Smartphone Programming Lecture #1

Android

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Required Hardware & Software

- Hardware
  - PC or laptop (Mac, Windows, Linux)
  - Android Phone (even a cheap one will do)
- Software
  - Android Studio
  - Java development kit

Main Topics

- Android development environment
- Android user interface
- Data persistence
- Messaging
- Location
- Networking
- Android services
- Android sensing

Technical terms

- Activity (java and XML)

- View

- Manifest

- Services

- Content provider

- Broadcast receivers

- Resources

- APK (Android packages)

What is Android?

- Based on Linux
- Originally developed by a startup company named "Android"
- 2005 Google purchased the startup
- Most of the Android code is open-source
- Android offers a unified approach to application development

Android Versions

Code name	Version number	Linux kernel version[3]	Initial release date	API level
(No codename)[4]	1.0	?	September 23, 2008	1
Petit Four[4]	1.1	2.6	February 9, 2009	2
Cupcake	1.5	2.6.27	April 27, 2009	3
Donut[5]	1.6	2.6.29	September 15, 2009	4
Eclair[6]	2.0 – 2.1	2.6.29	October 26, 2009	5 – 7
Froyo[7]	2.2 – 2.2.3	2.6.32	May 20, 2010	8
Gingerbread[8]	2.3 – 2.3.7	2.6.35	December 6, 2010	9 – 10
Honeycomb[9]	3.0 – 3.2.6	2.6.36	February 22, 2011	11 – 13
Ice Cream Sandwich[10]	4.0 – 4.0.4	3.0.1	October 18, 2011	14 – 15
Jelly Bean[11]	4.1 – 4.3.1	3.0.31 to 3.4.39	July 9, 2012	16 – 18
KitKat[12]	4.4 – 4.4.4	3.10	October 31, 2013	19 – 20
Lollipop[13]	5.0 – 5.1.1	3.16	November 12, 2014	21 – 22[14]
Marshmallow[15]	6.0 – 6.0.1	3.18	October 5, 2015	23
Nougat[16]	7.0 – 7.1.2	4.4	August 22, 2016	24 – 25
Oreo[17]	8.0 – 8.1	4.10	August 21, 2017	26 – 27
Pie[18]	9.0	4.4.107, 4.9.84, and 4.14.42	August 6, 2018	28

Legend: Old version   Older version, still supported   **Latest version**

- https://en.wikipedia.org/wiki/Android_version_history

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Android Architecture
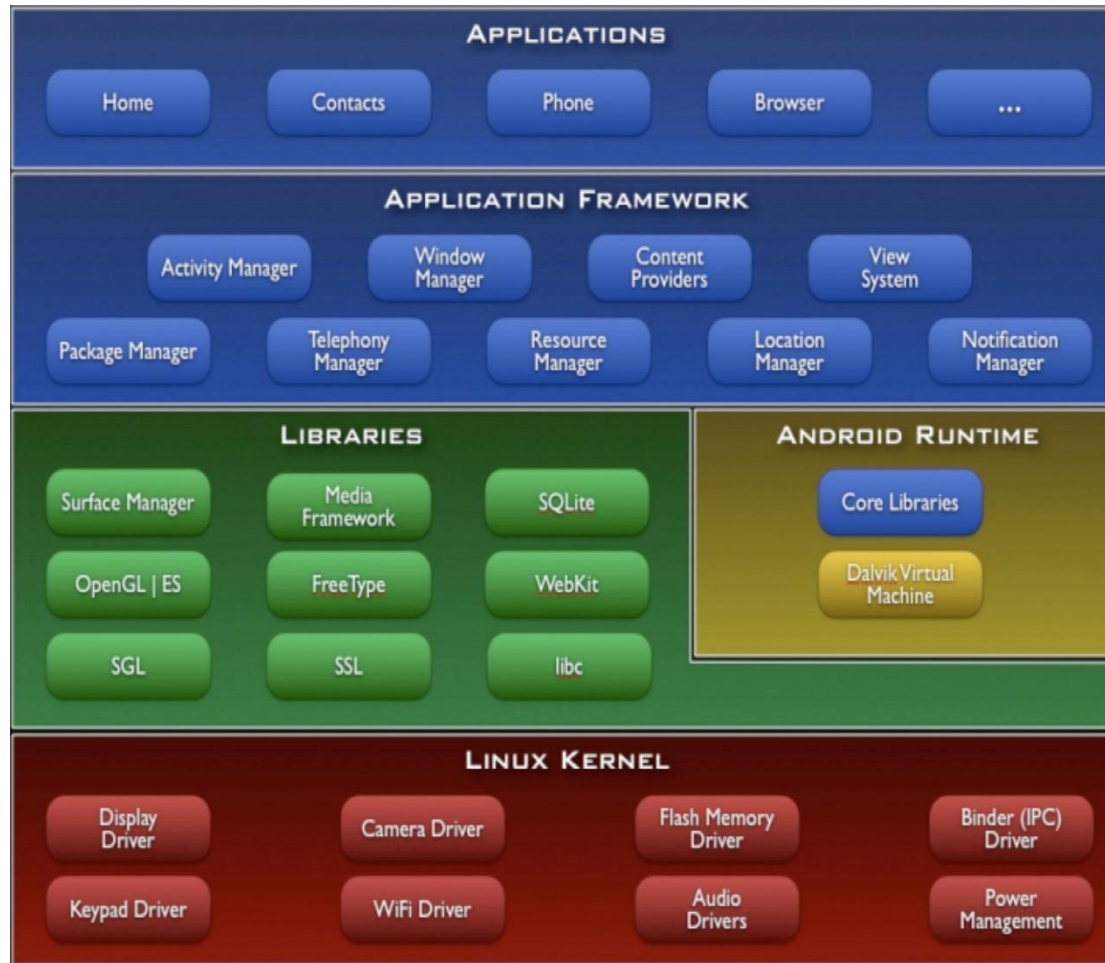
Android runtime (ART) is the managed runtime used by applications and some system services on Android. ART and its predecessor Dalvik were originally created specifically for the Android project

Dalvik is a discontinued [process virtual machine](#) (VM) in [Google](#)'s [Android operating system](#) that executes applications written for Android.

Refernces:
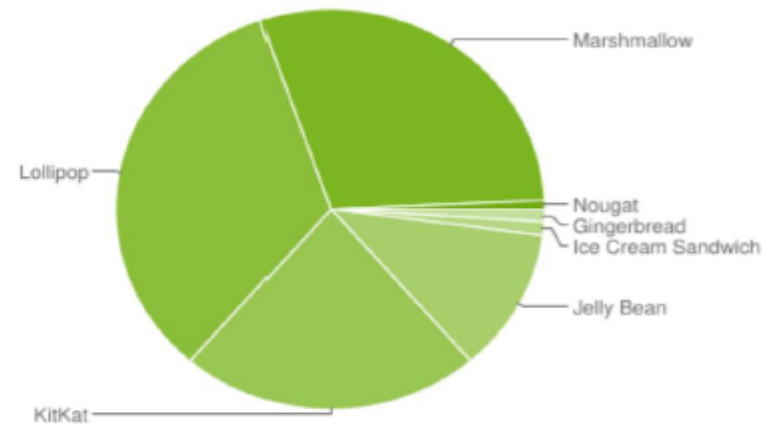• https://source.android.com/devices/tech/dalvik
• https://developer.android.com/about/

Blue background:
Java/ Kotlin
Other colors:
C/C++

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January 2017

Version	Codename	API	Distribution
2.3.3 - 2.3.7	Gingerbread	10	1.0%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	1.1%
4.1.x	Jelly Bean	16	4.0%
4.2.x		17	5.9%
4.3		18	1.7%
4.4	KitKat	19	22.6%
5.0	Lollipop	21	10.1%
5.1		22	23.3%
6.0	Marshmallow	23	29.6%
7.0	Nougat	24	0.5%
7.1		25	0.2%

- Developer decision?

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Mobile OS distribution 2017 q1

Smartphone OS Market Share Q1 2017

Windows Phone 0.1%

iOS 14.7%

Android 85%
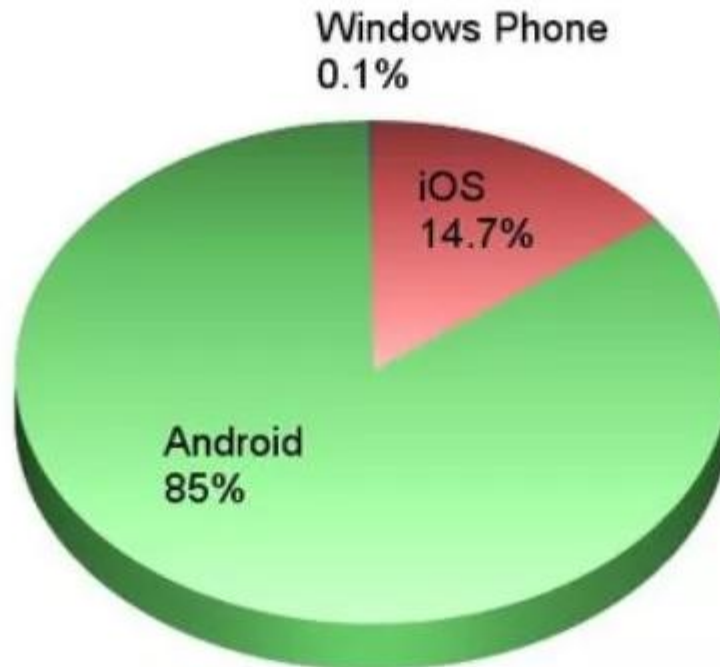
Smartphone Vendor Market Share, 2017 Q1

Period	Samsung	Apple	Huawei	OPPO	vivo	Others
2016Q1	23.8%	15.4%	8.4%	5.9%	4.4%	42.1%
2016Q2	22.7%	11.7%	9.3%	6.6%	4.8%	45.0%
2016Q3	20.9%	12.5%	9.3%	7.1%	5.9%	44.3%
2016Q4	18.0%	18.2%	10.5%	7.3%	5.7%	40.2%
2017Q1	23.3%	14.7%	10.0%	7.5%	5.5%	39.0%

Source: IDC, May 2017

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Android Development Tools

- Android Studio: http://developer.android.com/sdk/index.html
  - Android SDK
  - You can use SDK Manager to download lower API Levels
  - I suggest to down to 17
- Java SE Development Toolkit 8:
  www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html

Download the Android SDK Tools

Before downloading, you must agree to the following terms and conditions.

