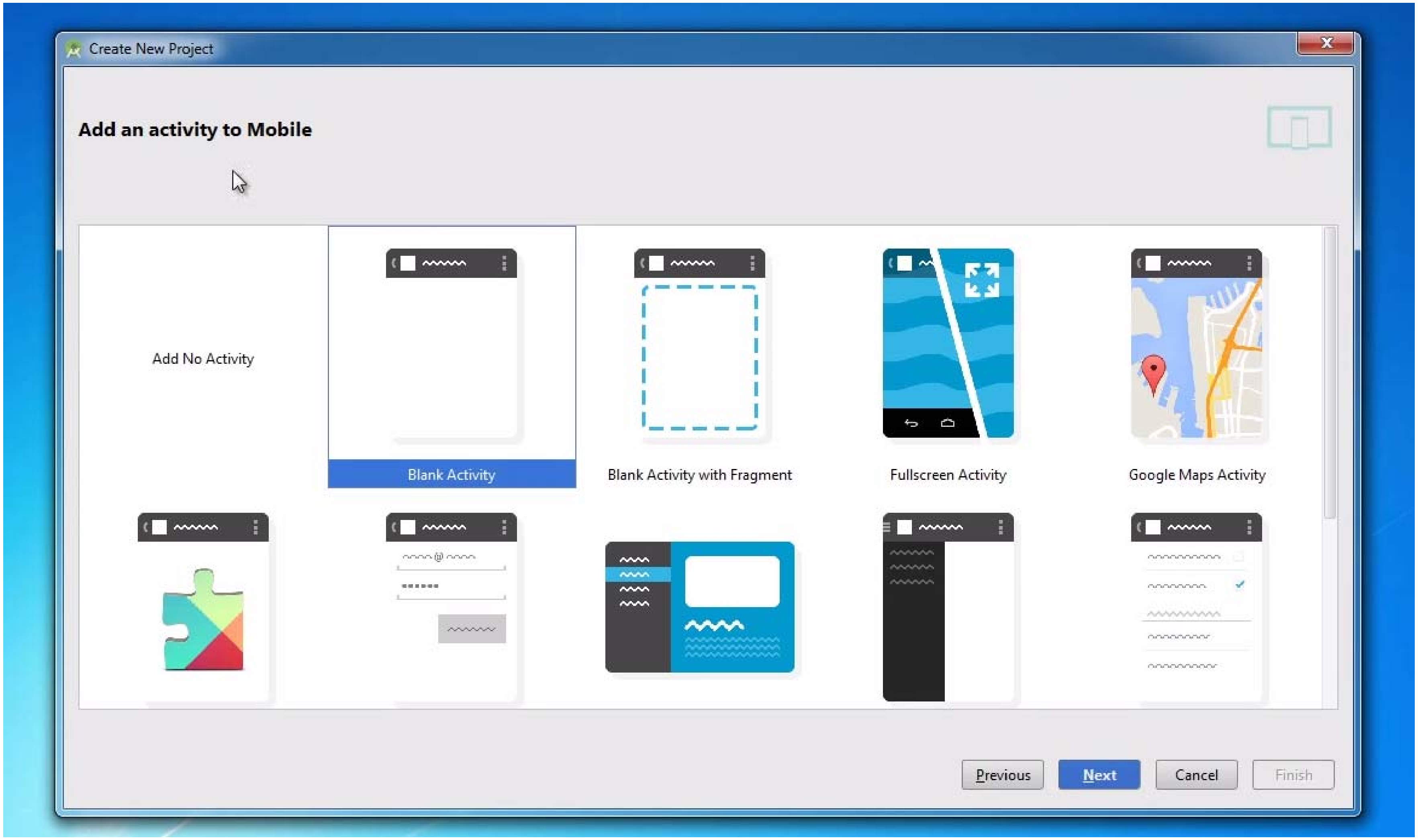
No Project Open Yet

Quick Start

- Start a new Android Studio project
- Open an existing Android Studio project
- Import an Android code sample
- Check out project from Version Control
- Import Non-Android Studio project
- Configure
- Docs and How-Tos

Android Studio 1.0 Build 135.1629389. Check for updates now.

Add an Activity (Blank Activity is Simplest)



Create New Project

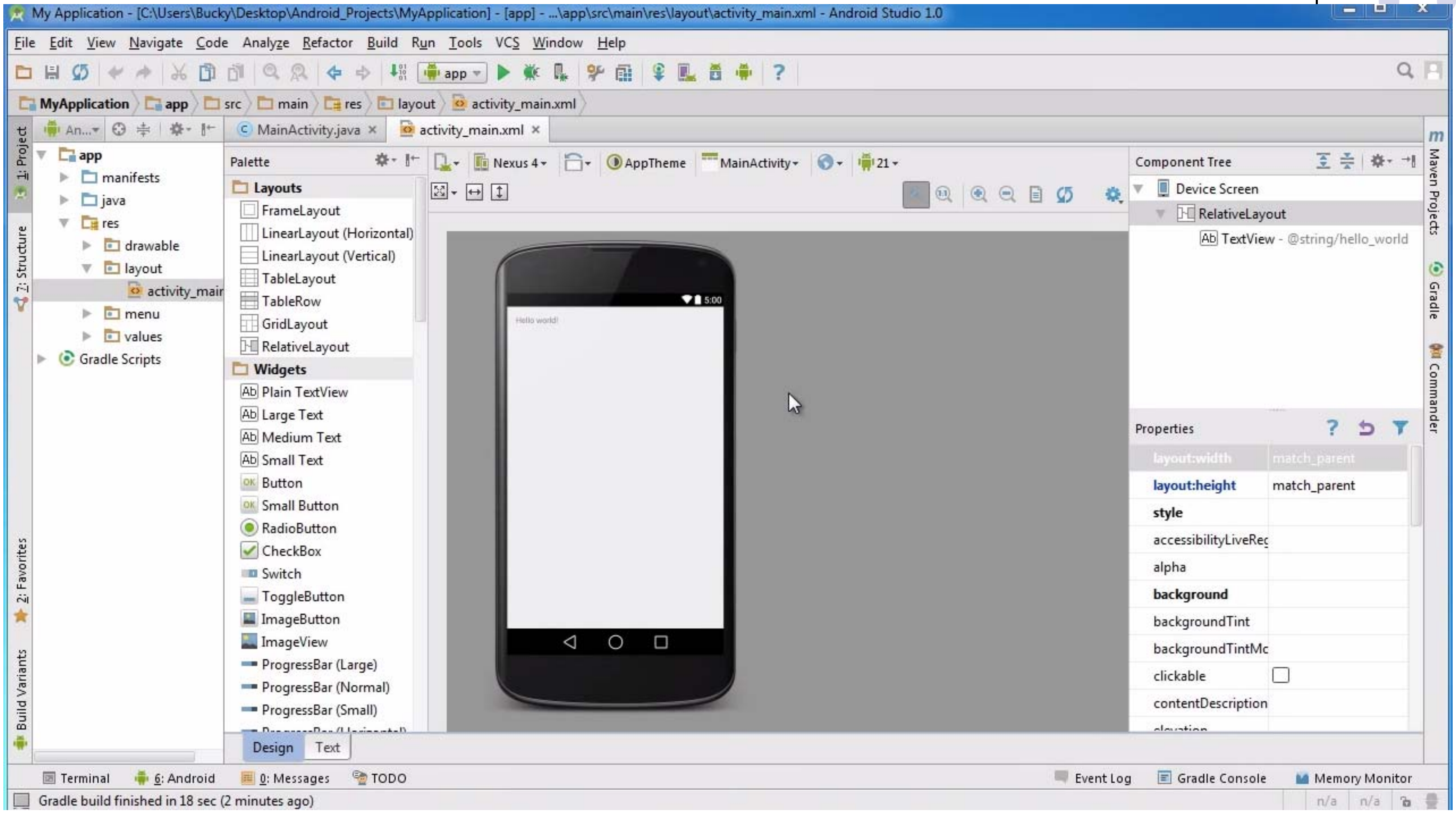
Add an activity to Mobile

Running a Simple App

- Tutorial 4: Android App Development for Beginners - 4 – Running a Simple App [10:48 mins] by Bucky Roberts
  - https://www.youtube.com/watch?v=qKRWC3Q8wRw

