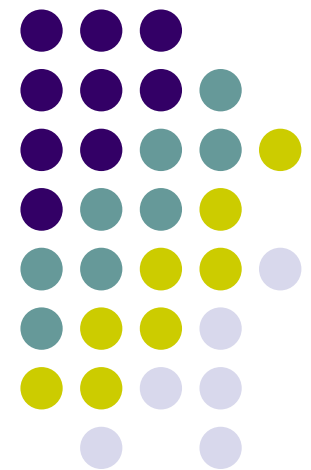


CS 403X Mobile and Ubiquitous Computing

Lecture 2: Introduction to Android

Emmanuel Agu

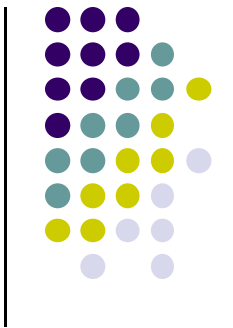




What is Android?

- 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



Google Glass



In-car console



Smartwatch



Android runs on all these devices



Tablet



Smartphone



Television

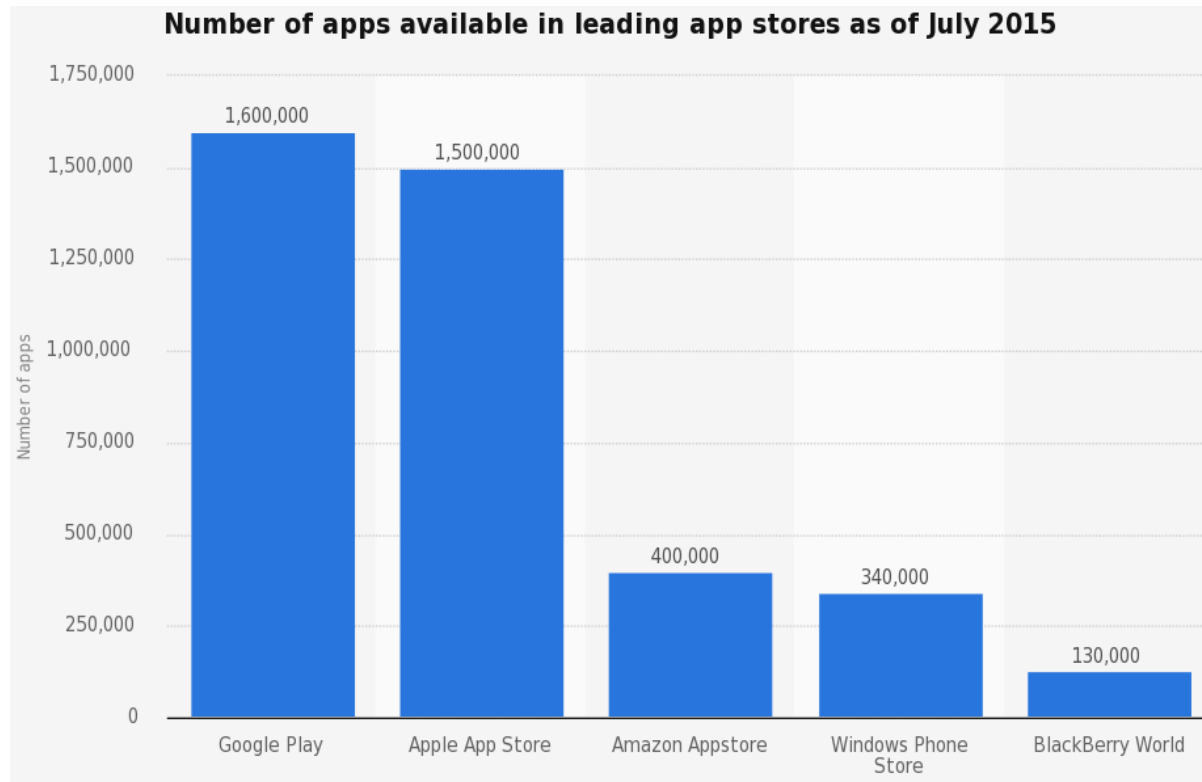


This Class: Focuses Mostly on Smartphones!



Android Growth

- October 2015, 1.4 billion Android users (ref: [WSJ](#))
- 1.6 million apps on the Android app market (ref: [statista.com](#))
 - Games, organizers, banking, entertainment, etc

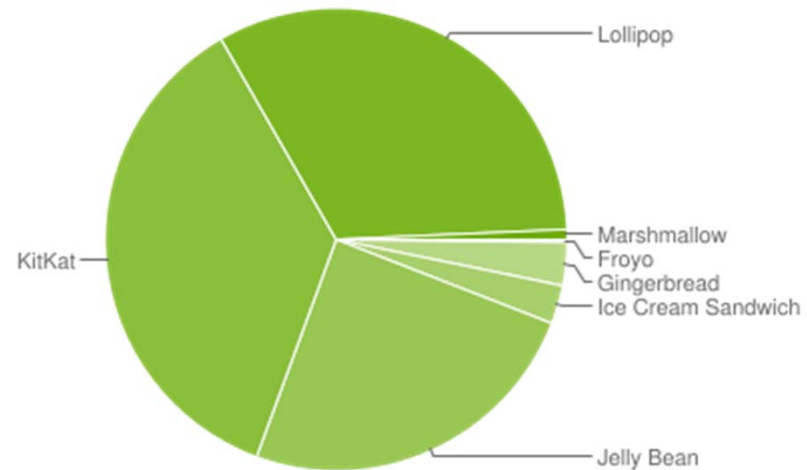


Android Versions



- Most recent Android version is Android L (6.0) or “Marshmallow”
- Officially released December 7, 2015
- Class will use Android 5.0 (lollipop)
- Android version distribution as at January 4, 2016

Version	Codename	API	Distribution
2.2	Froyo	8	0.2%
2.3.3 - 2.3.7	Gingerbread	10	3.0%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	2.7%
4.1.x	Jelly Bean	16	9.0%
4.2.x		17	12.2%
4.3		18	3.5%
4.4	KitKat	19	36.1%
5.0	Lollipop	21	16.9%
5.1		22	15.7%
6.0	Marshmallow	23	0.7%