Terms and Conditions

This is the Android Software Development Kit License Agreement

1. Introduction

1.1 The Android Software Development Kit (referred to in the License Agreement as the "SDK" and specifically including the Android system files, packaged APIs, and Google APIs add-ons) is licensed to you subject to the terms of the License Agreement. The License Agreement forms a legally binding contract between you and Google in relation to your use of the SDK.

1.2 "Android" means the Android software stack for devices, as made available under the Android Open Source Project, which is located at the following URL: http://source.android.com/, as updated from time to time.

☐ I have read and agree with the above terms and conditions

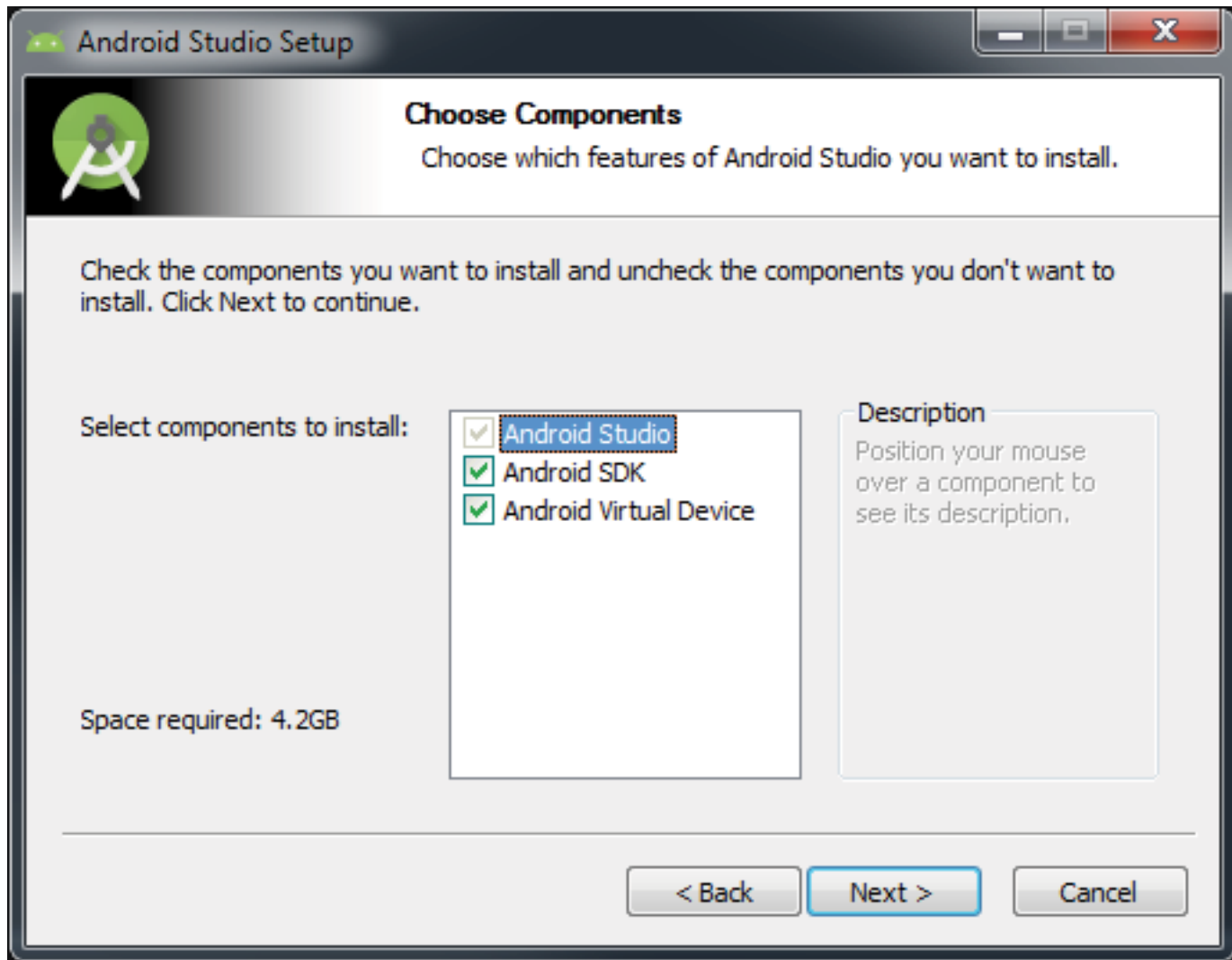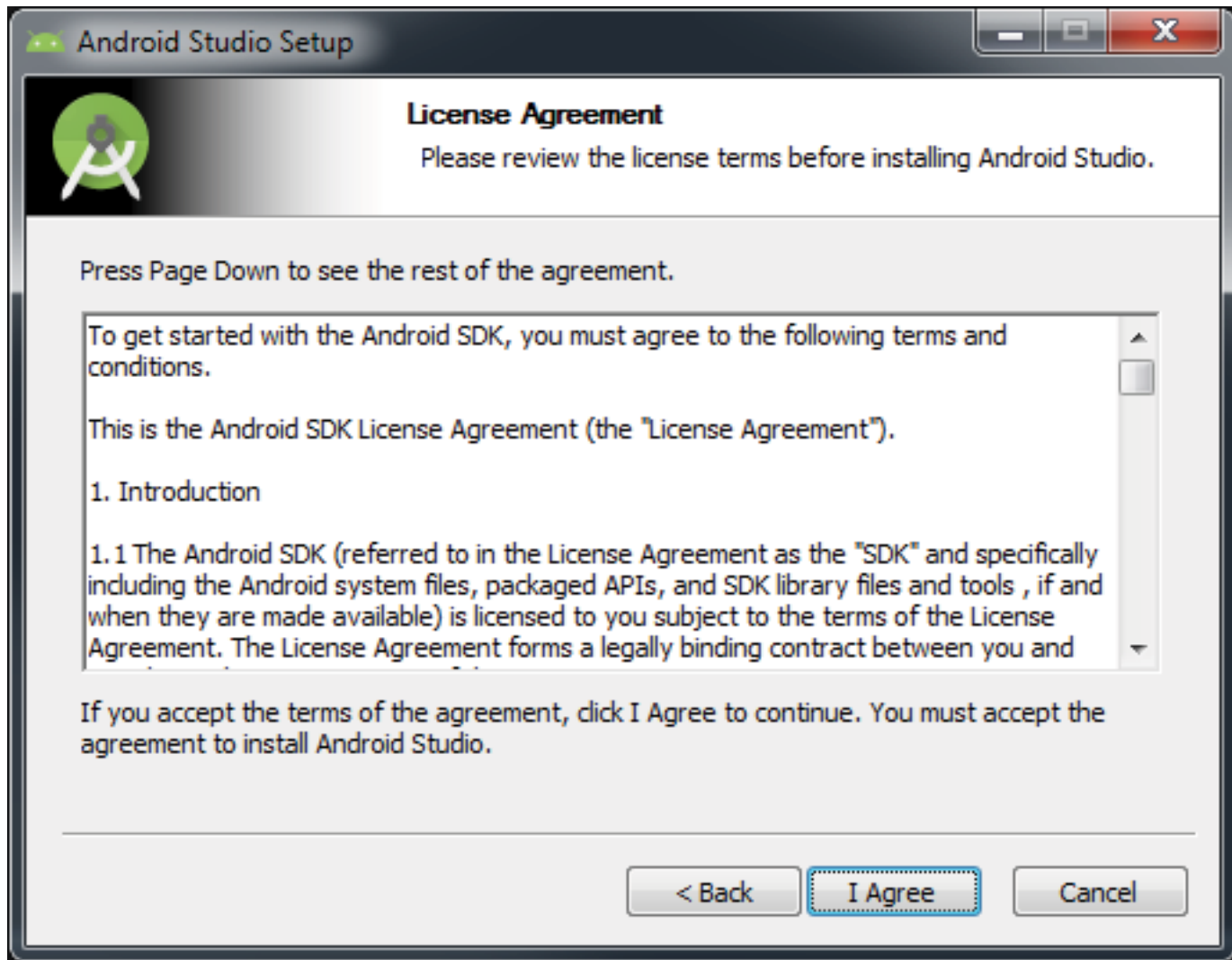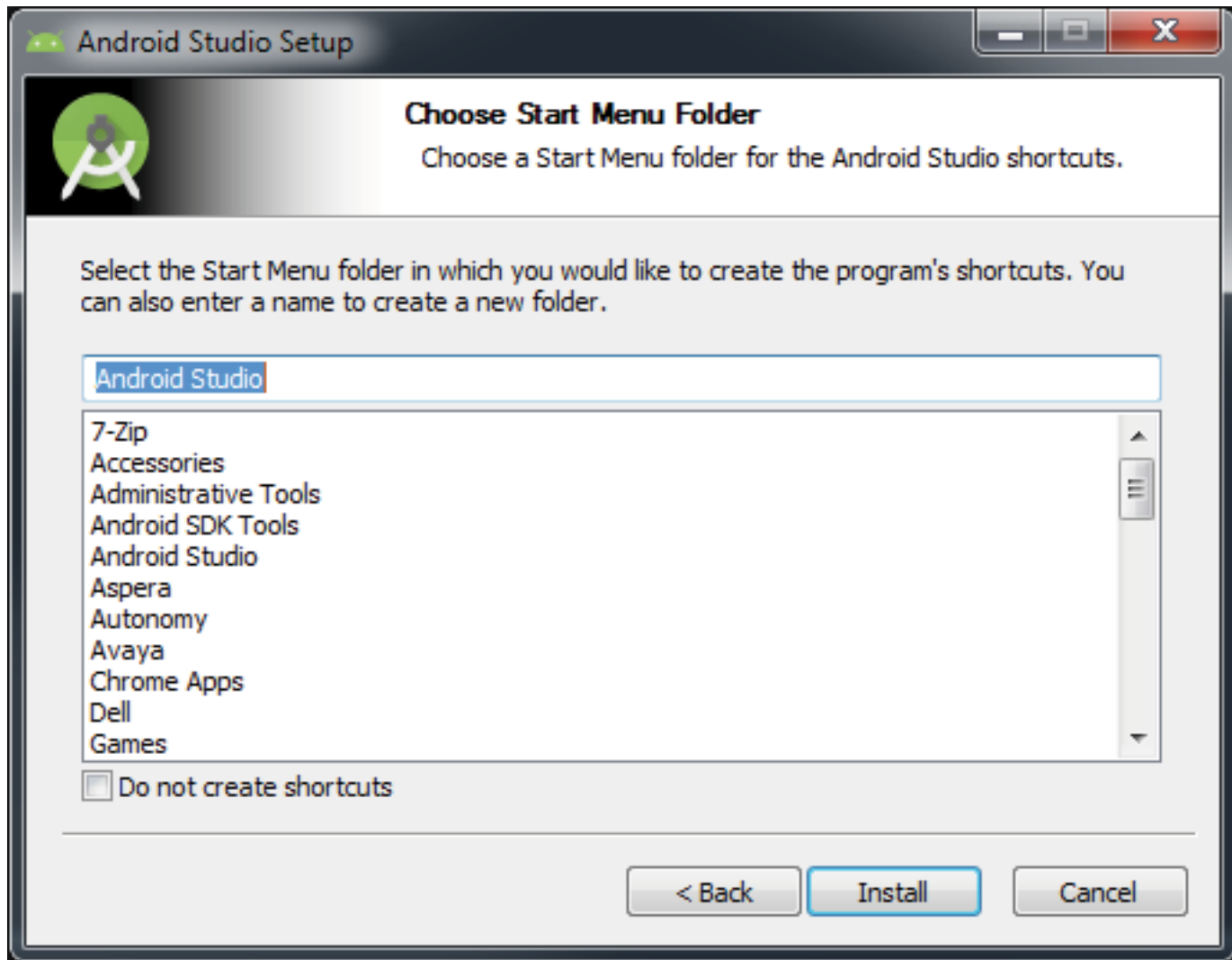**DOWNLOAD ANDROID STUDIO 2.0 FOR WINDOWS (1166 MB)**