- Main steps
  - Run Android Studio
  - Fix any remaining issues
  - Run AVD, select virtual device
  - Run App on selected virtual device

Open Android Studio

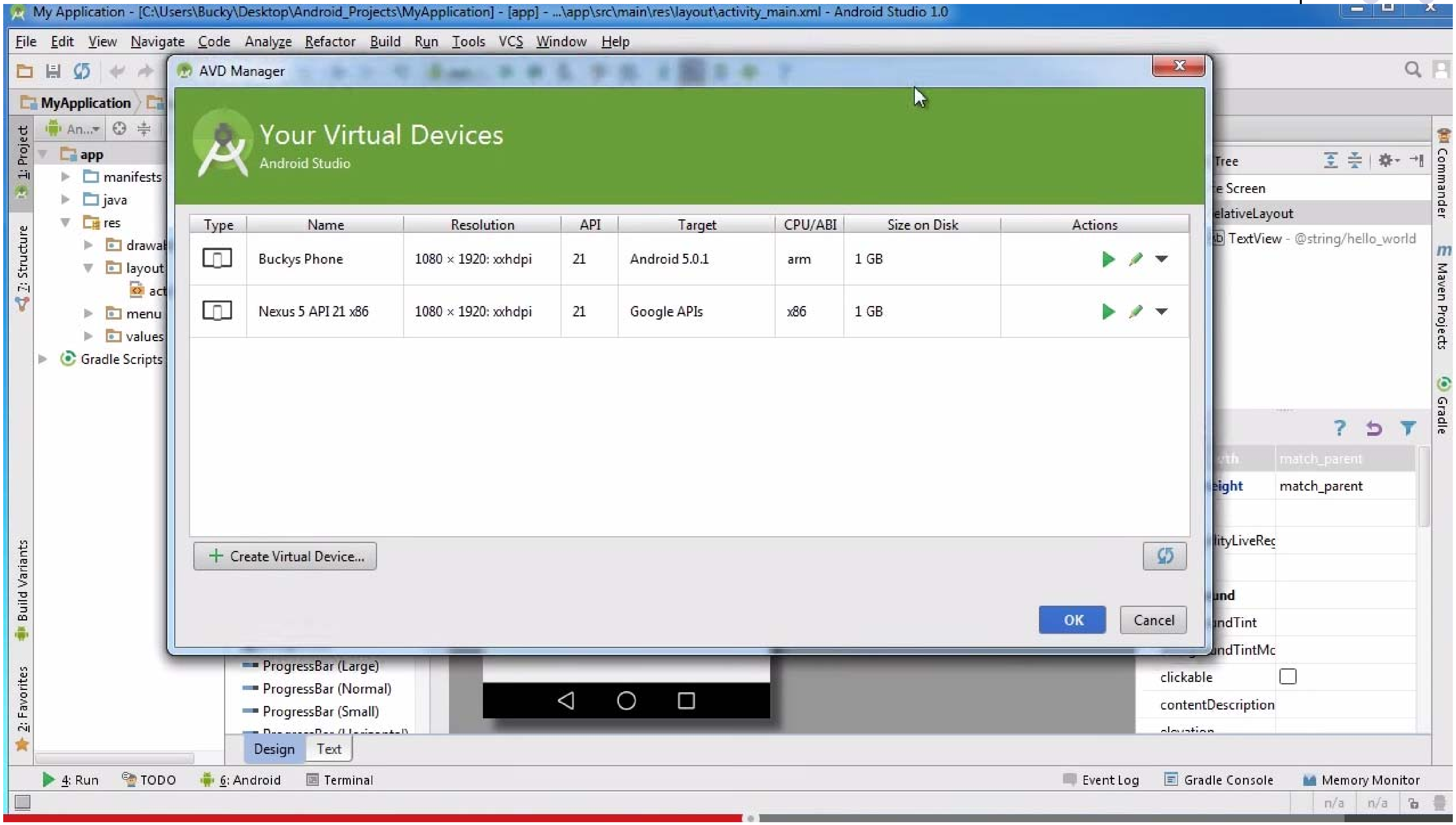


My Application - [C:\Users\Bucky\Desktop\Android_Projects\MyApplication] - [app] - ...\app\src\main\res\layout\activity_main.xml - Android Studio 1.0

Gradle build finished in 18 sec (2 minutes ago)

Property	Value
layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveReg	
alpha	
background	
backgroundTint	
backgroundTintMc	
clickable	□
contentDescription	

Run AVD Manager



My Application - [C:\Users\Bucky\Desktop\Android_Projects\MyApplication] - [app] - ...\app\src\main\res\layout\activity_main.xml - Android Studio 1.0