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

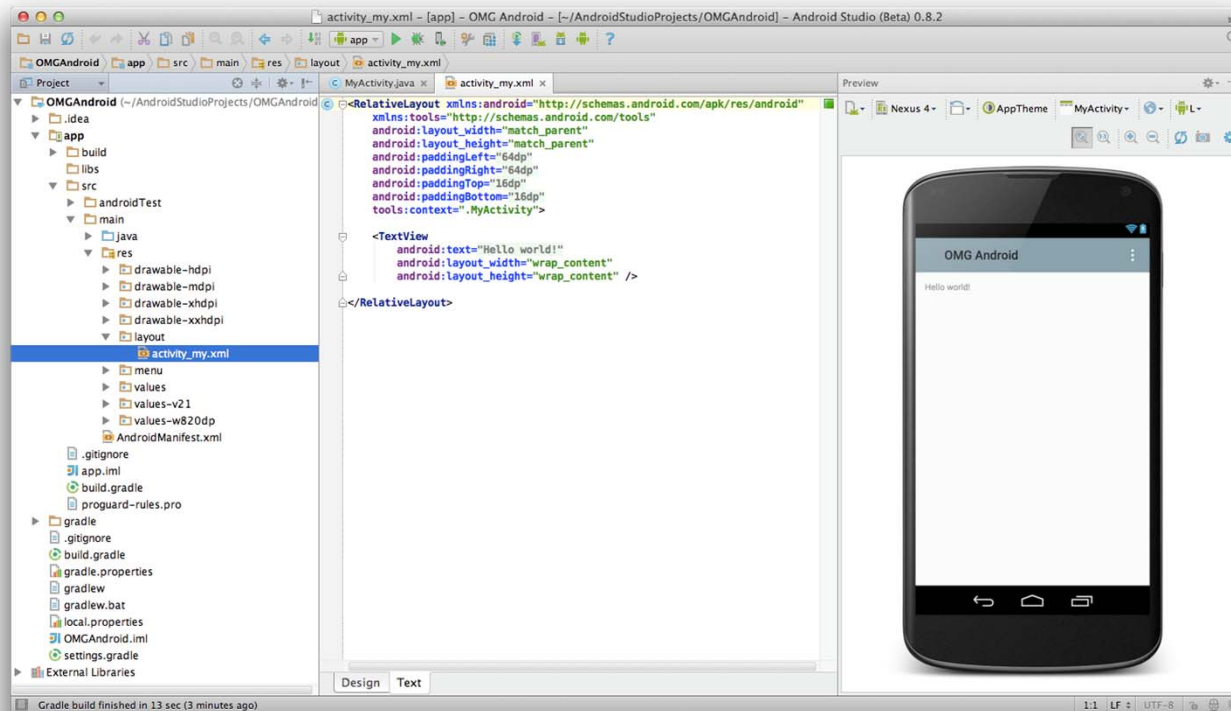


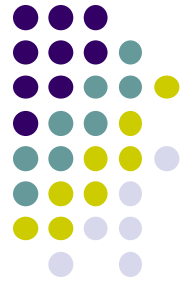
Android Developer Environment

New Android Environment: Android Studio



- Old Android dev environment used **Eclipse + plugins**
- Google developed it's own IDE called **Android Studio**
- Integrated development environment, cleaner interface, specifically for Android Development (e.g. drag and drop app design)
- In December 2014, Google announced it will stop supporting Eclipse IDE





Installing Android Studio

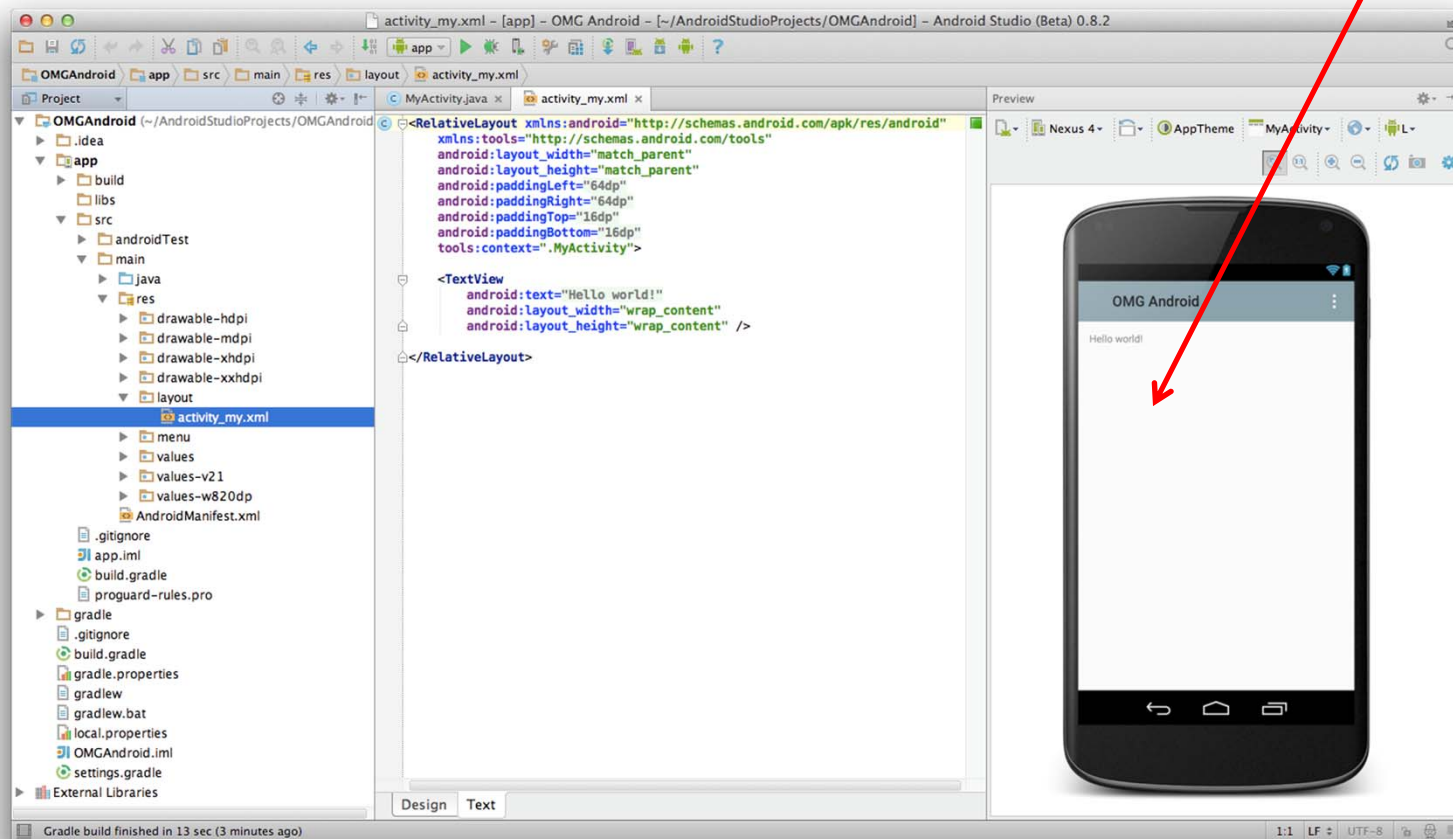
- **Step 1:** Install Java (at least version 1.7)
 - **Note:** You may already have Java installed. Check first
- **Step 2:** Set JAVA_HOME system variable
 - This variable tells applications that need Java where it is installed
- **Step 3:** Install Android Studio (version 1.5.1 is latest)
- Bucky Roberts (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**