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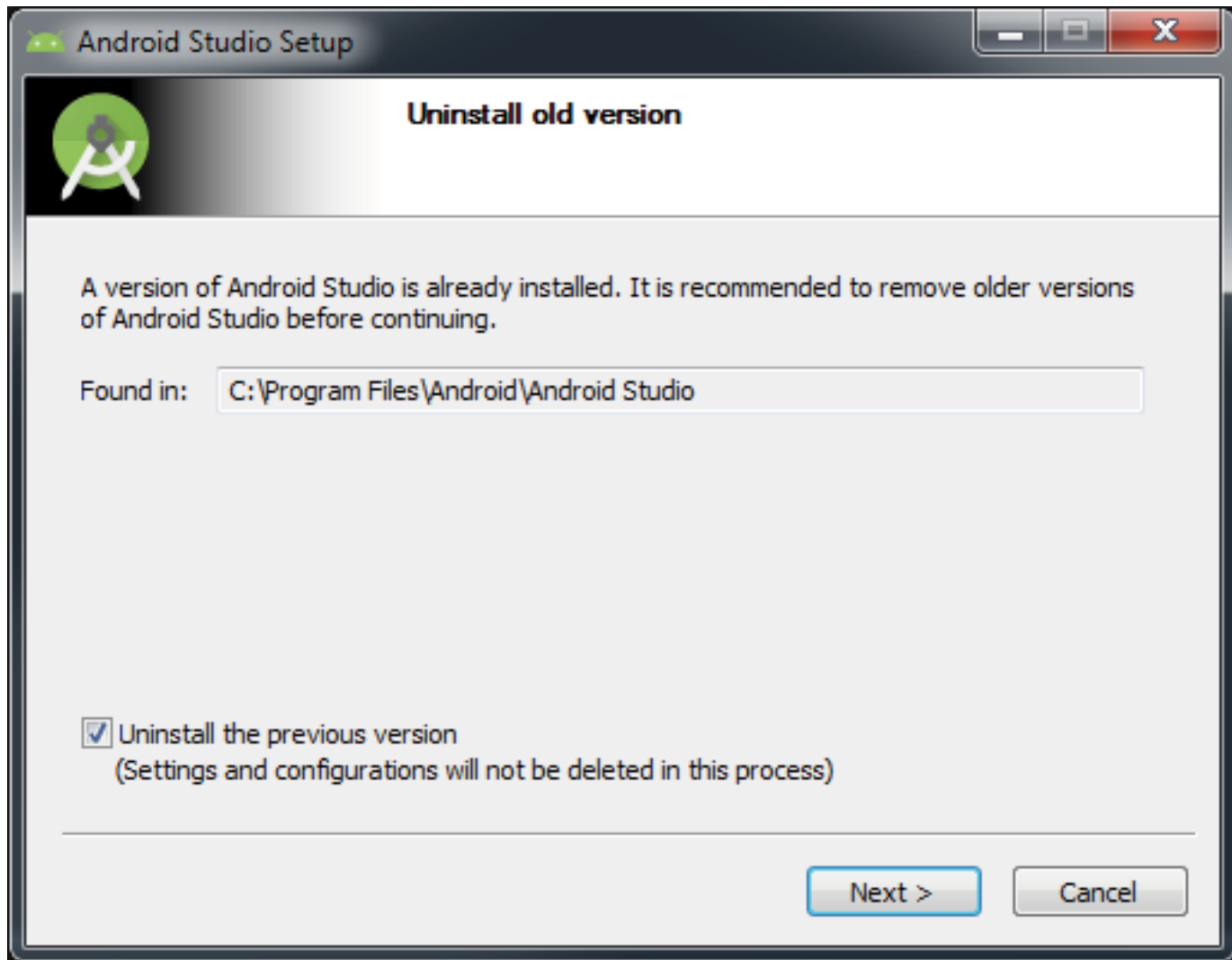
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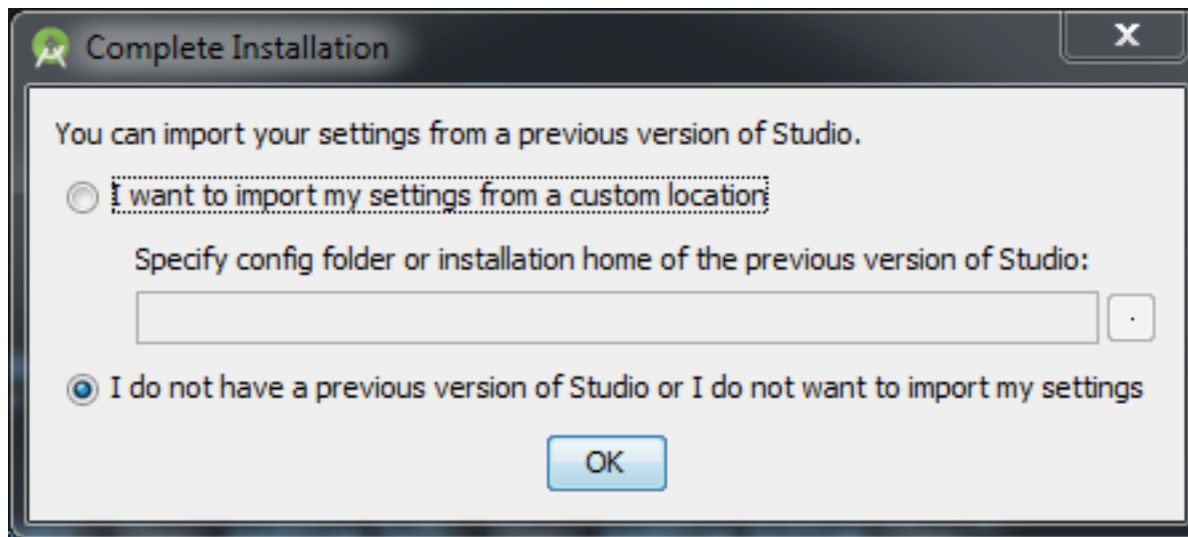Dr. khaled Alqawasmi/ Zarqa University/
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Android Studio Setup Wizard

Install Type

Choose the type of setup you want for Android Studio:

◉ **Standard**

Android Studio will be installed with the most common settings and options.
Recommended for most users.

◯ **Custom**

You can customize installation settings and components installed.

[Previous] [Next] [Cancel] [Finish]

Android Studio

Version 2.0

☀ Start a new Android Studio project

📁 Open an existing Android Studio project

⬇ Check out project from Version Control ▾

📥 Import project (Eclipse ADT, Gradle, etc.)

📥 Import an Android code sample

⚙ Configure ▾   Get Help ▾

License Agreement

Android Studio

Licenses

▼ android-sdk-preview-license

   ⬇ Android SDK Platform N, rev 2

To get started with the Android SDK Preview, you must agree to the following terms and conditions. As described below, please note that this is a preview version of the Android SDK, subject to change, that you use at your own risk. The Android SDK Preview is not a stable release, and may contain errors and defects that can result in serious damage to your computer systems, devices and data.

This is the Android SDK Preview License Agreement (the "License Agreement").

1. Introduction

1.1 The Android SDK Preview (referred to in the License Agreement as the "Preview" and specifically including the Android system files, packaged APIs, and Preview library files, if and when they are made available) is licensed to you subject to the terms of the License Agreement. The License Agreement forms a legally binding contract between you and Google in relation to your use of the Preview.

1.2 "Android" means the Android software stack for devices, as made available under the Android Open Source Project, which is located at the following URL: http://source.android.com/, as updated from time to time.

1.3 "Google" means Google Inc., a Delaware corporation with principal place of business at 1600 Amphitheatre Parkway, Mountain View, CA 94043, United States.