AVD Manager

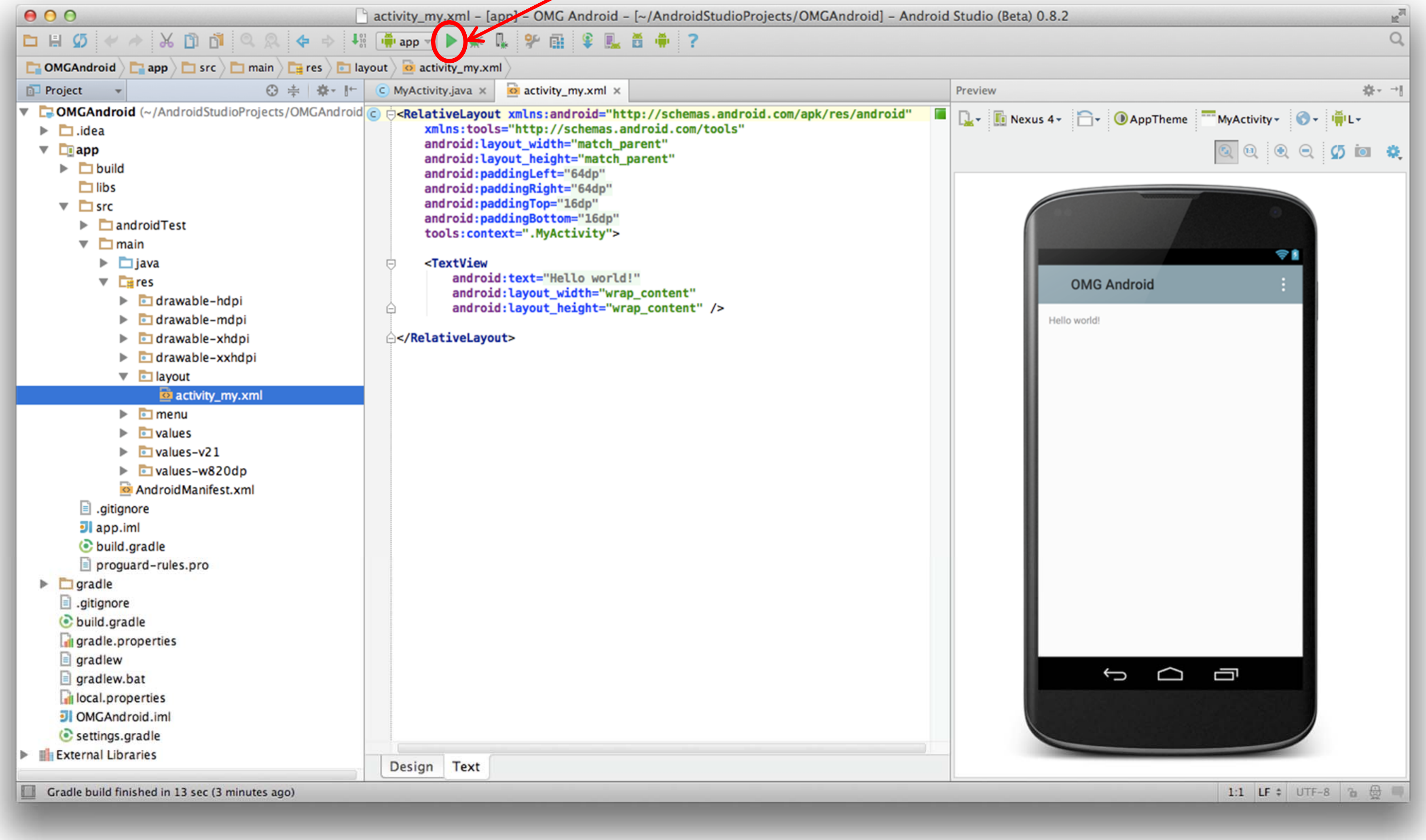
Your Virtual Devices

Android Studio

Type	Name	Resolution	API	Target	CPU/ABI	Size on Disk	Actions
	Buckys Phone	1080 × 1920: xxhdpi	21	Android 5.0.1	arm	1 GB	
	Nexus 5 API 21 x86	1080 × 1920: xxhdpi	21	Google APIs	x86	1 GB	

How to Run the App?

Click here to run the app



activity_my.xml - [app] - OMG Android - [~/AndroidStudioProjects/OMGAndroid] - Android Studio (Beta) 0.8.2