Running Android App on Real Phone

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





Emulator Vs Real Phone 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



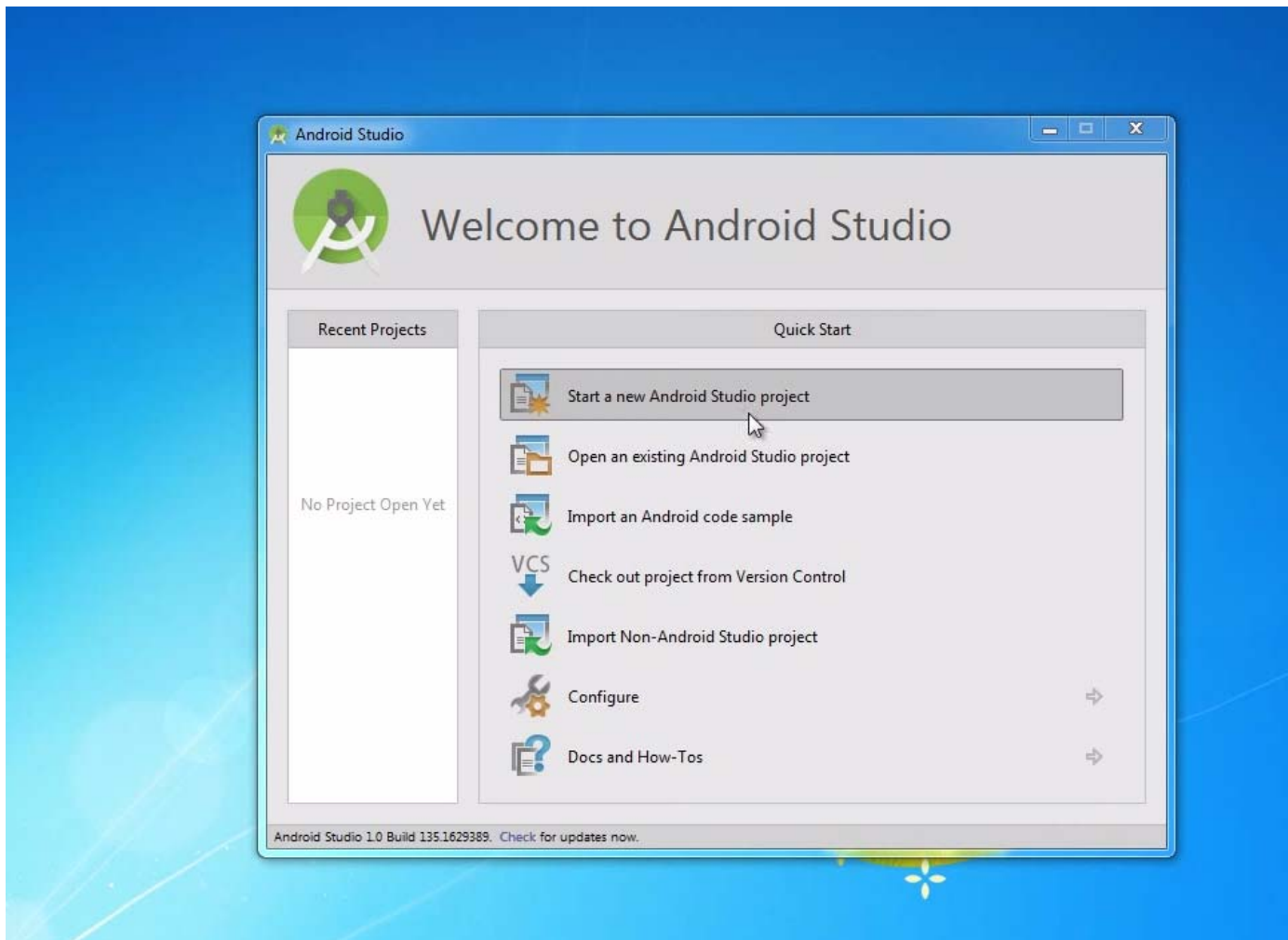
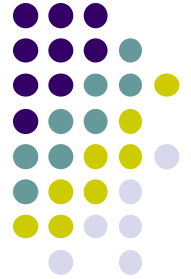
- No support for
 - Phone calls (calling or receiving)
 - USB connections
 - Camera/video capture (input)
 - Bluetooth
 - Sensors, accelerometer, gyroscope, etc
 - Device-attached headphones
 - Determining battery charge level and AC charging state
 - Determining SD card insert/eject
- Slow!!!



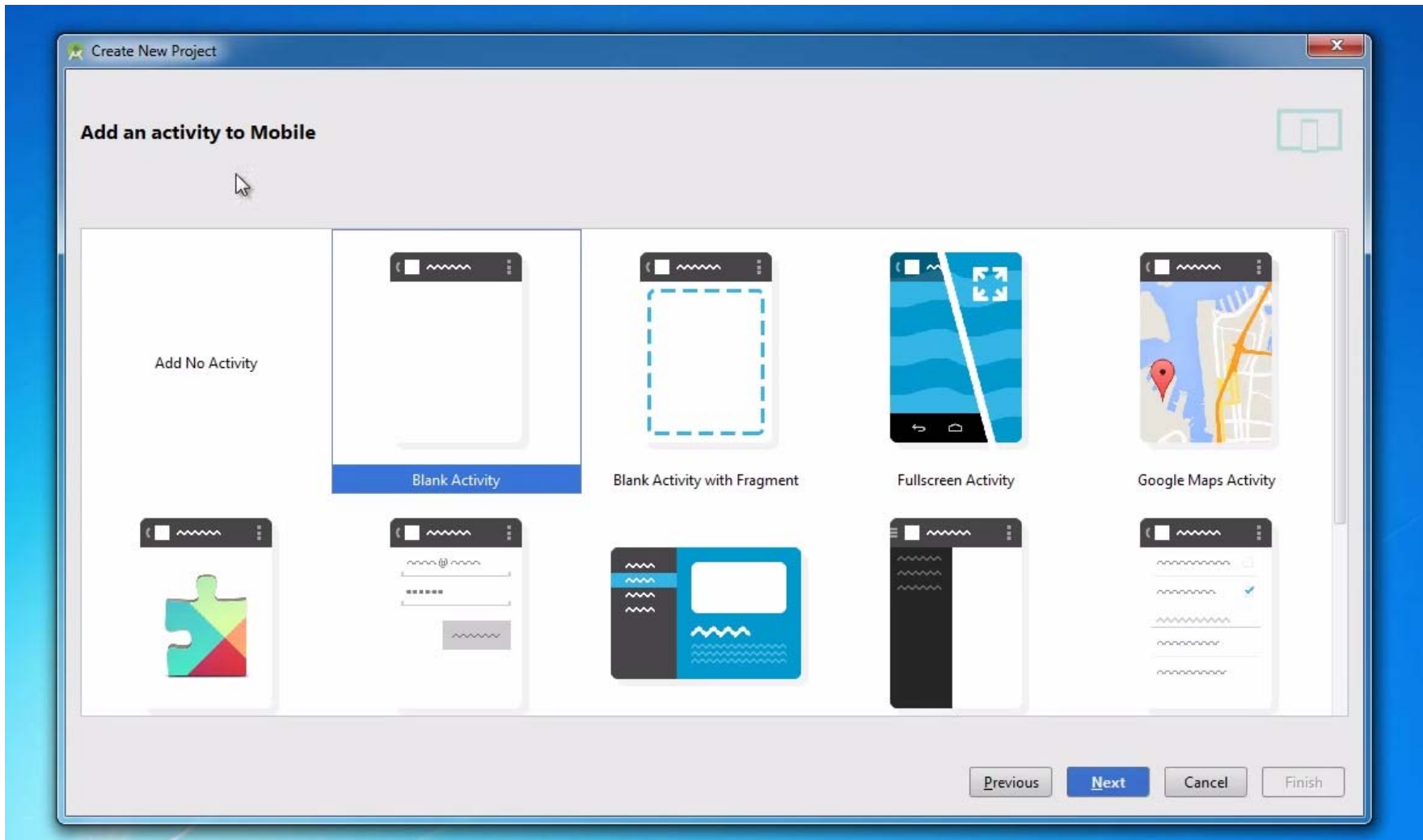
Setting up your Project

- **Tutorial 3: Android App Development for Beginners - 3**
 - Setting up your project by Bucky Roberts (thenewboston)
 - <https://www.youtube.com/watch?v=r4olez0sfvY>
- 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



Add an Activity (Blank Activity is Simplest)