2. Accepting the License Agreement

2.1 In order to use the Preview, you must first agree to the License Agreement. You may not use
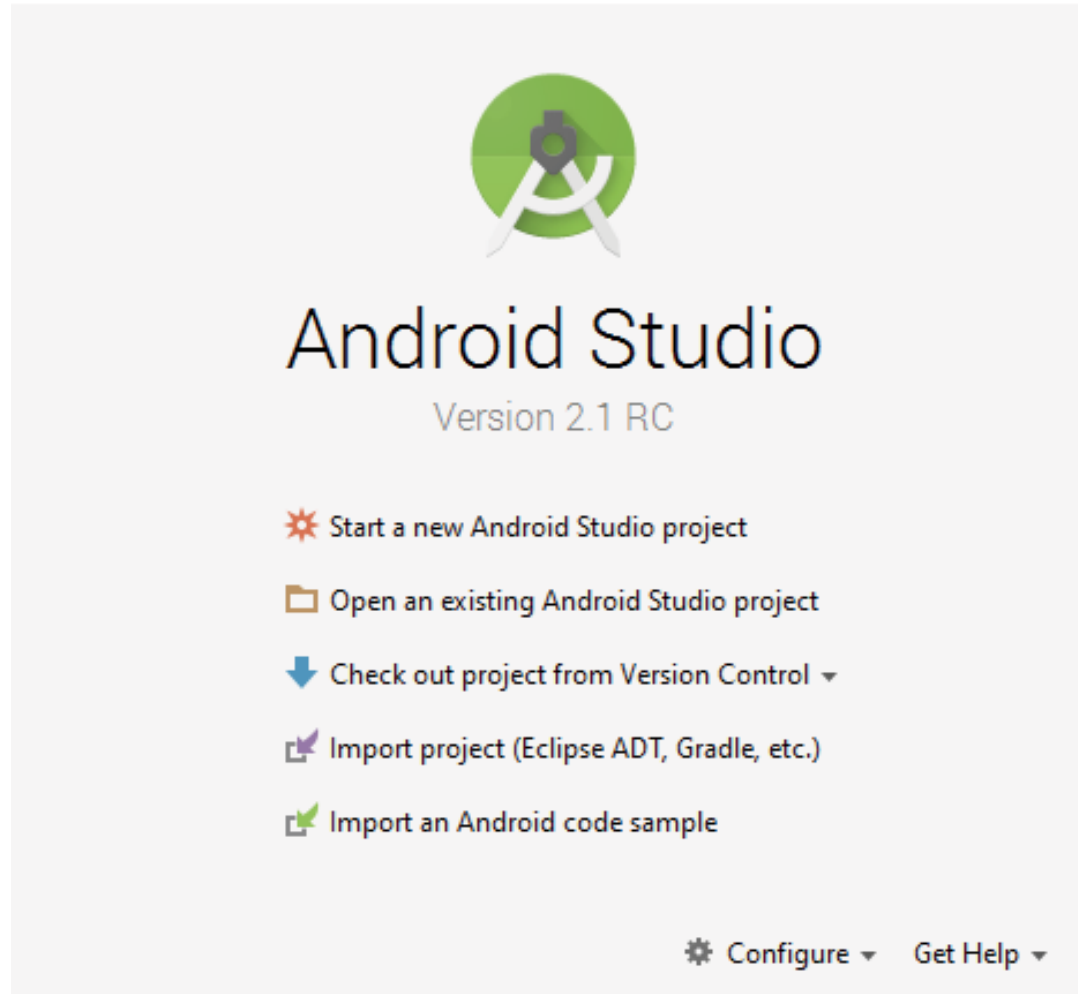
○ Decline   ● Accept

Previous   **Next**   Cancel   Finish

Start Android Studio so that the Welcome screen is visible. Click Start a New Android Studio Project. You see the Create New Project Wizard.

Set up a HelloWorld project. Type Chapter1Helloworld in the Application Name field

Set target Android devices. Accept default, click next
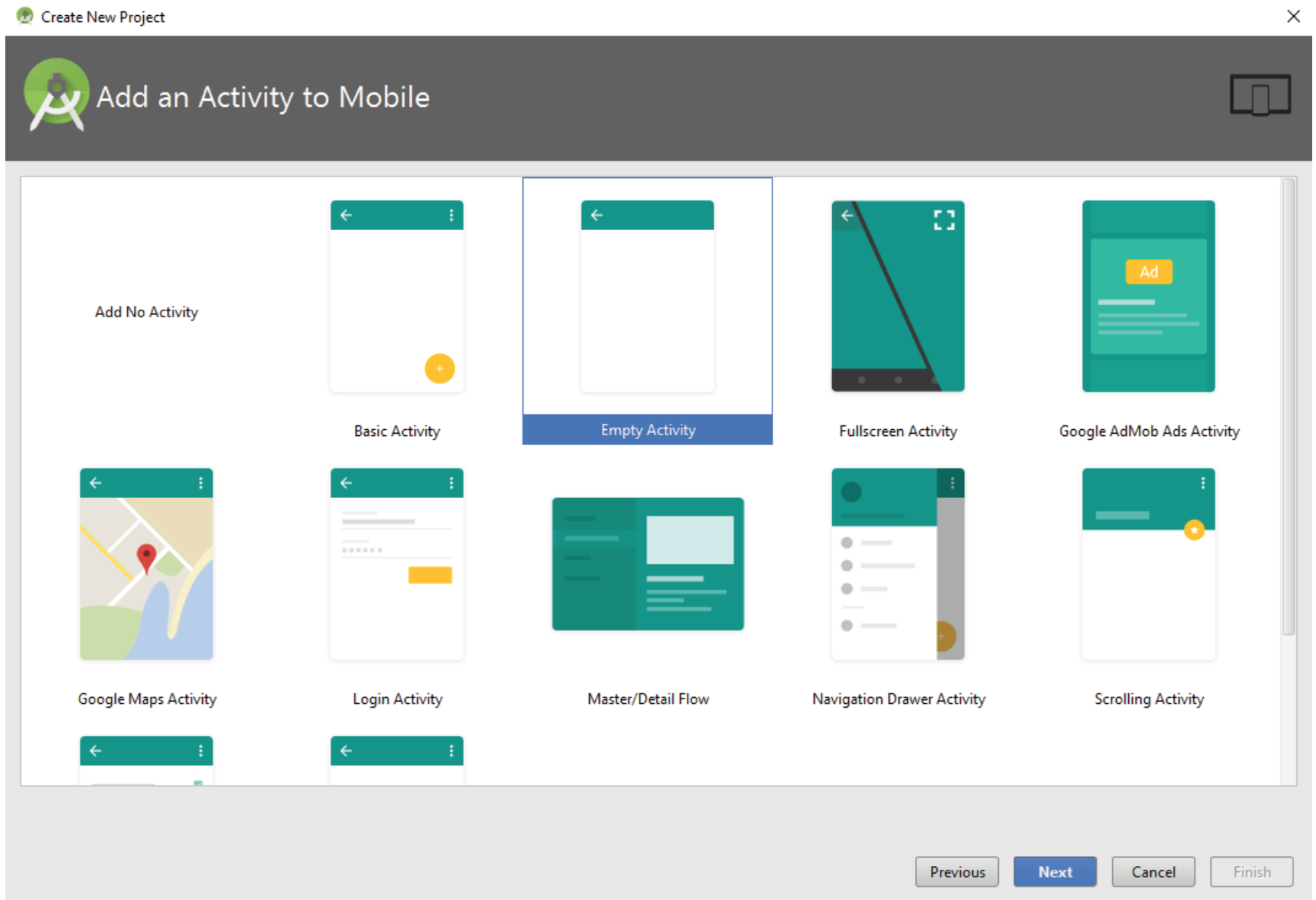
Add and Activity to Mobile. Accept default, click next

Customize the Activity. Accept default, click next

Create New Project

Customize the Activity

Creates a new empty activity

Activity Name: MainActivity

☑ Generate Layout File

Layout Name: activity_main
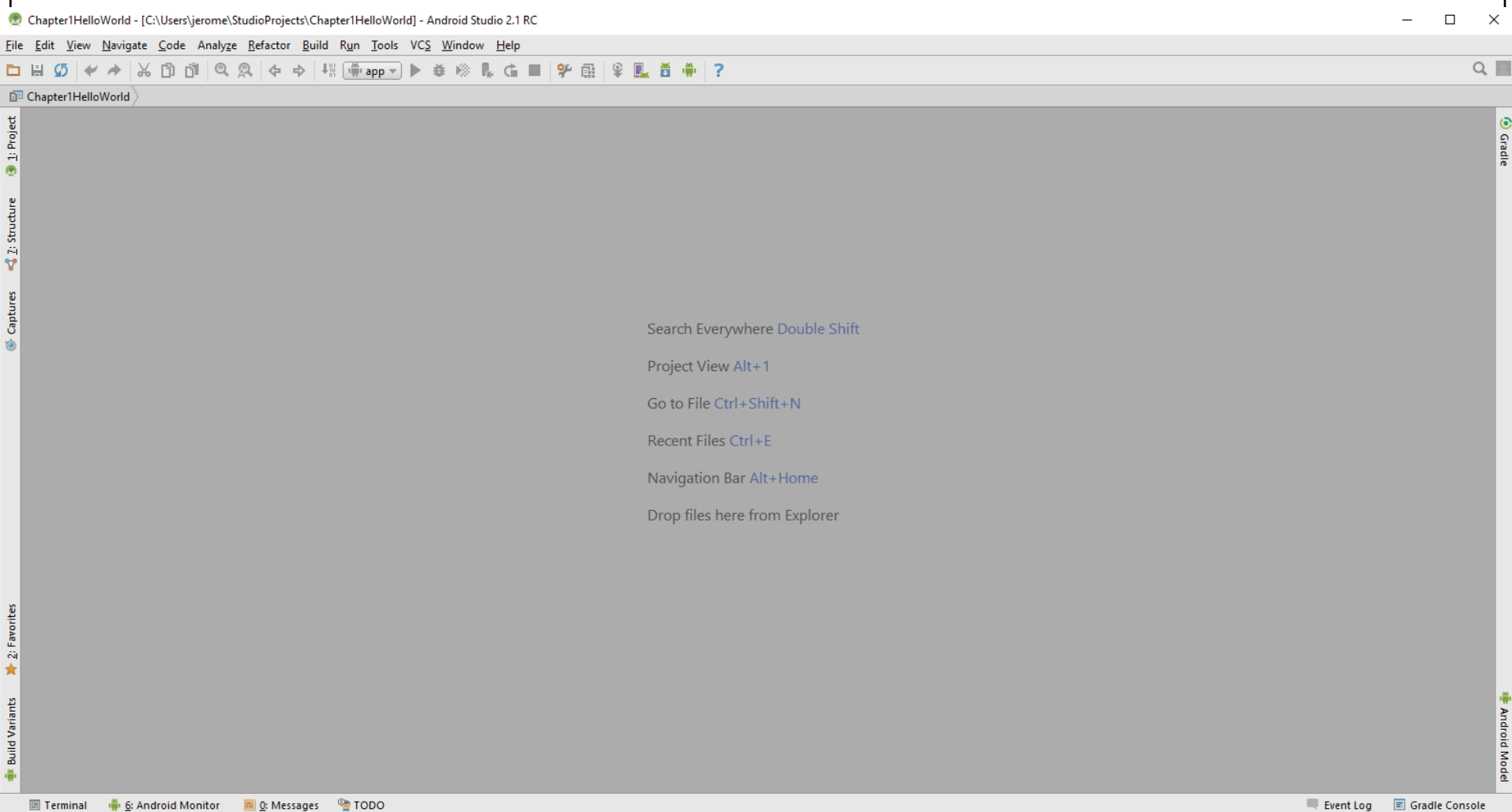
Empty Activity