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  app
    build
    libs
    src
      androidTest
      main
        java
        res
          drawable-hdpi
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          drawable-xhdpi
          drawable-xxhdpi
          layout
            activity_my.xml
          menu
          values
          values-v21
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    app.iml
    build.gradle
    proguard-rules.pro
  gradle
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  gradle.properties
  gradlew
  gradlew.bat
  local.properties
  OMGAndroid.iml
  settings.gradle
External Libraries
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<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
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        android:text="Hello world!"
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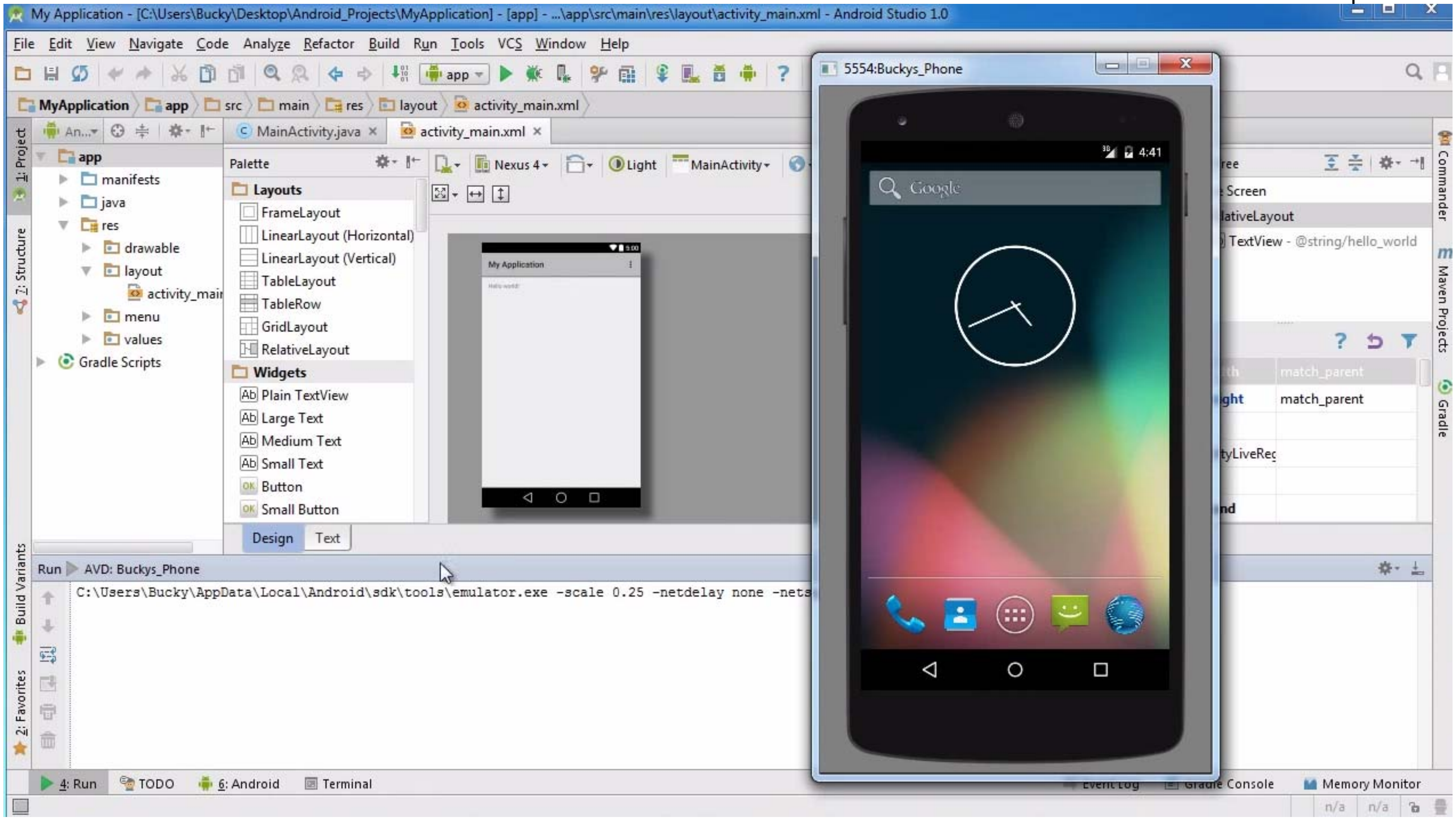
</RelativeLayout>
```

Gradle build finished in 13 sec (3 minutes ago)

Run App on Virtual Device (Phone)



My Application - [C:\Users\Bucky\Desktop\Android_Projects\MyApplication] - [app] - ...\app\src\main\res\layout\activity_main.xml - Android Studio 1.0

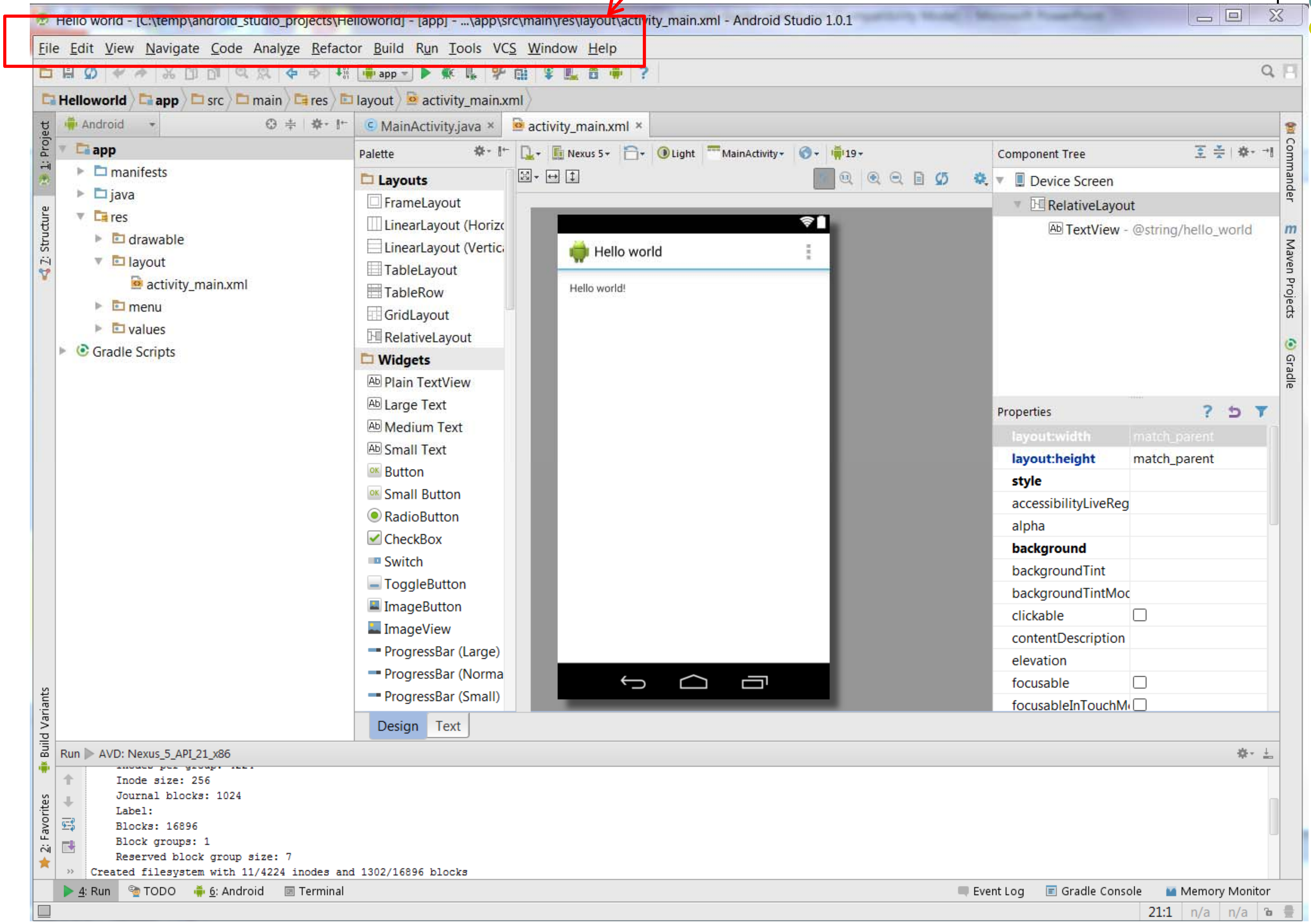
```
C:\Users\Bucky\AppData\Local\Android\sdk\tools\emulator.exe -scale 0.25 -netdelay none -nets
```

Tour of Android Studio Interface

- Tutorial 5: Tour of Android Studio Interface [6:01 mins]
  - https://www.youtube.com/watch?v=-pdTqBq2TFQ

- Quick overview of main sections of Android Studio
  - Windows menu bar
  - Android tool bar
  - Project window
  - Editor Window
  - Palette for Drag-and-Drop Design of Android buttons
- More detailed coverage of specific UI aspects later

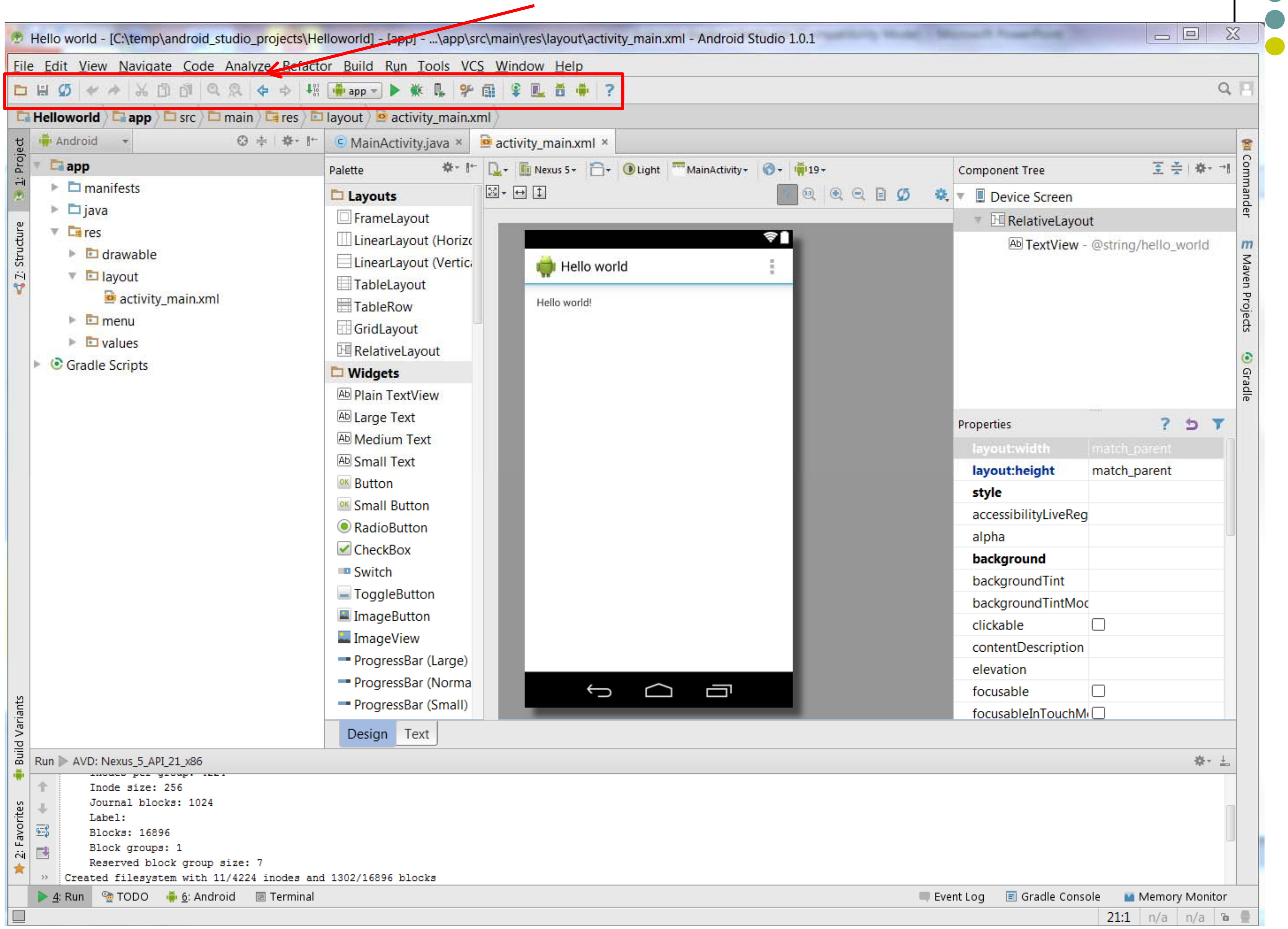
Typical Windows Menu Bar (File, edit, etc)



layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveReg	
alpha	
background	
backgroundTint	
backgroundTintMoc	
clickable	□
contentDescription	
elevation	
focusable	□
focusableInTouchM	□

```
    Inode size: 256
    Journal blocks: 1024
    Label:
    Blocks: 16896
    Block groups: 1
    Reserved block group size: 7
Created filesystem with 11/4224 inodes and 1302/16896 blocks
```

Tool Bar: Shortcuts to Frequently used Android-specific Functions (E.g. One-click access to SDK manager)