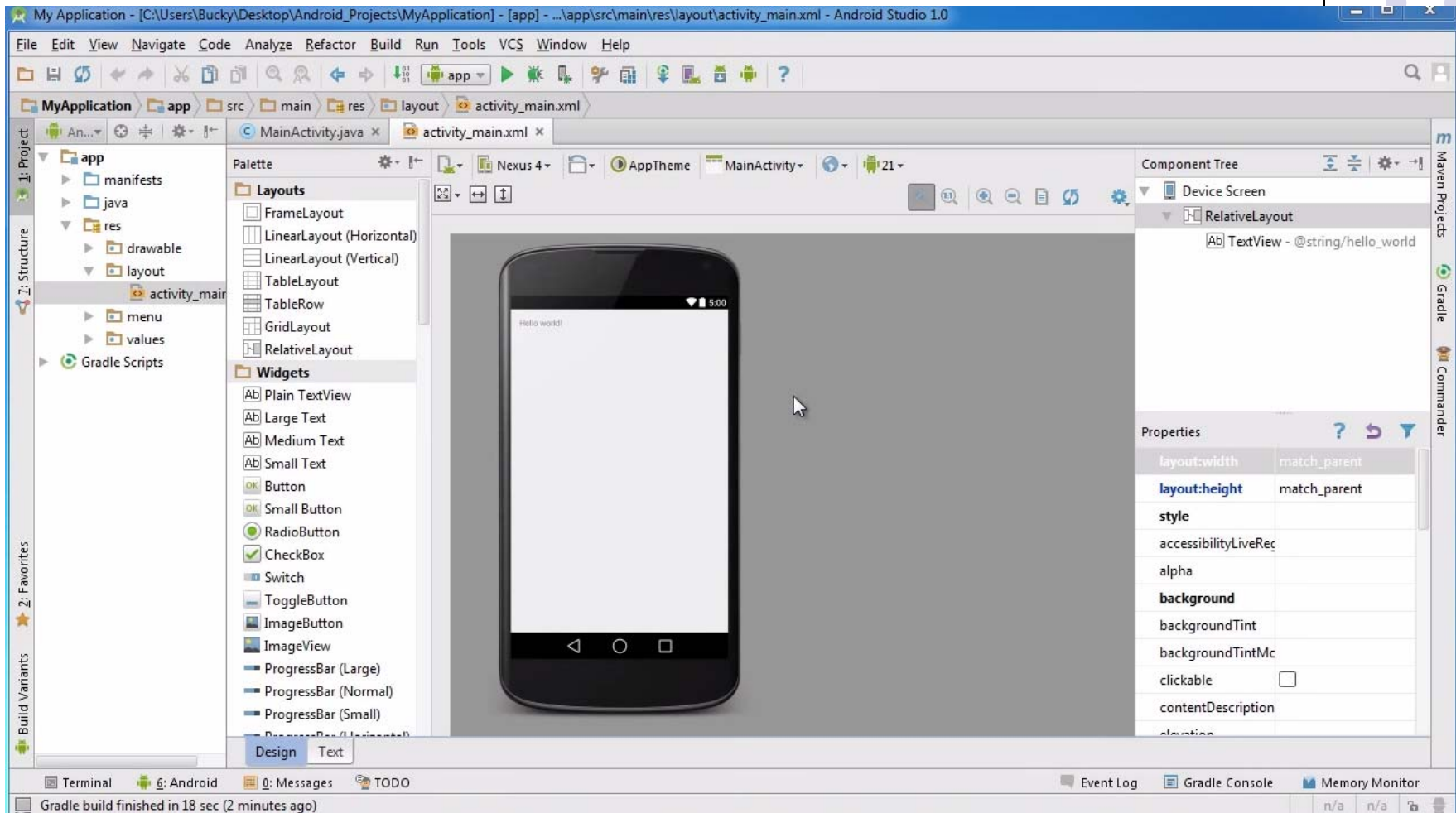
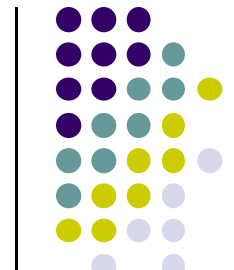




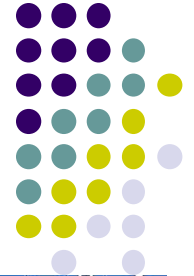
Running a Simple App

- 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



Run AVD Manager



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	

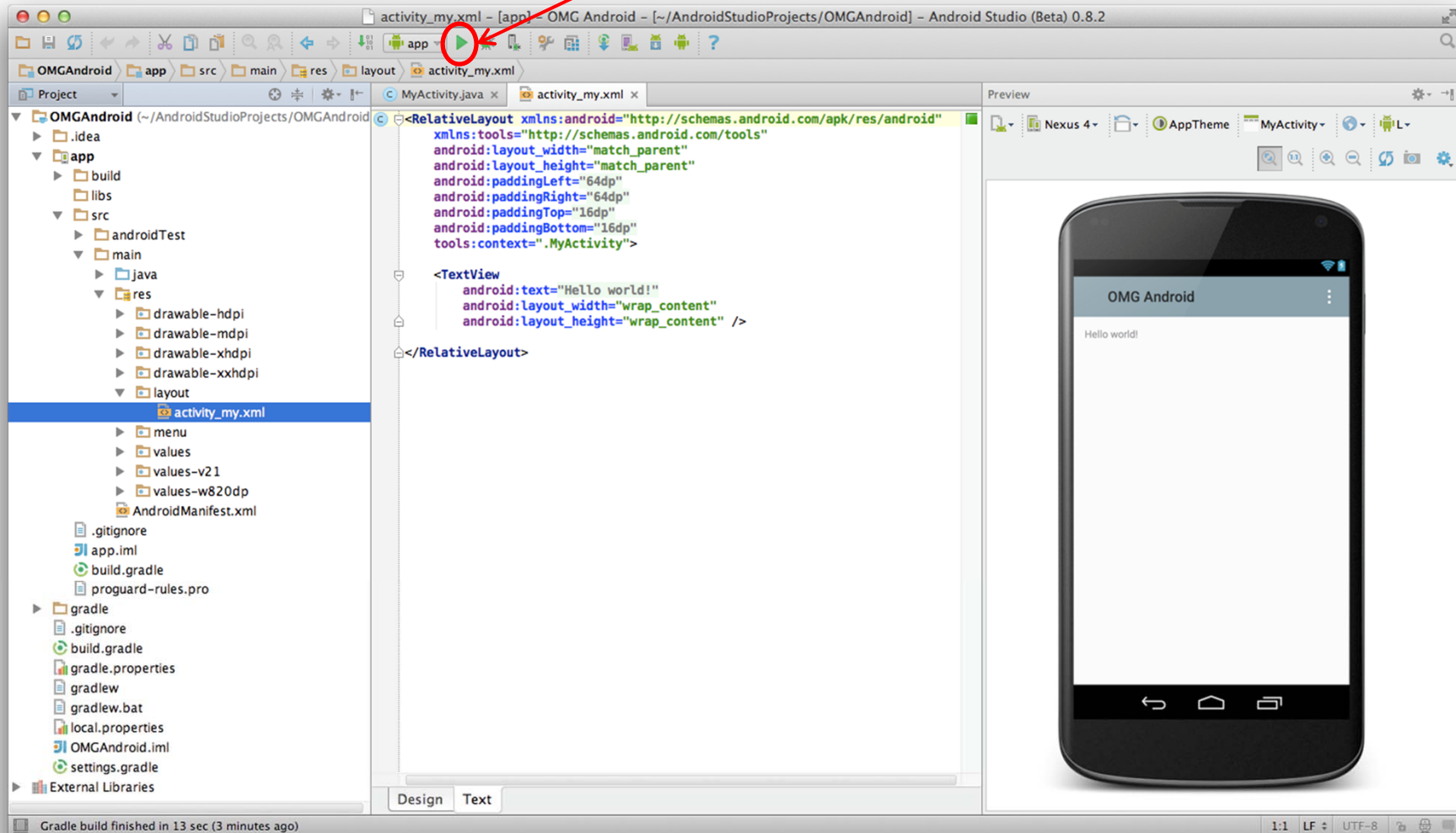
+ Create Virtual Device...