The name of the activity class to create

Previous   Next   Cancel   Finish

After clicking finish, shows the open Android Studio IDE

Chapter1HelloWorld - [C:\Users\jerome\StudioProjects\Chapter1HelloWorld] - Android Studio 2.1 RC

File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help

Chapter1HelloWorld

Search Everywhere Double Shift

Project View Alt+1

Go to File Ctrl+Shift+N

Recent Files Ctrl+E

Navigation Bar Alt+Home

Drop files here from Explorer

Terminal   6: Android Monitor   0: Messages   TODO   Event Log   Gradle Console
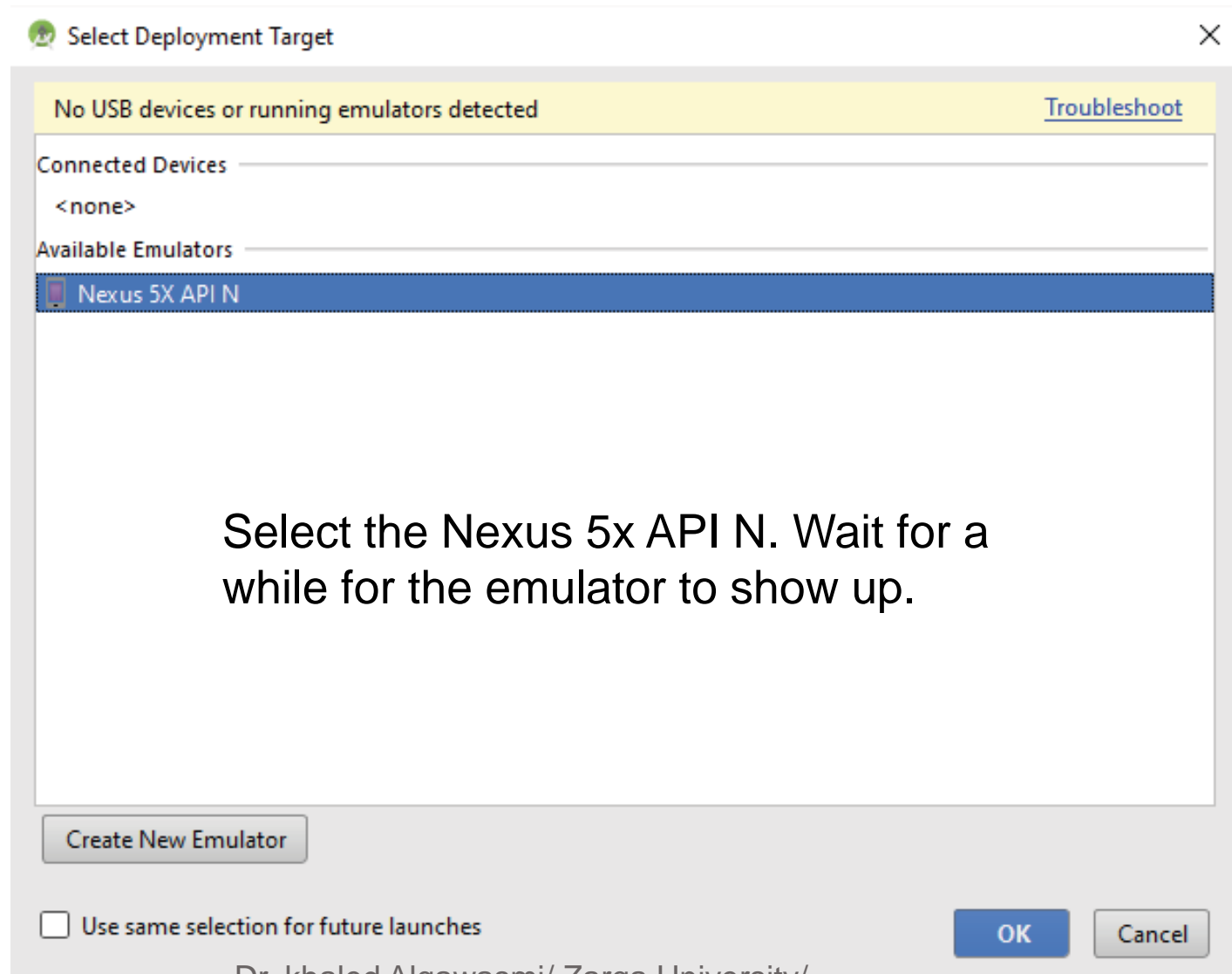
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Launching your first Android App

- By default, when you create a new application in Android Studio, it creates a Hello World application.

- Steps on launching the app

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Select Run ⇨ Run app from the Android Studio menu bar. You should see the Select Deployment Target dialog shown below:

Select the Nexus 5x API N. Wait for a while for the emulator to show up.

Chapter1HelloWorld

Hello World!

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Elements of Android Projects

- ***Application Name***

- —seen by users on app chooser, app list, store

- •***Project Name***

- —in IDE, can be different, often directory

- •***Package Name***

- —Java package name, not using default package

- •***Minimum SDK Level***

- —how far back do you support, ~16 as of Jan 2017

- •***Target SDK Level***

- —device / apiyou had in mind for app, most recent?

Android Projects

- Creating a project results in multiple files and resources being created

- Android Project View
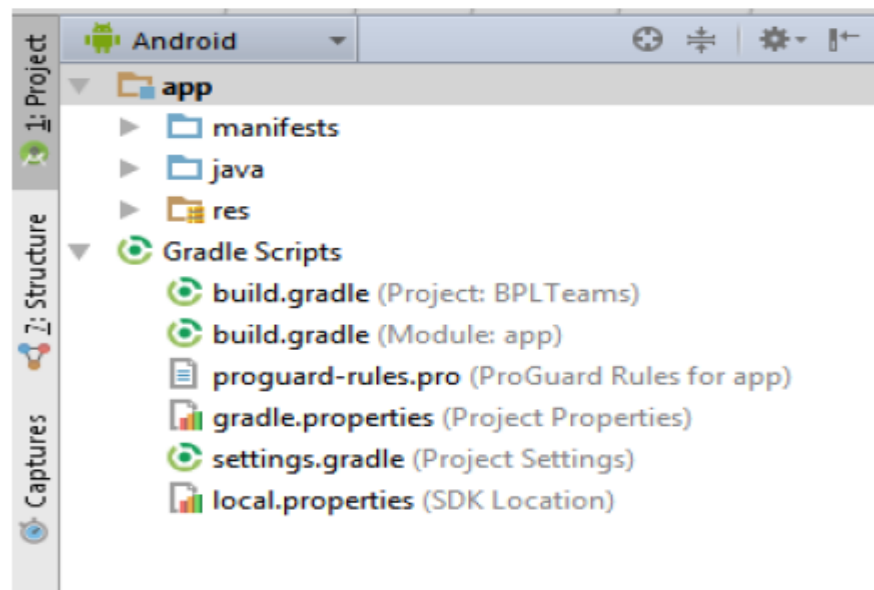
Android Projects -ComponentsManifest

- AndroidManifest.xml

- •Like a table of contents for your app

- •Main activity

- •Target and min SDK

- •Declare all the parts of your apps:

- –activities, services

- •Request permissions

- –network, location, …

- Manifest will be explained in the later chapters in details.
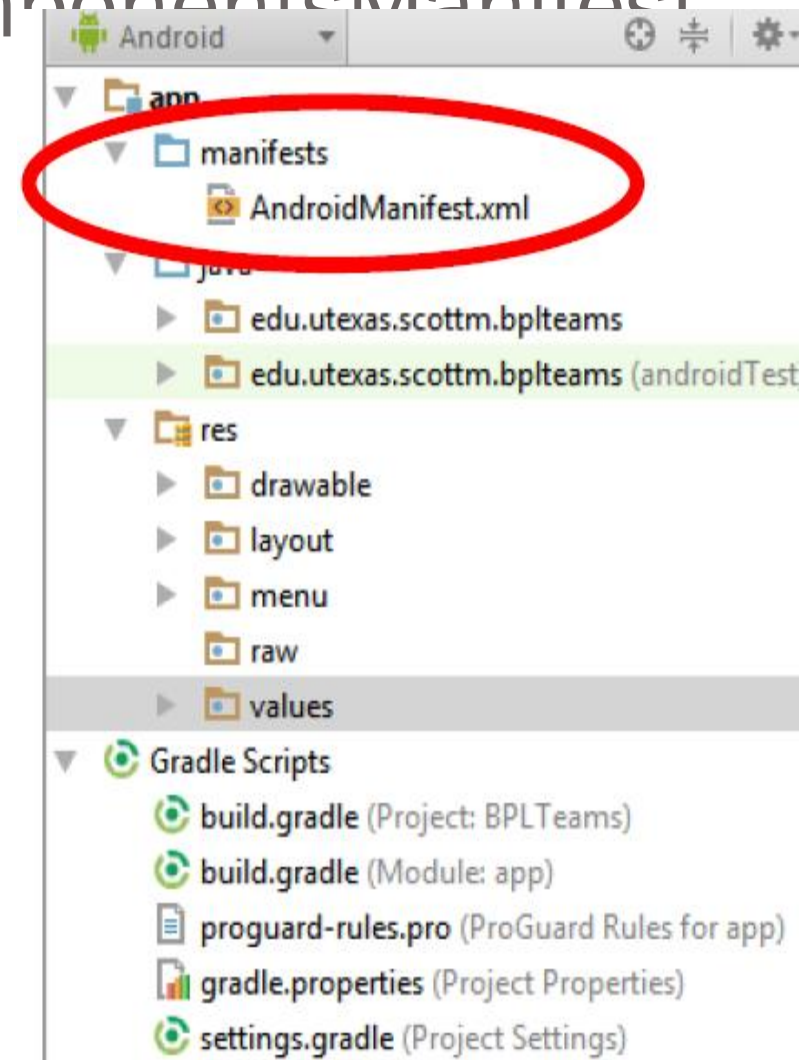
Android Projects -Cor