```
    Inodes per group: 4224
    Inode size: 256
    Journal blocks: 1024
    Label:
    Blocks: 16896
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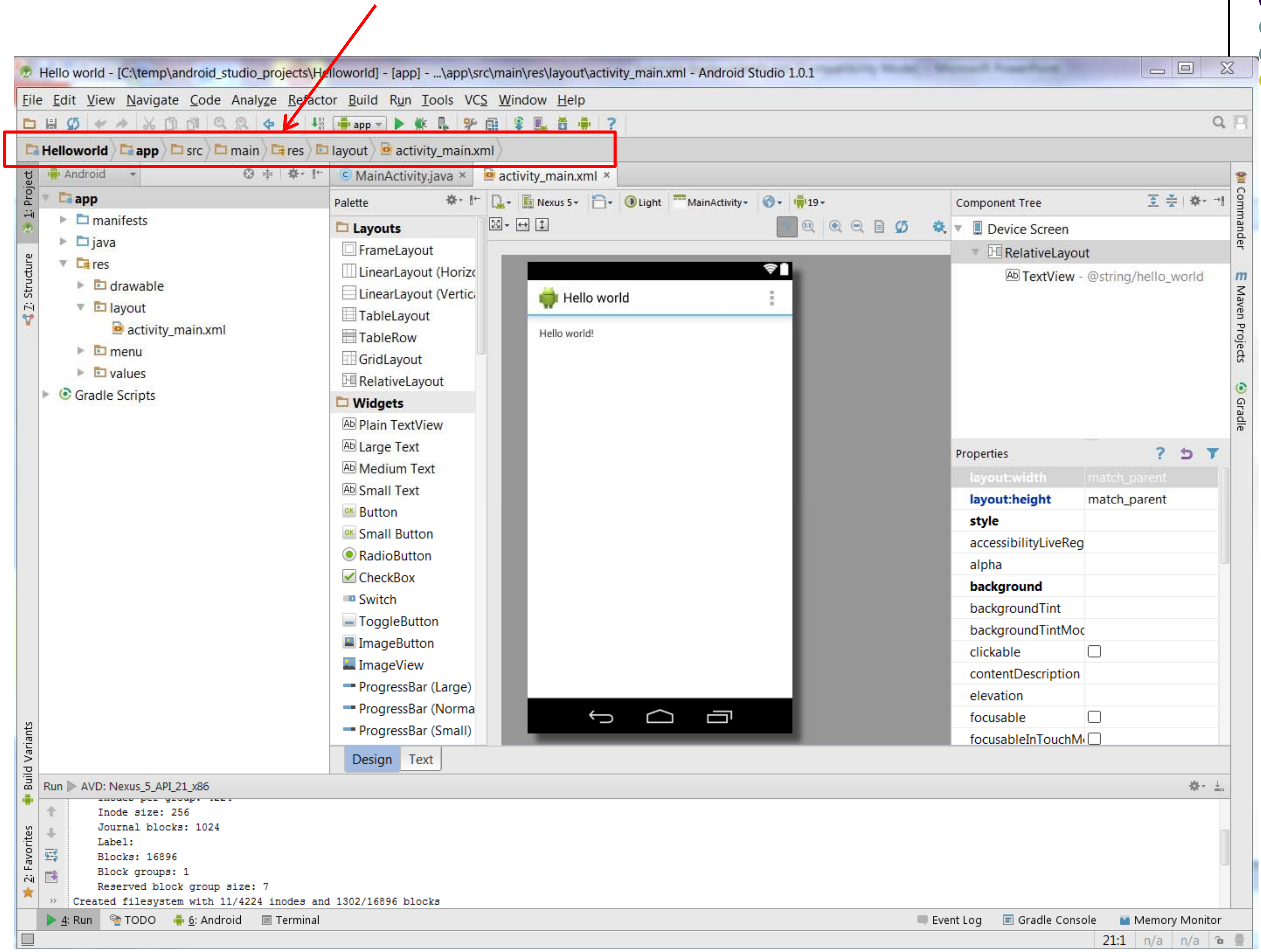
    Reserved block group size: 7
Created filesystem with 11/4224 inodes and 1302/16896 blocks
```

Path to Current File in IDE Window (Clickable)