OK Cancel

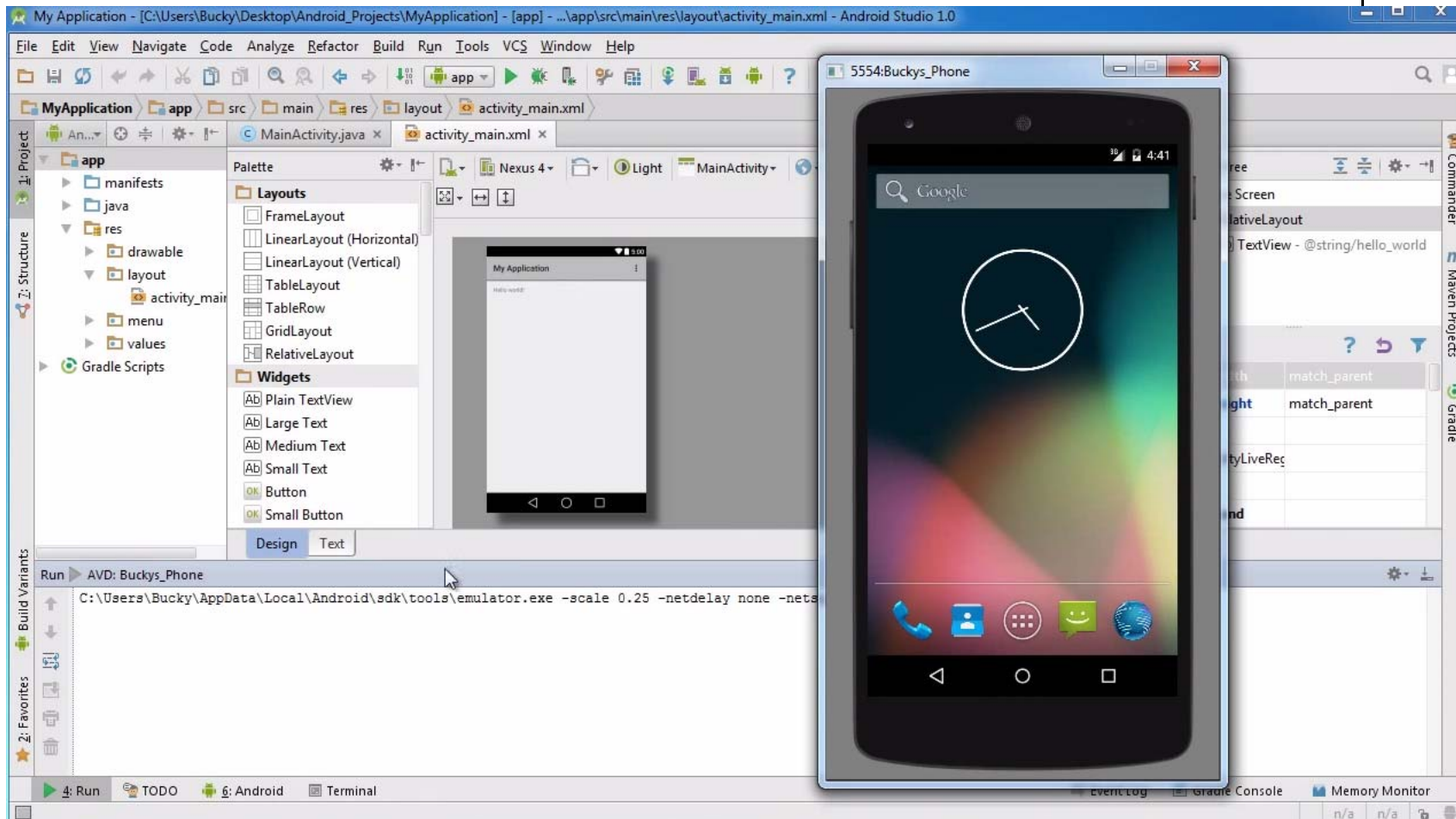
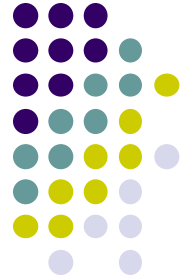
How to Run the App?



Click here to run the app



Run App on Virtual Device (Phone)