- Resources or the res directory

- •non source code resources for the app

- •packaged up with app

- •important role and use in development of app
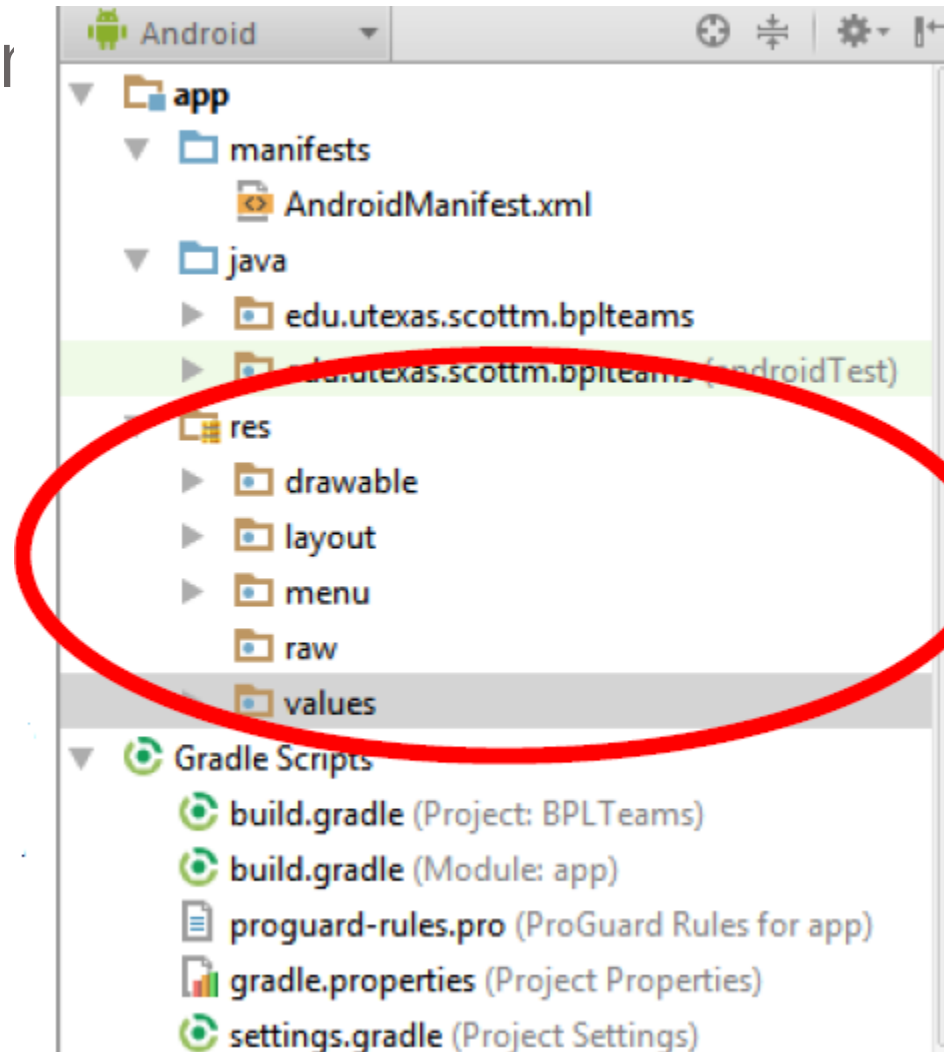
Resource Directories

- res/drawable for graphic images such as png, jpeg

- res/layout for xml files that define the layout of user interfaces inside the app

- res/menu for xml based menu specifications

- res/values for lists of strings, dimensions, colors, lists of data

- res/raw for other kinds of files such as audio clips, video clips, csv files, raw text

- res/xml for other general purpose xml files

Gradle

- *.apk files, Android Package Kit – Android executables

- Development environment takes, source code, manifest, libraries, resources, etc and packages them together in an APK

- Gradle is the build engine that Android Studio uses to convert your project into an APK

- What needs to be created and how to do it

- Like:

  – make for C/C++

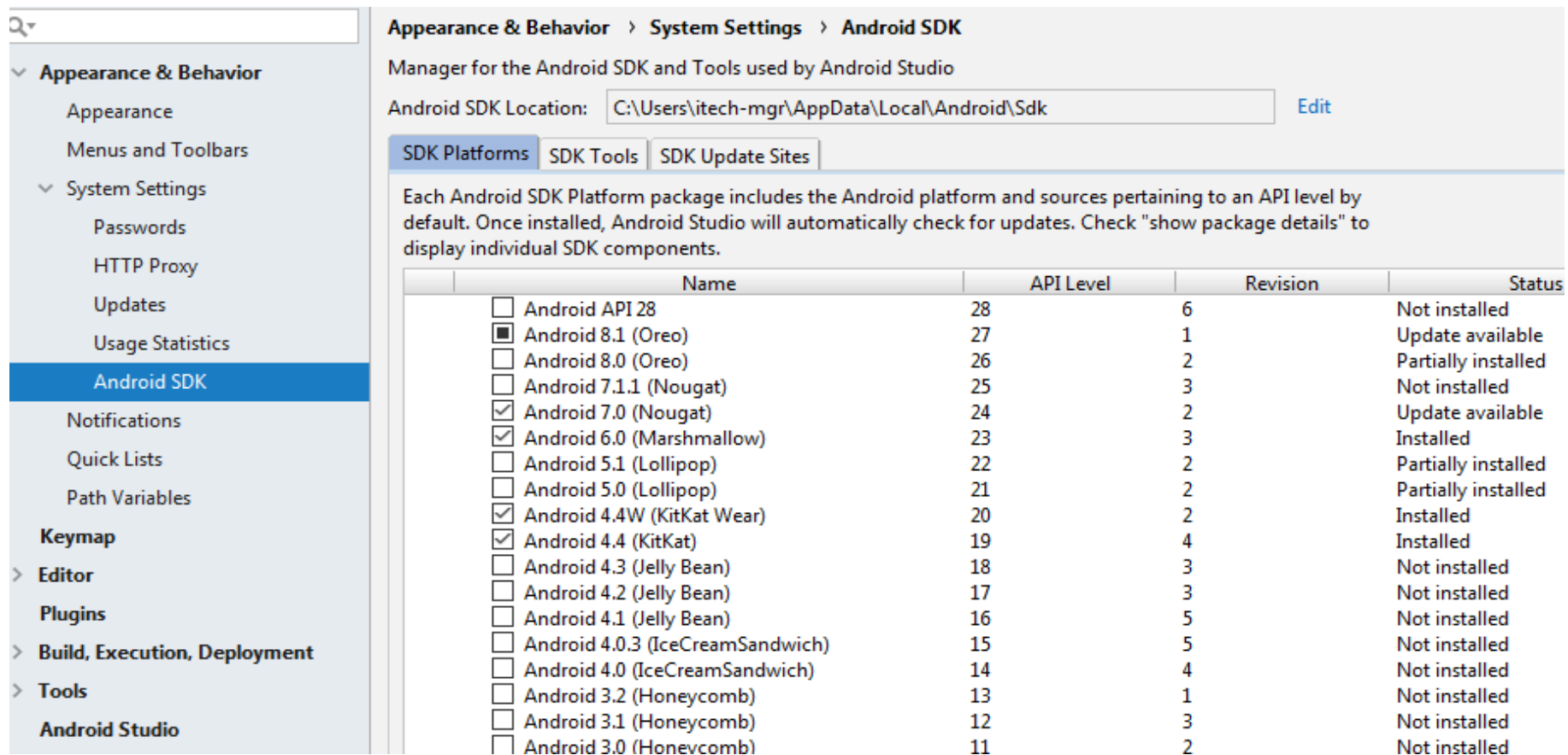 – Ant/Maven for Java

- build.gradle file
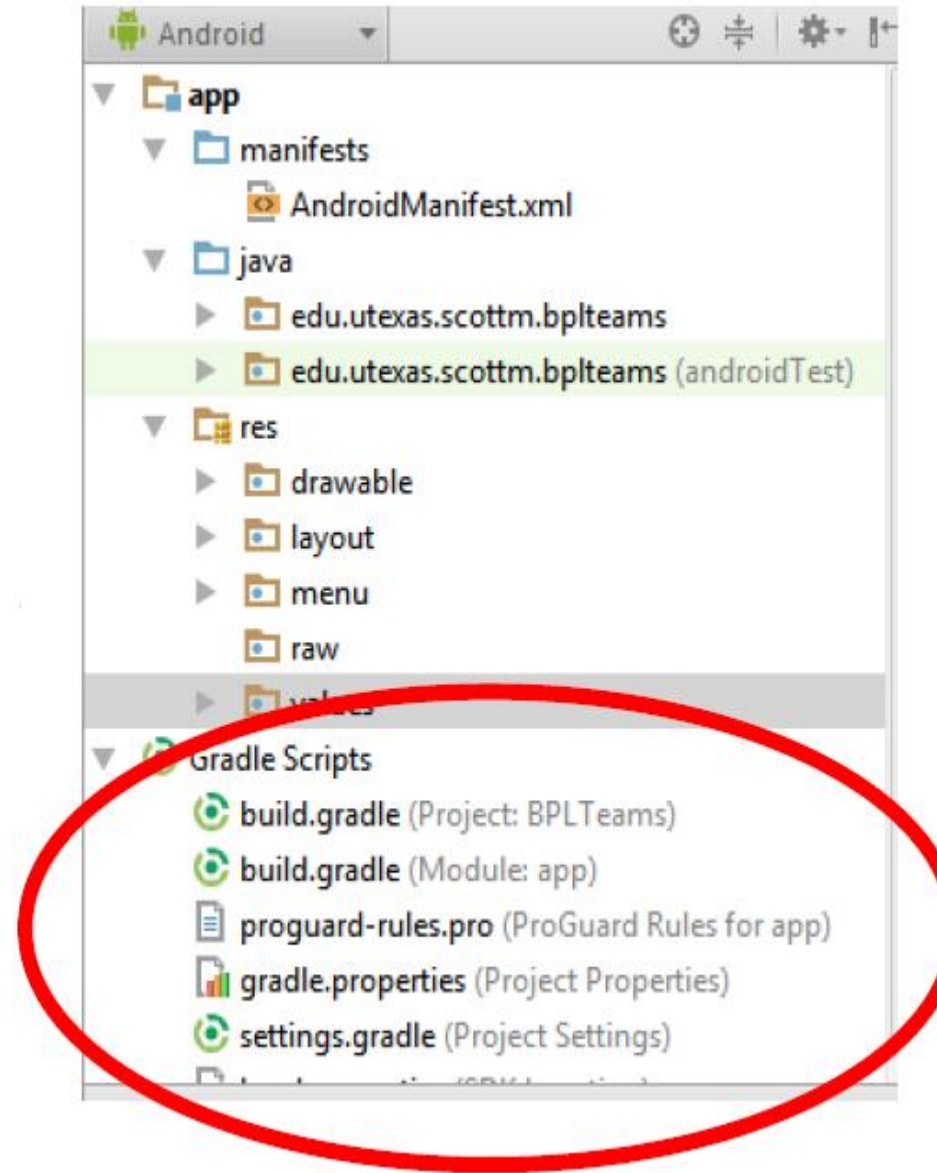
EMULATORS

AVD Manager

SDK Manager
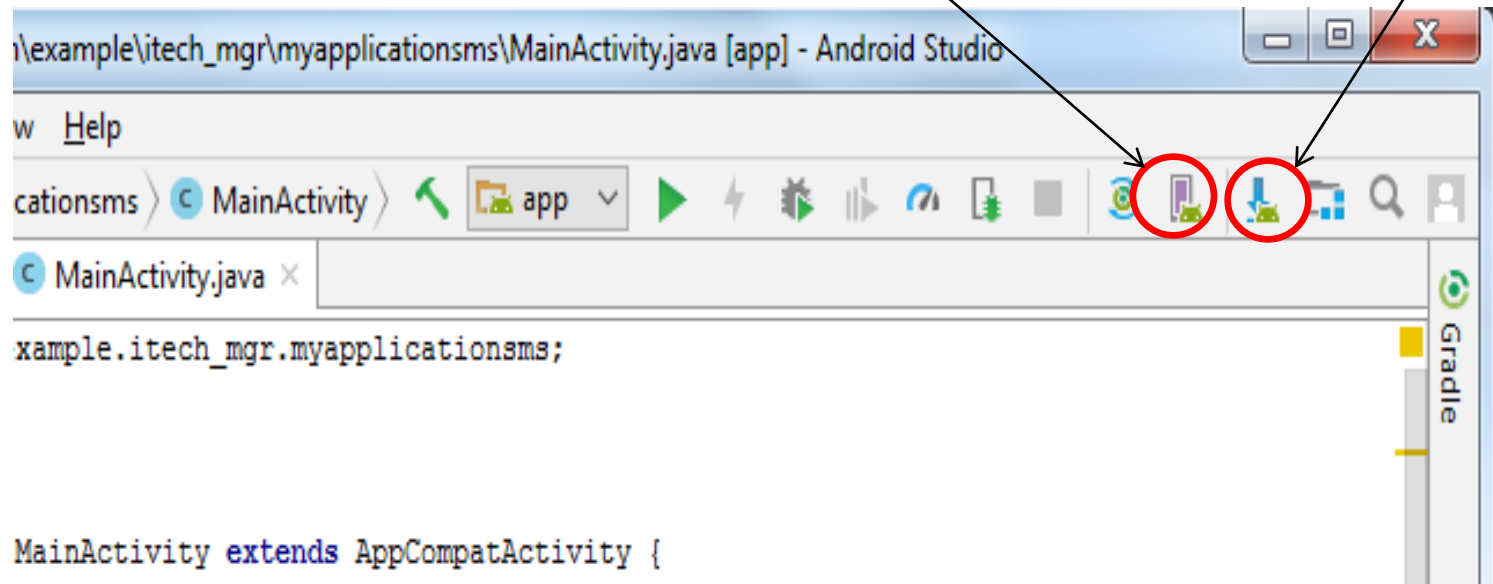
SDK Manager

- The Android SDK Manager helps you download the SDK tools, platforms, and other components you need to develop your apps.

- To open the SDK Manager from Android Studio, click **Tools > SDK Manager** or click **SDK Manager** in the toolbar

Appearance & Behavior > System Settings > Android SDK

Manager for the Android SDK and Tools used by Android Studio

Android SDK Location: C:\Users\itech-mgr\AppData\Local\Android\Sdk   Edit

SDK Platforms   SDK Tools   SDK Update Sites

Each Android SDK Platform package includes the Android platform and sources pertaining to an API level by default. Once installed, Android Studio will automatically check for updates. Check "show package details" to display individual SDK components.

Appearance & Behavior
- Appearance
- Menus and Toolbars
- System Settings
  - Passwords
  - HTTP Proxy
  - Updates
  - Usage Statistics
  - **Android SDK**
- Notifications
- Quick Lists
- Path Variables
- **Keymap**
- **Editor**
- **Plugins**
- **Build, Execution, Deployment**
- **Tools**
- **Android Studio**

| Name	API Level	Revision	Status
☐ Android API 28	28	6	Not installed
☒ Android 8.1 (Oreo)	27	1	Update available
☐ Android 8.0 (Oreo)	26	2	Partially installed
☐ Android 7.1.1 (Nougat)	25	3	Not installed
☑ Android 7.0 (Nougat)	24	2	Update available
☑ Android 6.0 (Marshmallow)	23	3	Installed
☐ Android 5.1 (Lollipop)	22	2	Partially installed
☐ Android 5.0 (Lollipop)	21	2	Partially installed
☑ Android 4.4W (KitKat Wear)	20	2	Installed
☑ Android 4.4 (KitKat)	19	4	Installed
☐ Android 4.3 (Jelly Bean)	18	3	Not installed
☐ Android 4.2 (Jelly Bean)	17	3	Not installed
☐ Android 4.1 (Jelly Bean)	16	5	Not installed
☐ Android 4.0.3 (IceCreamSandwich)	15	5	Not installed
☐ Android 4.0 (IceCreamSandwich)	14	4	Not installed
☐ Android 3.2 (Honeycomb)	13	1	Not installed
☐ Android 3.1 (Honeycomb)	12	3	Not installed
☐ Android 3.0 (Honeycomb)	11	2	Not installed

Managing virtual devices

- An Android Virtual Device (AVD) is a configuration that defines the characteristics of an Android phone, tablet, Wear OS, or Android TV device that you want to simulate in the Android Emulator.

- To open the AVD Manager, do one of the following:

- Select **Tools > AVD Manager**.

- Click **AVD Manager** in the toolbar.

Android Emulator or AVD

- Emulator is useful for testing apps but is not a substitute for a real device

- Emulators are called **Android Virtual Devices (AVDs)**

- Android SDK and AVD Manager allows you to create AVDs that target any Android API level

- AVD have configurable resolutions, RAM, SD cards, skins, and other hardware

Android Emulator: 1.6
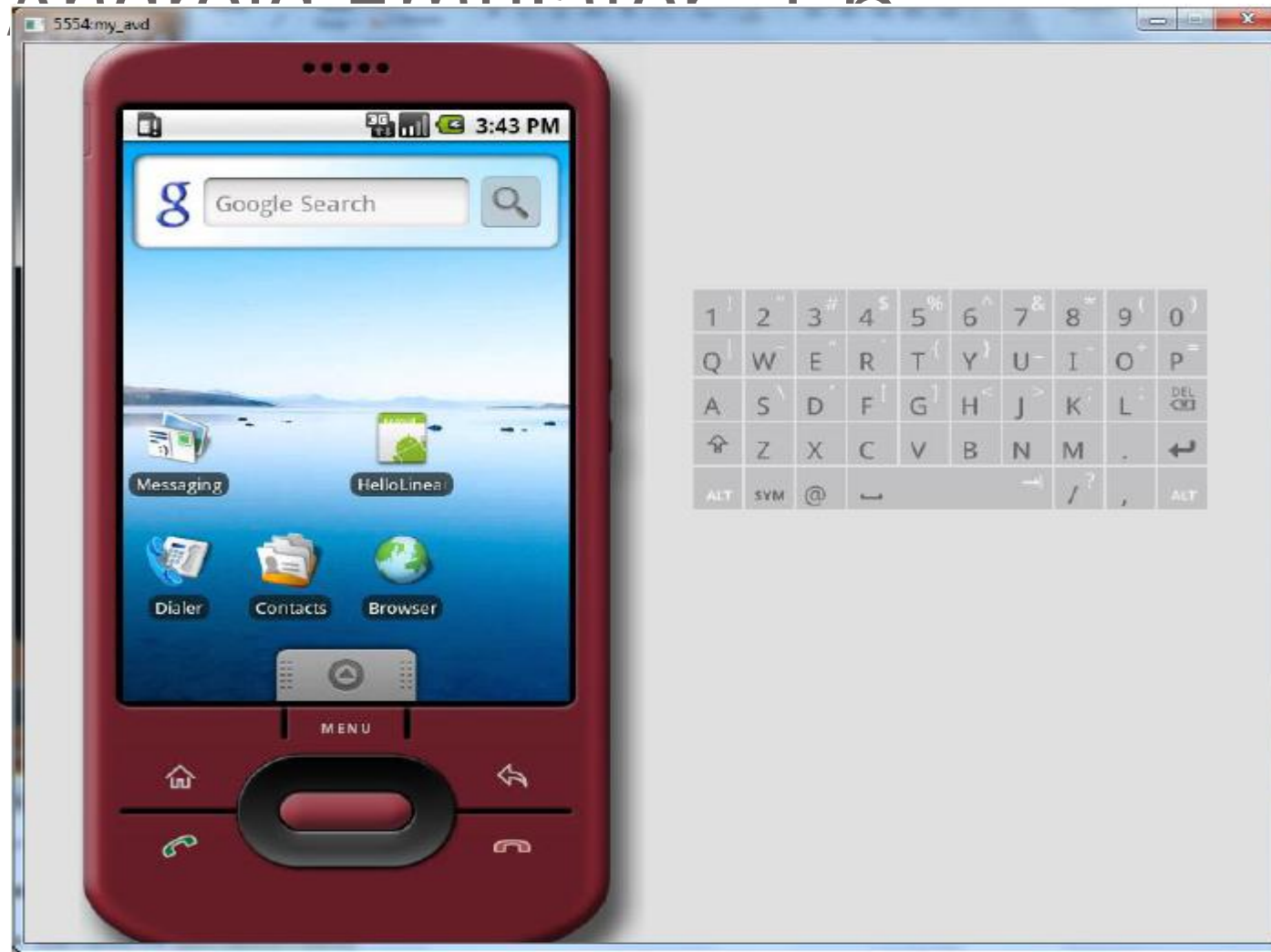
Dr. khaled Alqawasmi/ Zarqa University/
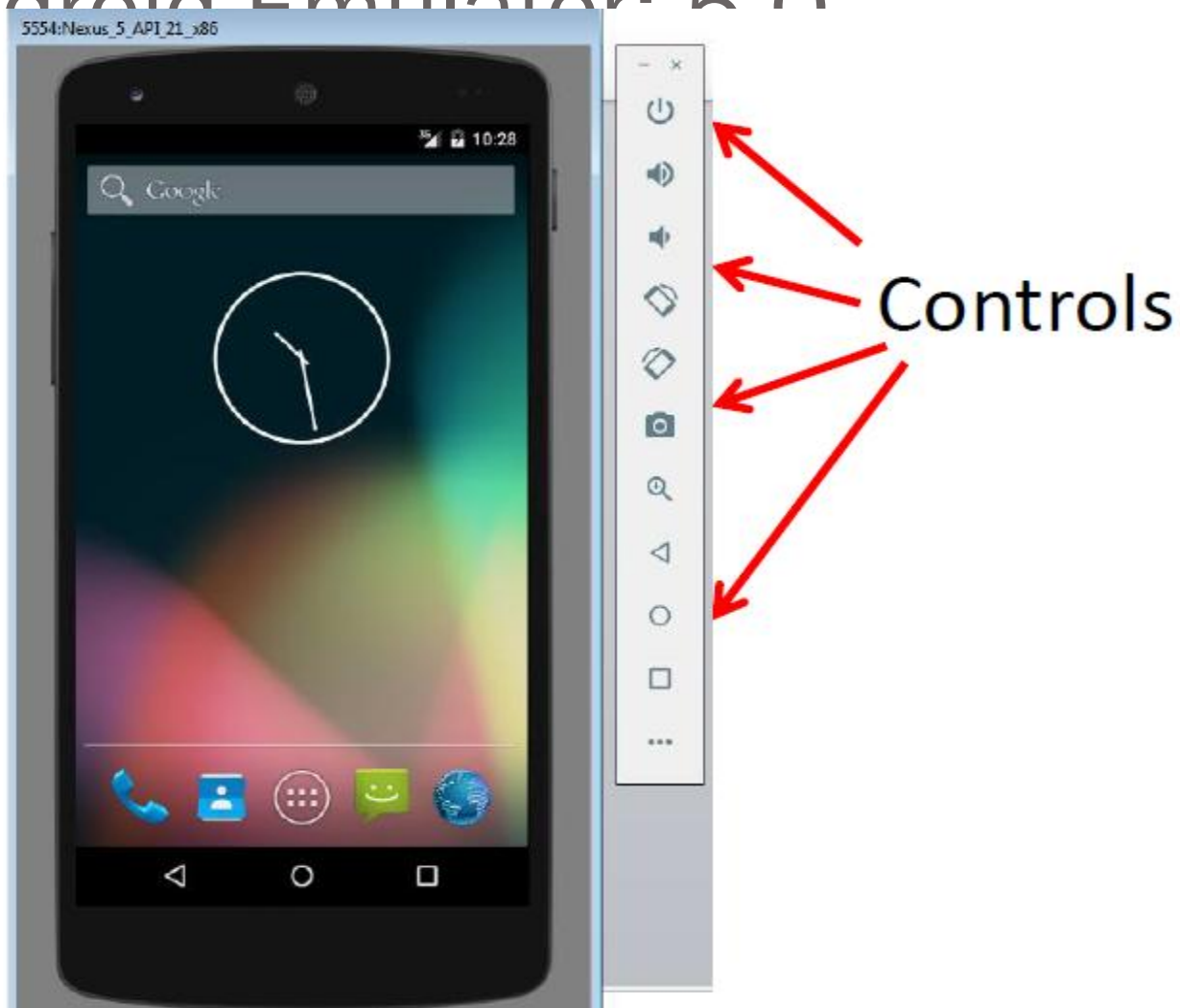Internet Technology Dep.