```
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Block groups: 1
Reserved block group size: 7
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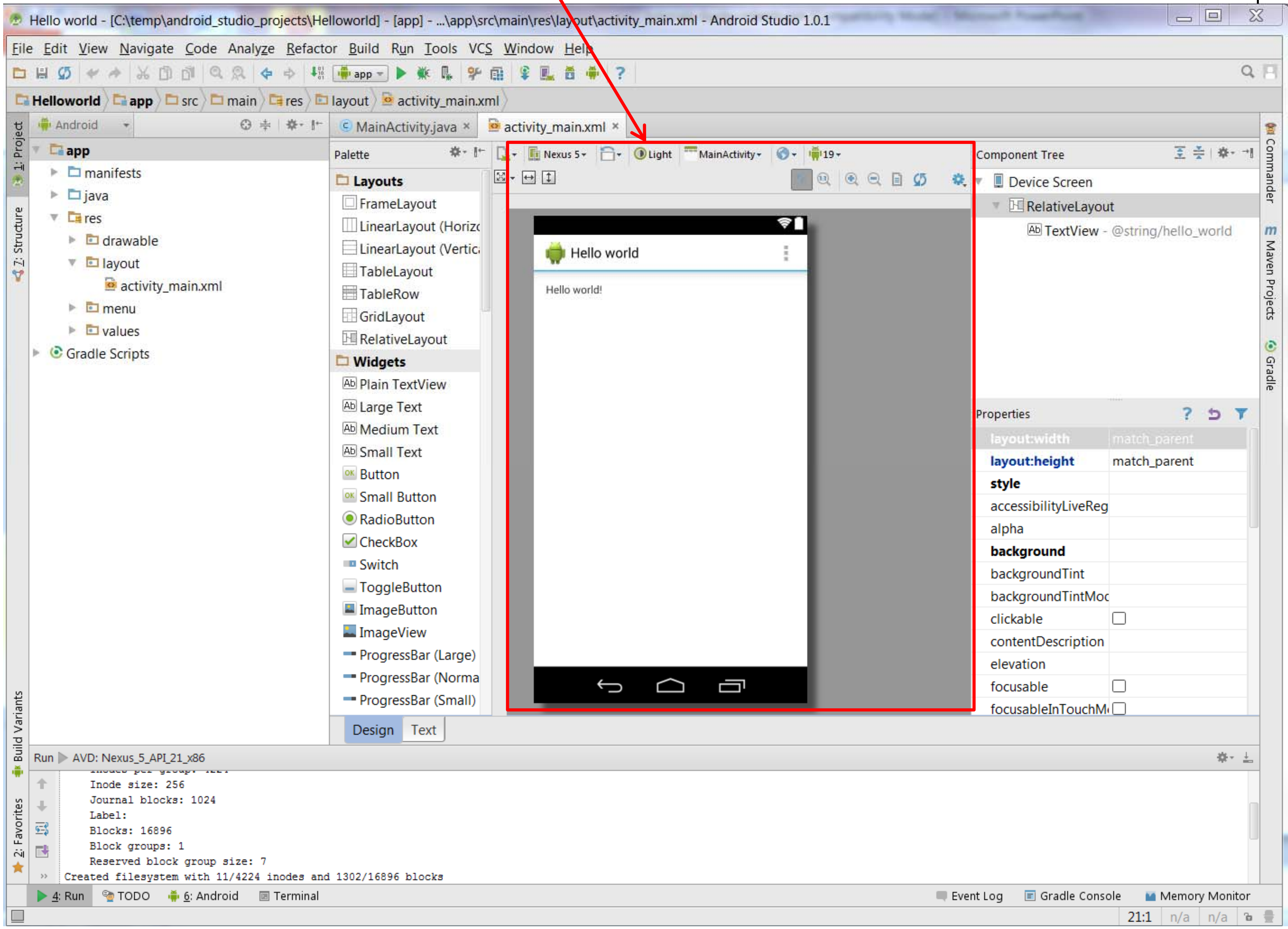
```

Editor Window (Allows editting of current file we are working on)



layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveReg	
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```
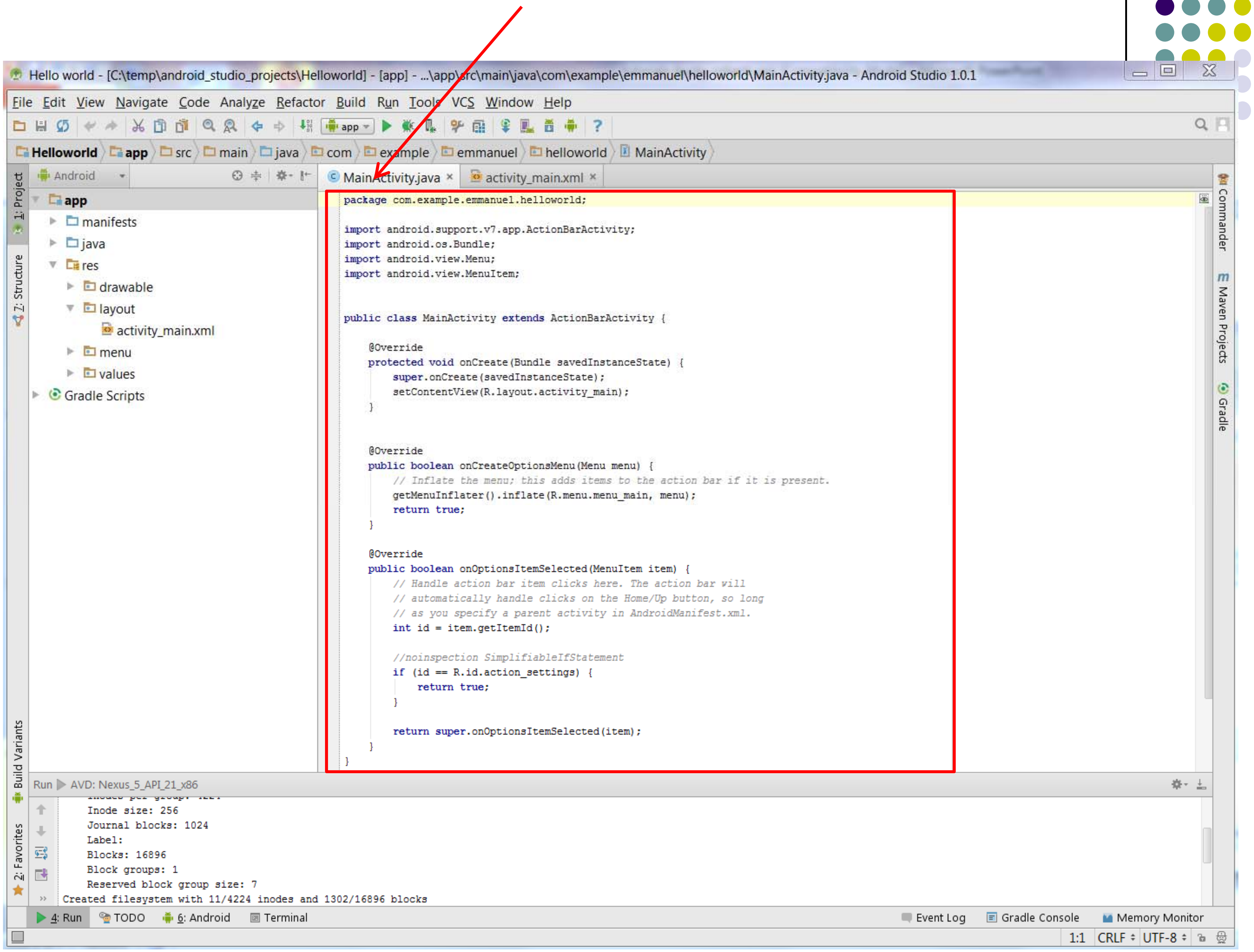
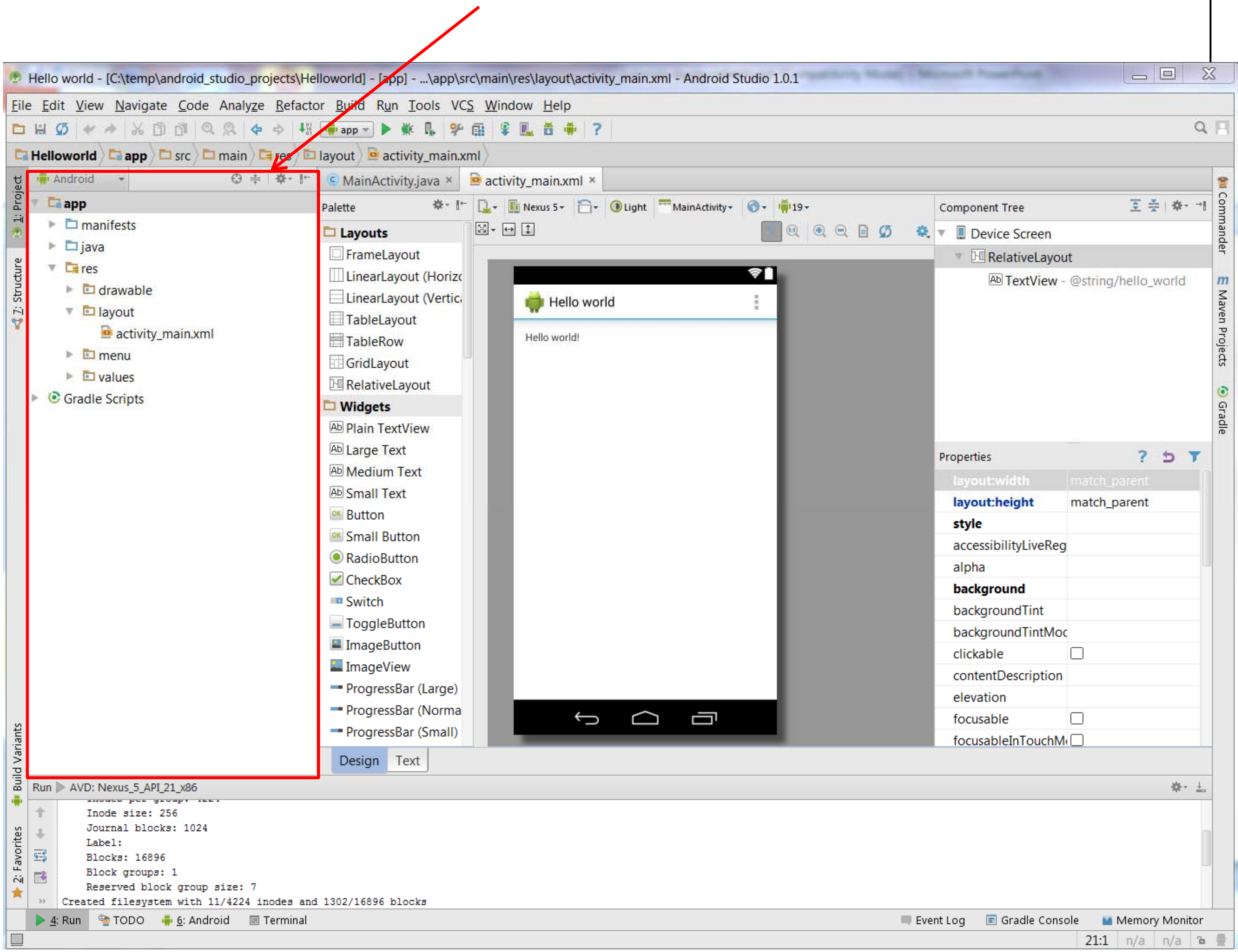

Clicking on Editor Window Tabs switches between Java code and Visual Interface


Hello world - [C:\temp\android_studio_projects\Helloworld] - [app] - ...\app\src\main\java\com\example\emmanuel\helloworld\MainActivity.java - Android Studio 1.0.1
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
app
Helloworld app src main java com example emmanuel helloworld MainActivity
Android
app
manifests
java
res
drawable
layout
activity_main.xml
menu
values
Gradle Scripts
MainActivity.java ×
activity_main.xml ×
1: Project
7: Structure
Build Variants
2: Favorites
Commander
Maven Projects
Gradle
Run AVD: Nexus_5_API_21_x86
4: Run
TODO
6: Android
Terminal
Event Log
Gradle Console
Memory Monitor
1:1 CRLF UTF-8