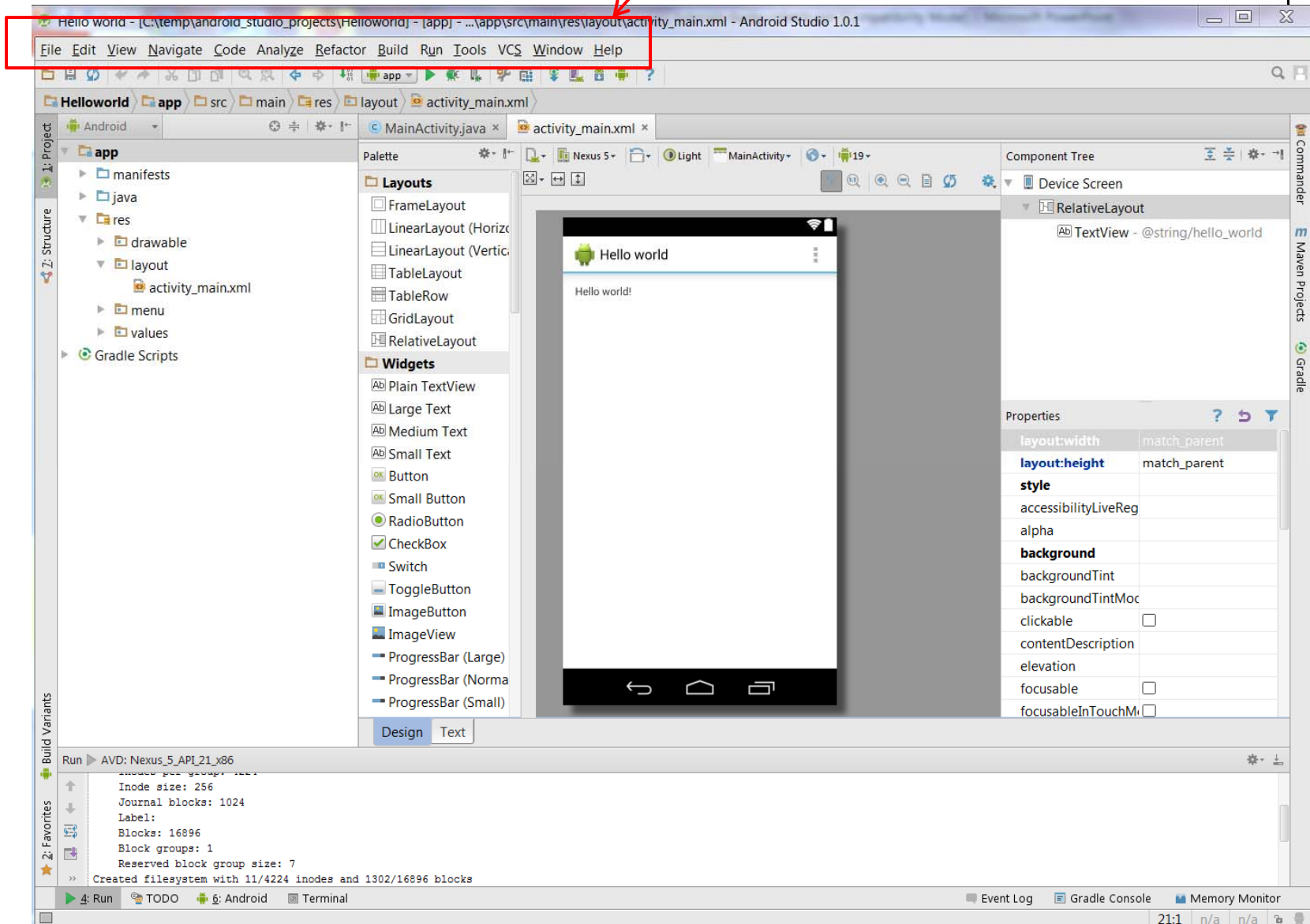


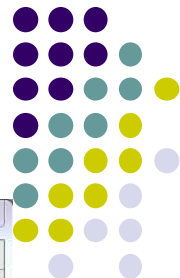


Tour of Android Studio Interface

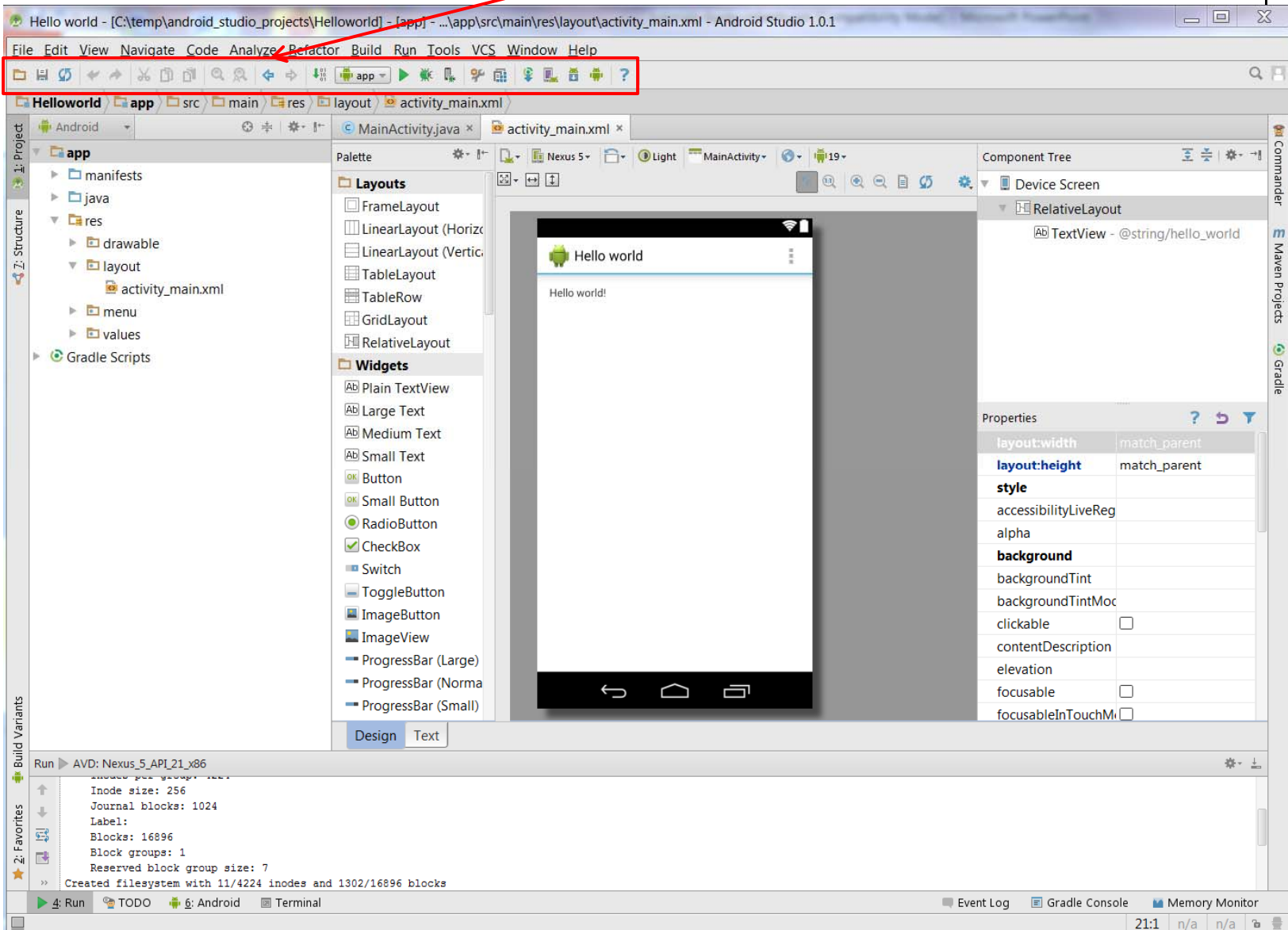
- Tutorial 5: Tour of Android Studio Interface [6:01 mins]
 - <https://www.youtube.com/watch?v=-pdTqBq2TFQ>
- Quick overview of main sections of Android Studio
 - Windows menu bar
 - Android tool bar
 - Project window
 - Editor Window
 - Palette for Drag-and-Drop Design of Android buttons
- More detailed coverage of specific UI aspects later

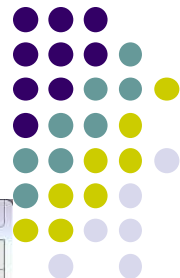
Typical Windows Menu Bar (File, edit, etc)





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

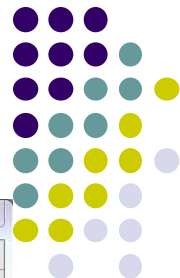




Path to Current File in IDE Window (Clickable)

The screenshot shows the Android Studio IDE interface. A red box highlights the breadcrumb path at the top of the editor window: `Helloworld > app > src > main > res > layout > activity_main.xml`. A red arrow points from the text above to this path. The main editor displays the XML code for the layout, and the Design tab shows a preview of the app with the text "Hello world!". The Properties panel on the right shows the attributes for the selected `TextView` widget.

Properties	
<code>layout:width</code>	<code>match_parent</code>
<code>layout:height</code>	<code>match_parent</code>
style	
<code>accessibilityLiveReg</code>	
<code>alpha</code>	
background	
<code>backgroundTint</code>	
<code>backgroundTintMoc</code>	
<code>clickable</code>	<input type="checkbox"/>
<code>contentDescription</code>	
<code>elevation</code>	
<code>focusable</code>	<input type="checkbox"/>
<code>focusableInTouchM</code>	<input type="checkbox"/>