```java
package com.example.emmanuel.helloworld;

import android.support.v7.app.ActionBarActivity;
import android.os.Bundle;
import android.view.Menu;
import android.view.MenuItem;


public class MainActivity extends ActionBarActivity {

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


    @Override
    public boolean onCreateOptionsMenu(Menu menu) {
        // Inflate the menu; this adds items to the action bar if it is present.
        getMenuInflater().inflate(R.menu.menu_main, menu);
        return true;
    }

    @Override
    public boolean onOptionsItemSelected(MenuItem item) {
        // Handle action bar item clicks here. The action bar will
        // automatically handle clicks on the Home/Up button, so long
        // as you specify a parent activity in AndroidManifest.xml.
        int id = item.getItemId();

        //noinspection SimplifiableIfStatement
        if (id == R.id.action_settings) {
            return true;
        }

        return super.onOptionsItemSelected(item);
    }
}
```

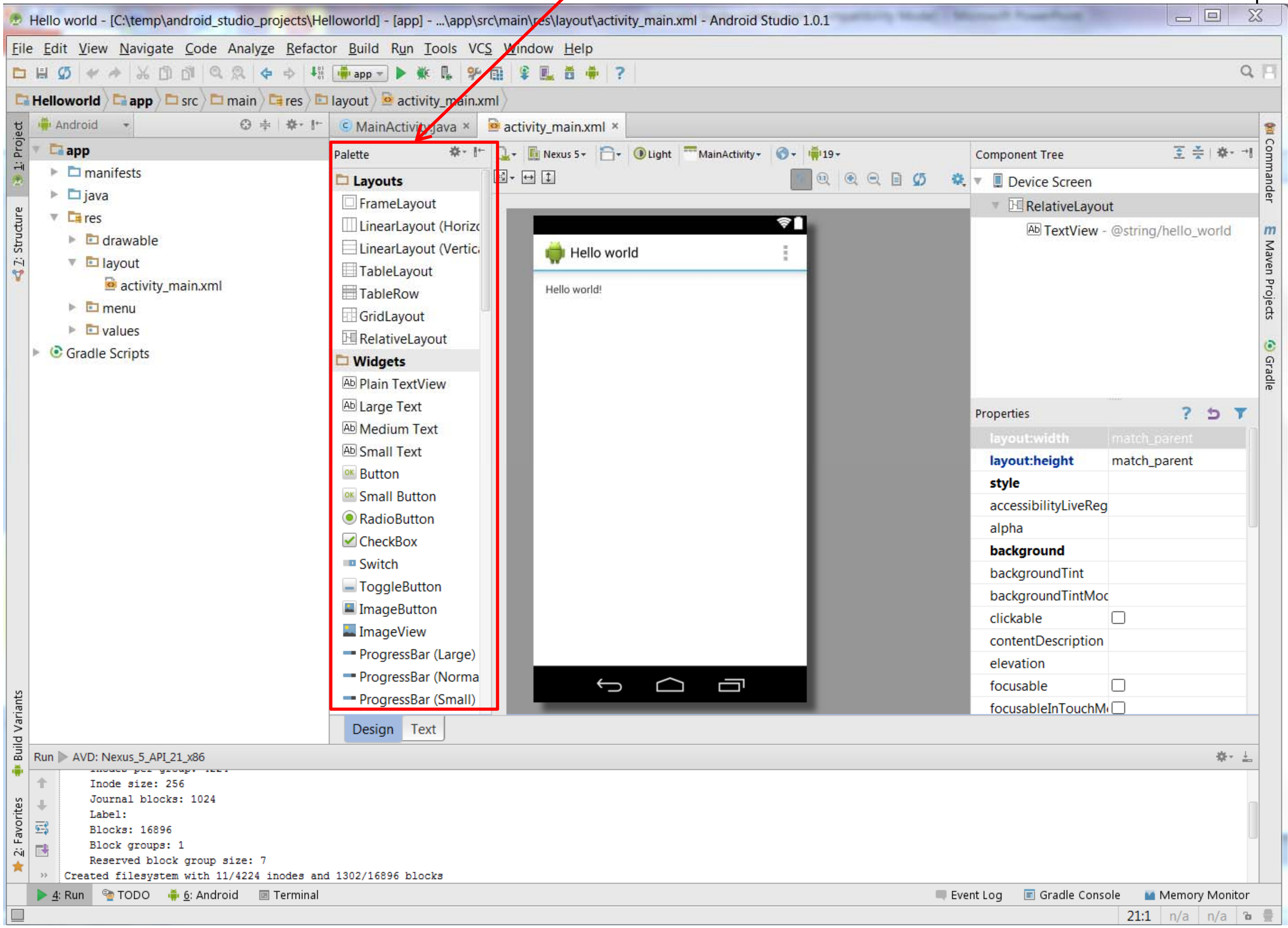
```
    Inode size: 256
    Journal blocks: 1024
    Label:
    Blocks: 16896
    Block groups: 1
    Reserved block group size: 7
Created filesystem with 11/4224 inodes and 1302/16896 blocks
```

Project Window (Allows between project files, packages, etc)



```
Inode size: 256
Journal blocks: 1024
Label:
Blocks: 16896
Block groups: 1
Reserved block group size: 7
Created filesystem with 11/4224 inodes and 1302/16896 blocks
```

Palette of Drag-and-Drop Elements for Designing Interface (Layout, widgets, etc)

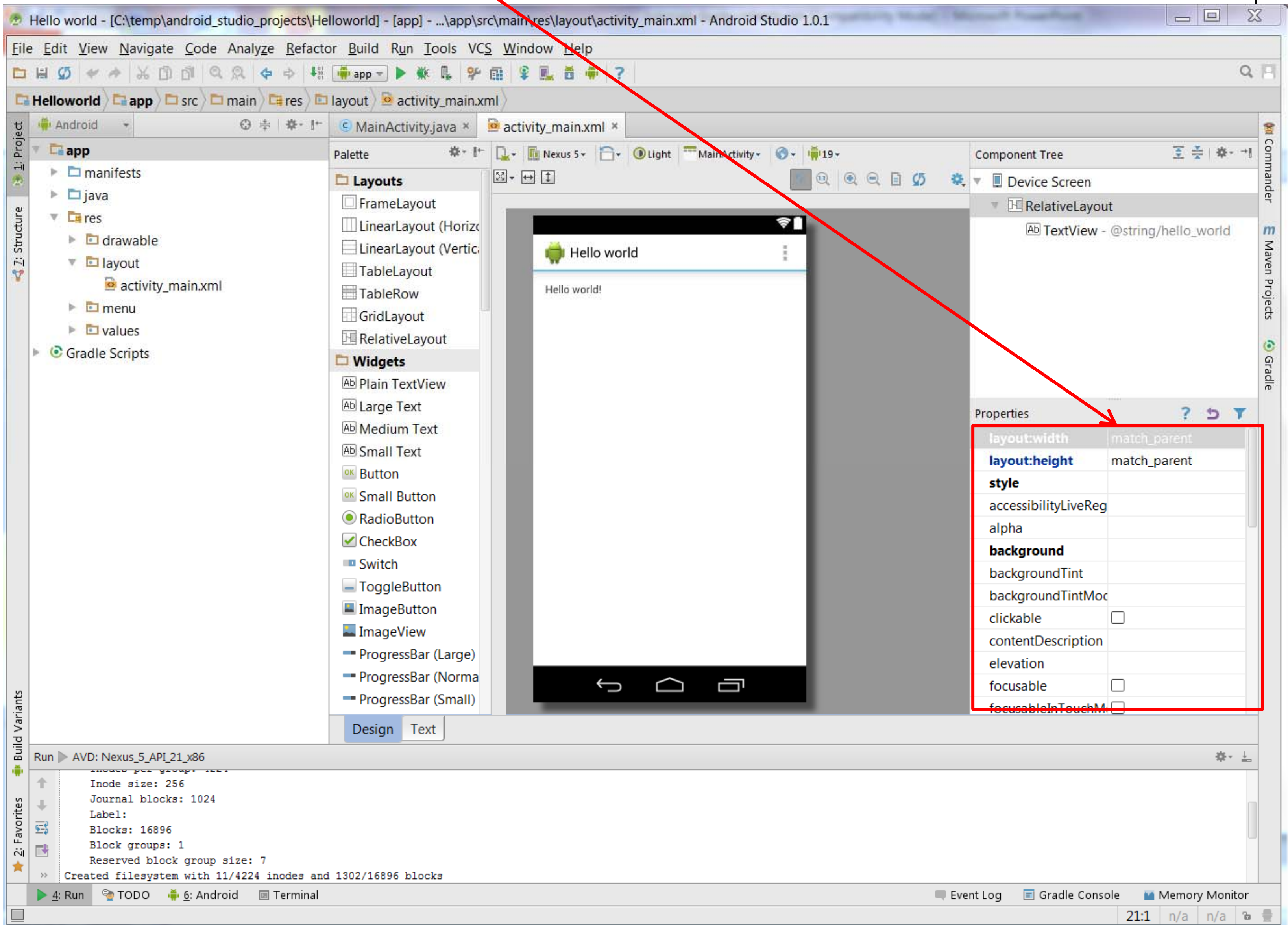


Properties	
layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveReg	
alpha	
background	
backgroundTint	
backgroundTintMoc	
clickable	□
contentDescription	
elevation	
focusable	□
focusableInTouchM	□

Run ▶ AVD: Nexus_5_API_21_x86

```
    Inodes per group: 4224
    Inode size: 256
    Journal blocks: 1024
    Label:
    Blocks: 16896
    Block groups: 1
    Reserved block group size: 7
Created filesystem with 11/4224 inodes and 1302/16896 blocks
```

Parameters of Drag-and-Drop Elements for Designing Interface (e.g. colors, dimensions of widgets, etc)



Properties	
layout:width	match_parent
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```
    Inode size: 256
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    Label:
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Created filesystem with 11/4224 inodes and 1302/16896 blocks
```
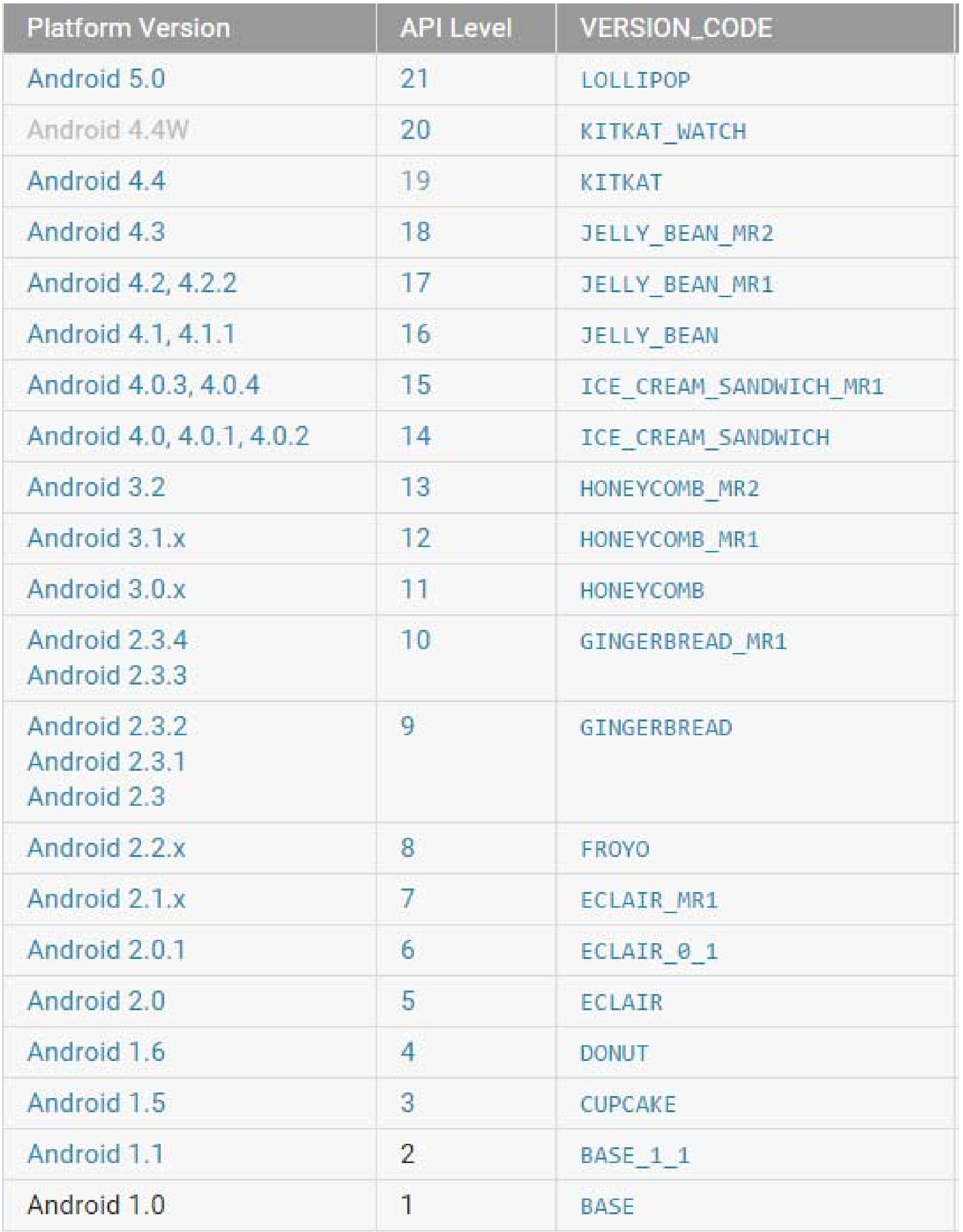

Importing Existing Code

- Can also import existing code
- The text comes with lots of free code you can learn from, use in projects as starting point
- Can import from gitHub repository
- See tutorial #2 of busy coders book

Android Versions/API Levels



Platform Version	API Level	VERSION_CODE
Android 5.0	21	LOLLIPOP
Android 4.4W	20	KITKAT_WATCH
Android 4.4	19	KITKAT
Android 4.3	18	JELLY_BEAN_MR2
Android 4.2, 4.2.2	17	JELLY_BEAN_MR1
Android 4.1, 4.1.1	16	JELLY_BEAN
Android 4.0.3, 4.0.4	15	ICE_CREAM_SANDWICH_MR1
Android 4.0, 4.0.1, 4.0.2	14	ICE_CREAM_SANDWICH
Android 3.2	13	HONEYCOMB_MR2
Android 3.1.x	12	HONEYCOMB_MR1
Android 3.0.x	11	HONEYCOMB
Android 2.3.4 Android 2.3.3	10	GINGERBREAD_MR1
Android 2.3.2 Android 2.3.1 Android 2.3	9	GINGERBREAD
Android 2.2.x	8	FROYO
Android 2.1.x	7	ECLAIR_MR1
Android 2.0.1	6	ECLAIR_0_1
Android 2.0	5	ECLAIR
Android 1.6	4	DONUT
Android 1.5	3	CUPCAKE
Android 1.1	2	BASE_1_1
Android 1.0	1	BASE

References

- Ask A Dev, Android Wear: What Developers Need to Know, https://www.youtube.com/watch?v=zTS2NZpLyQg
- Ask A Dev, Mobile Minute: What to (Android) Wear, https://www.youtube.com/watch?v=n5Yjzn3b_aQ
- Busy Coder’s guide to Android version 4.4
- CS 65/165 slides, Dartmouth College, Spring 2014
- CS 371M slides, U of Texas Austin, Spring 2014