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

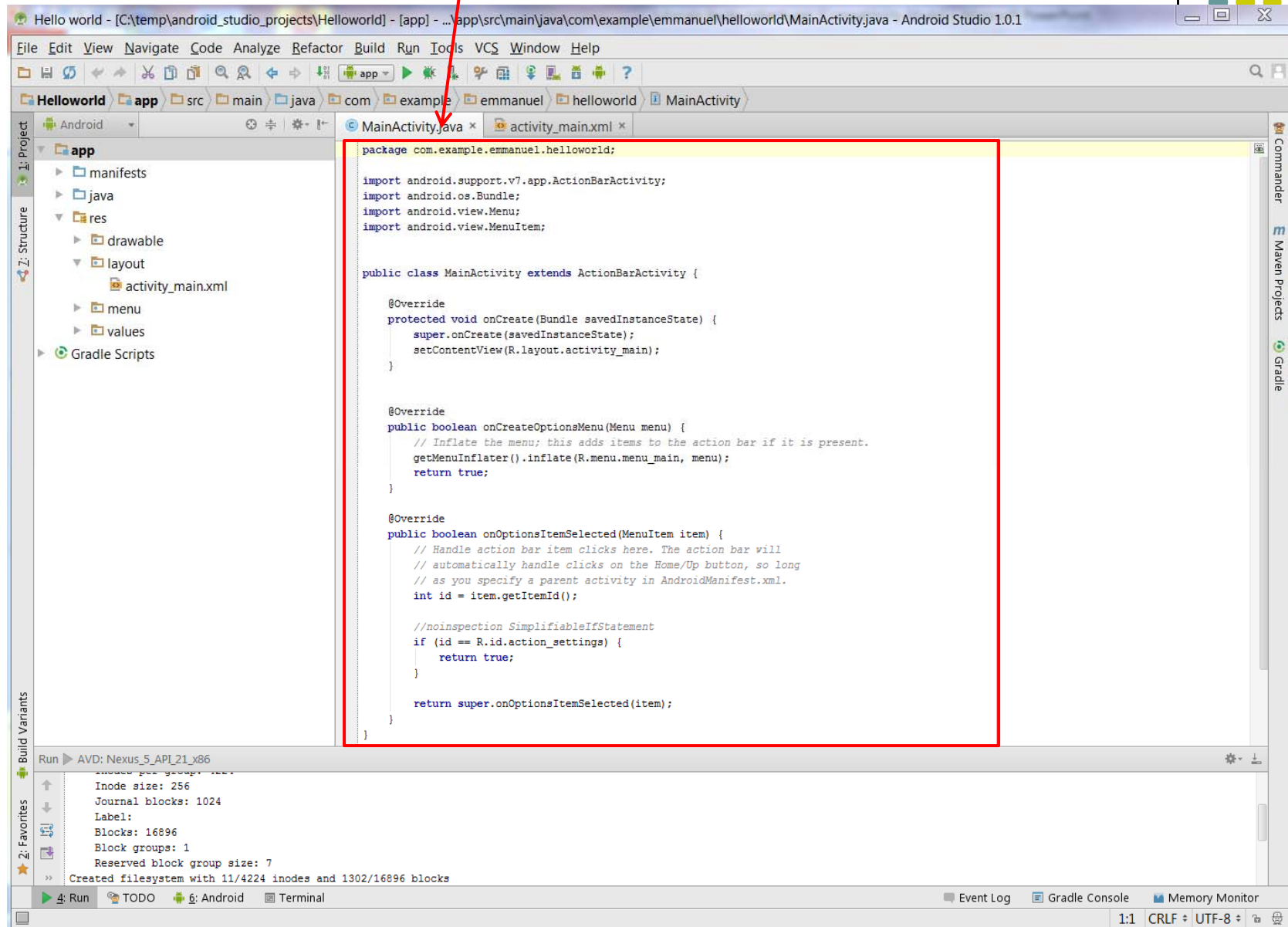
The screenshot displays the Android Studio IDE interface. The central Editor Window is highlighted with a red border and a red arrow pointing to it from the text above. The Editor Window shows the design view of the activity_main.xml file, displaying a mobile screen with the text "Hello world!".

The interface includes several panels:

- Project:** Shows the project structure with folders like manifests, java, res, and layout.
- Palette:** Contains Layouts (FrameLayout, LinearLayout, etc.) and Widgets (TextView, Button, etc.).
- Component Tree:** Shows the hierarchy of UI components, including RelativeLayout and TextView.
- Properties:** Lists various properties for the selected TextView, such as layout:width, layout:height, style, and background.
- Run:** Shows the AVD (Android Virtual Device) configuration and the output of the build process.

Property	Value
layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveReg	
alpha	
background	
backgroundTint	
backgroundTintMoc	
clickable	<input type="checkbox"/>
contentDescription	
elevation	
focusable	<input type="checkbox"/>
focusableInTouchM	<input type="checkbox"/>

Clicking on Editor Window Tabs switches between project files



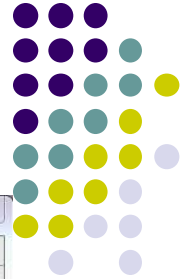
Run ▶ AVD: Nexus_5_API_21_x86

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

4: Run 6: Android Terminal Event Log Gradle Console Memory Monitor

1:1 CRLF UTF-8

Project Window (Shows project files, packages, etc)



The screenshot displays the Android Studio 1.0.1 interface for a project named 'Hello world'. The Project Window on the left shows the project structure:

- app
 - manifests
 - java
 - res
 - drawable
 - layout
 - activity_main.xml
 - menu
 - values
 - Gradle Scripts

The Palette in the center-left lists various UI components under 'Layouts' and 'Widgets'. The Design view in the center shows a mobile device screen with the text 'Hello world!'. The Component Tree on the right shows a RelativeLayout containing a TextView with the text '@string/hello_world'. The Properties panel on the right shows the following properties:

Property	Value
layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveReg	
alpha	
background	
backgroundTint	
backgroundTintMoc	
clickable	<input type="checkbox"/>
contentDescription	
elevation	
focusable	<input type="checkbox"/>
focusableInTouchM	<input type="checkbox"/>

The bottom of the interface shows the Run console with the following output:

```
Run ▶ AVD: Nexus_5_API_21_x86
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)



The screenshot displays the Android Studio IDE interface for an Android application. The main window shows the design view of the app, with a preview of a Nexus 5 device displaying the text "Hello world!". The Palette of Drag-and-Drop Elements is open, showing a list of layouts and widgets. A red arrow points to the Palette. The Component Tree on the right shows a RelativeLayout containing a TextView with the text "@string/hello_world". The Properties panel below the Component Tree shows the properties for the selected TextView, including layout:width, layout:height, style, accessibilityLiveReg, alpha, background, backgroundTint, backgroundTintMoc, clickable, contentDescription, elevation, focusable, and focusableInTouchM.

Layouts:

- FrameLayout
- LinearLayout (Horizontal)
- LinearLayout (Vertical)
- TableLayout
- TableRow
- GridLayout
- RelativeLayout

Widgets:

- Plain TextView
- Large Text
- Medium Text
- Small Text
- Button
- Small Button
- RadioButton
- CheckBox
- Switch
- ToggleButton
- ImageButton
- ImageView
- ProgressBar (Large)
- ProgressBar (Normal)
- ProgressBar (Small)

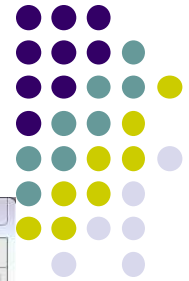
Component Tree:

- Device Screen
 - RelativeLayout
 - TextView - @string/hello_world

Properties:

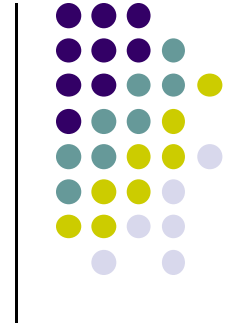
Property	Value
layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveReg	
alpha	
background	
backgroundTint	
backgroundTintMoc	
clickable	<input type="checkbox"/>
contentDescription	
elevation	
focusable	<input type="checkbox"/>
focusableInTouchM	<input type="checkbox"/>

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



The screenshot shows the Android Studio IDE with the design interface for an activity. The main window displays a preview of the activity on a Nexus 5 device, showing the text "Hello world!". The Properties panel on the right is highlighted with a red box and contains the following parameters:

Parameter	Value
layout:width	match_parent
layout:height	match_parent
style	
accessibilityLiveReg	
alpha	
background	
backgroundTint	
backgroundTintMoc	
clickable	<input type="checkbox"/>
contentDescription	
elevation	
focusable	<input type="checkbox"/>
focusableInTouchM	<input type="checkbox"/>

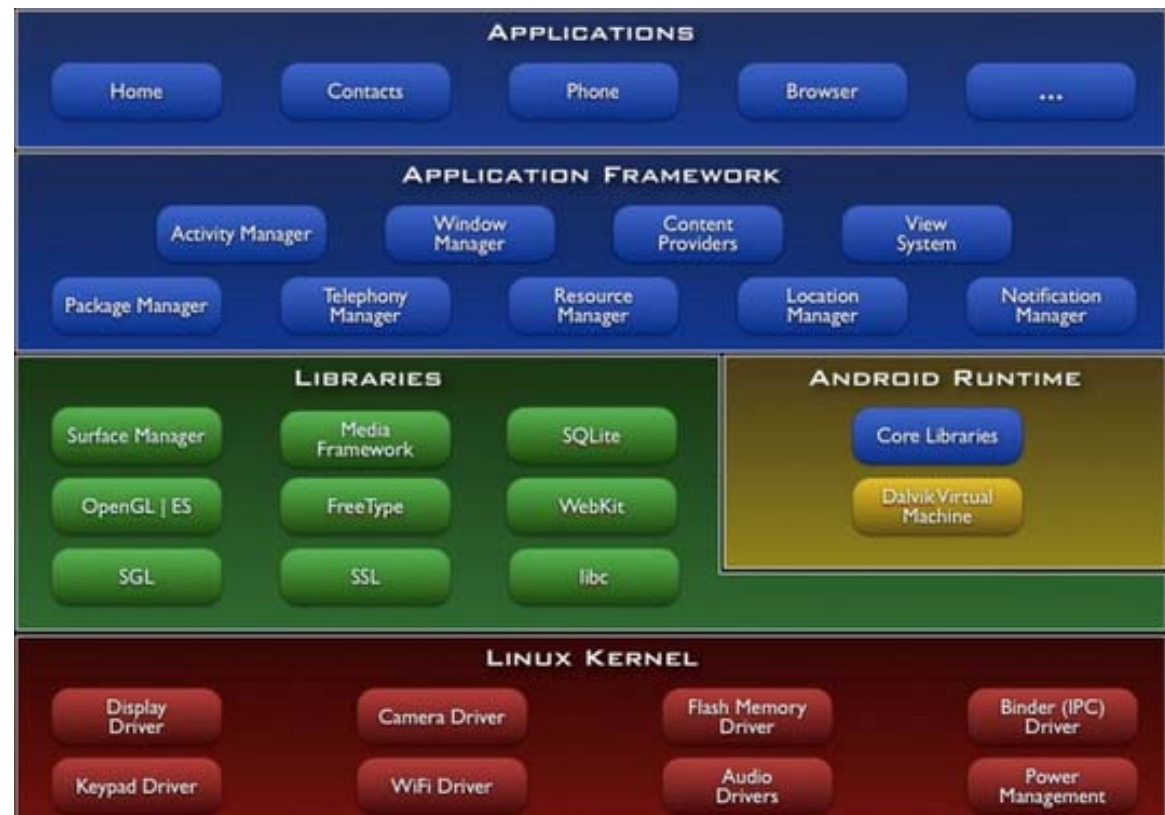


Android Software Framework

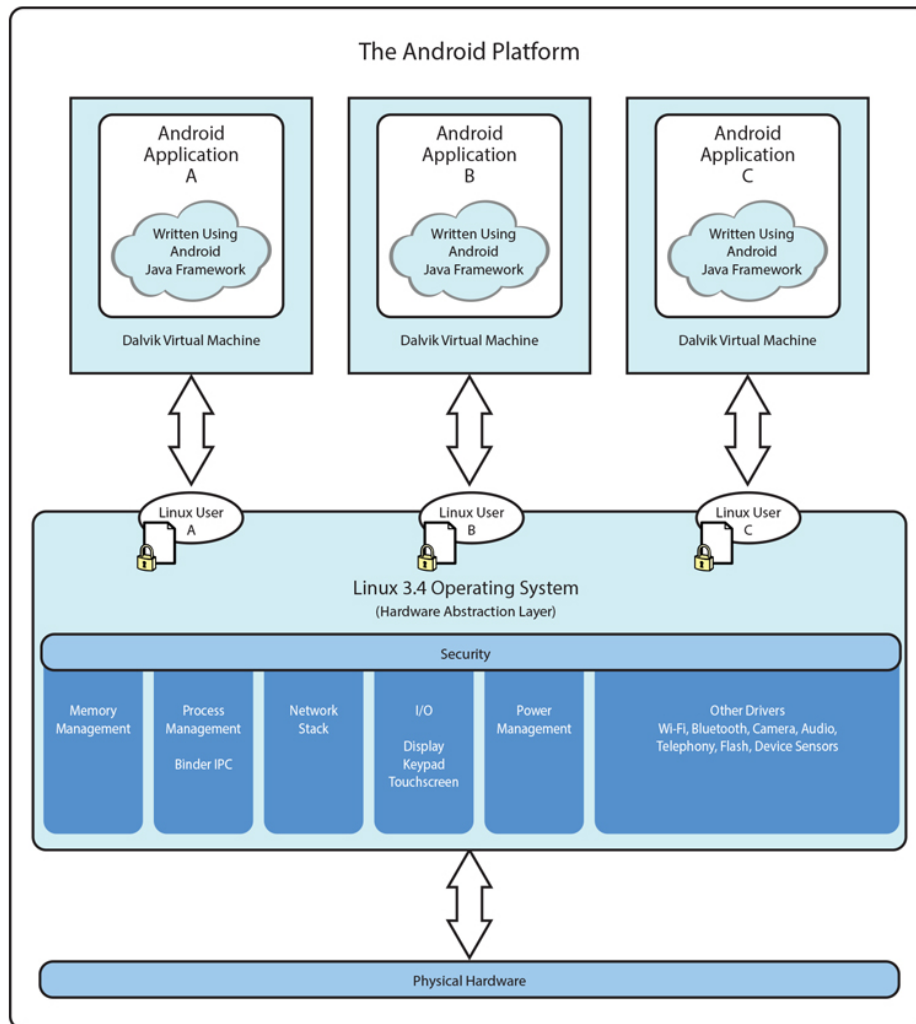


Android Software Framework

- **OS:** has Linux kernel, drivers
- **Apps:** programmed in Java
- **Libraries:** OpenGL ES (graphics), SQLite (database), etc

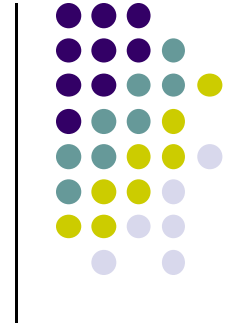


Android Software Framework



Ref: Introduction to Android Programming, Anuzzi, Darcey & Conder

- Each Android app runs in its own security sandbox (VM, minimizes complete system crashes)
- Android OS multi-user Linux system
- Each app is a different user (assigned unique Linux ID)
- Access control: only process with the app's user ID can access its files
- Android starts app's process when its components need to be executed, shuts down the process when no longer needed



EML: Cooperative Based Groups



EML: Cooperative Based Groups

- Japanese students visiting Boston for 2 week vacation
- Speak little English, need help to find
 - Attractions to visit, where to stay (cheap, central), meet Americans, getting around, eat (Japanese, some Boston food), weather info, events, anything
- Your task: Search android market for helpful apps (6 mins)
 - **Runs on mobile device:** 2 points
 - **Truly mobile:** 5 points
 - **Ubicomp or smartwatch:** 10 points





References

- Android App Development for Beginners videos by Bucky Roberts (thenewboston)
- 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