Android Emulator: 2.2

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Android Emulator: 4.0

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Android Emulator: 5.0

Controls

Emulator Basics

- Host computer's keyboard can be used

- •Host's mouse acts as finger

- •Uses host's Internet connection

- •Other buttons work: Home, Back, Search, volume up and down, etc.

- •More info athttps://developer.android.com/studio/run/managing-avds.html

Emulator Limitations

- No support for placing or receiving actual phone calls

- –Simulate phone calls (placed and received)

- •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'sSensor Simulator

- That's why we need the devphones and tablets!
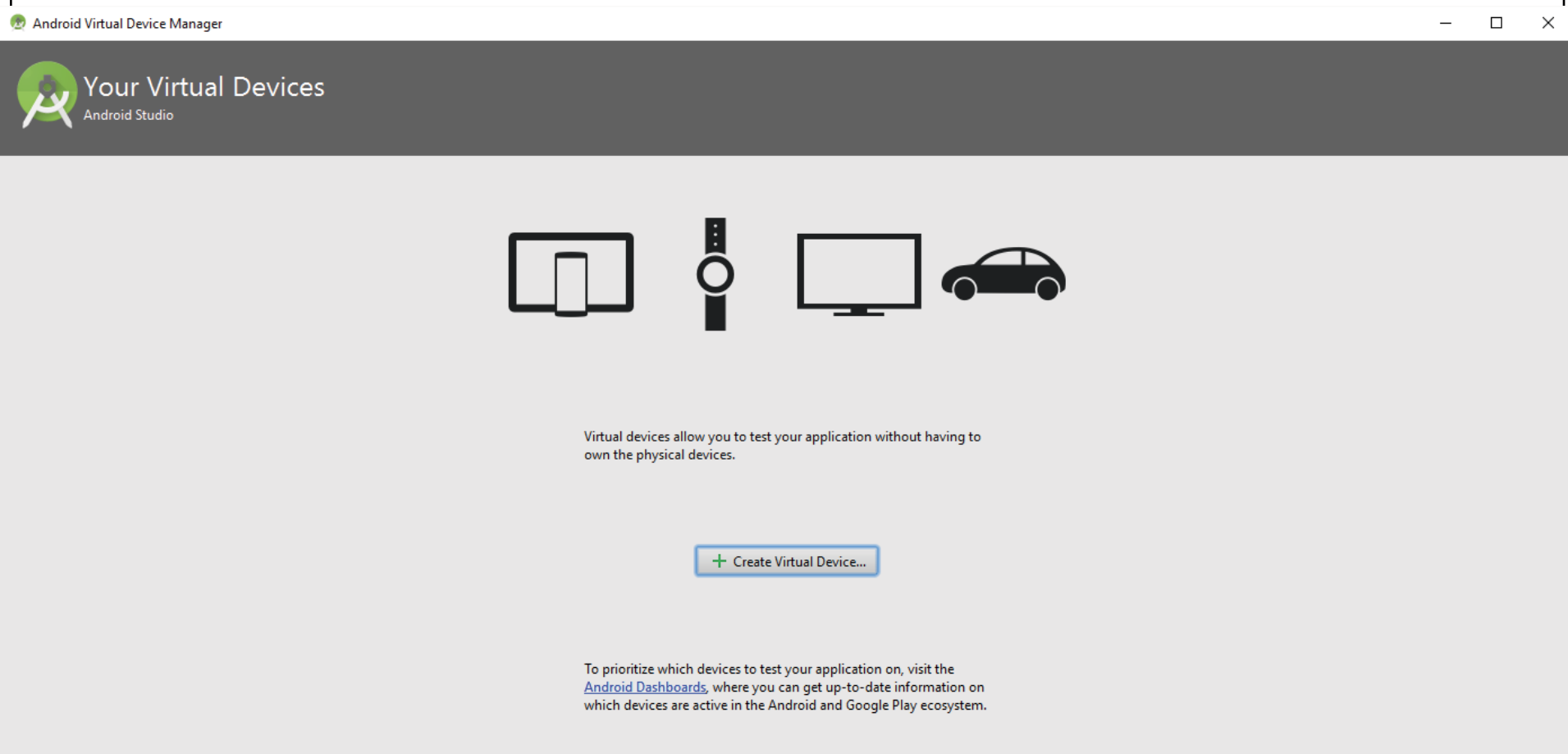
Android Runtime: DalvikVM

- Subset of Java developed by Google
- Optimized for mobile devices (better memory management, battery utilization, etc.)
- Dalvikruns .dexfiles that are compiled from .class files
- Introduces new libraries
- Does not support some Java libraries like AWT, Swing
- http://developer.android.com/reference/packages.html

Creating Android Virtual Devices

- Android Studio offers an emulator for testing of Android apps

- Steps in creating AVD

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Launch the AVD manager by selecting Tools => Android => AVD Manager.
Click the +Create Virtual Device button to create a new AVD

Android Virtual Device Manager   — ☐ ✕

Your Virtual Devices
Android Studio

Virtual devices allow you to test your application without having to
own the physical devices.

+ Create Virtual Device...

To prioritize which devices to test your application on, visit the
Android Dashboards, where you can get up-to-date information on
which devices are active in the Android and Google Play ecosystem.

AVD configuration: select the Nexus 5x hardware profile and click next

System image: select and install the latest option. Click the x86 Images tab, select N from the list of images, then click Next

Virtual Device Configuration ✕

System Image
Select a system image

| Recommended | x86 Images | Other Images |

Release Name	API Level ▼	ABI	Target
N	N	x86_64	Android 6.X
N Download	N	x86	Android 6.X
Marshmallow	23	x86	Android 6.0
Marshmallow	23	x86_64	Android 6.0
Lollipop Download	22	x86_64	Android 5.1
Lollipop Download	22	x86	Android 5.1
Lollipop Download	21	x86_64	Android 5.0 (with Google APIs)
Lollipop Download	21	x86	Android 5.0 (with Google APIs)
Lollipop Download	21	x86	Android 5.0
Lollipop Download	21	x86_64	Android 5.0
KitKat Download	19	x86	Android 4.4
Jelly Bean Download	18	x86	Android 4.3
Jelly Bean Download	17	x86	Android 4.2
Jelly Bean Download	16	x86	Android 4.1
Gingerbread Download	10	x86	Android 2.3.3

N

API Level
N

Android
**Android Open
Source Project**

System Image
x86_64

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

Previous Next Cancel Finish

Accept default, click Finish

Applications Are Boxed

- By default, each app is run in its own Linux process

- –Process started when app's code needs to be executed

- –Threads can be started to handle time-consuming operations

- •Each process has its own DalvikVM

- •By default, each app is assigned unique Linux ID

- –Permissions are set so app's files are only visible to that app

Producing an Android App

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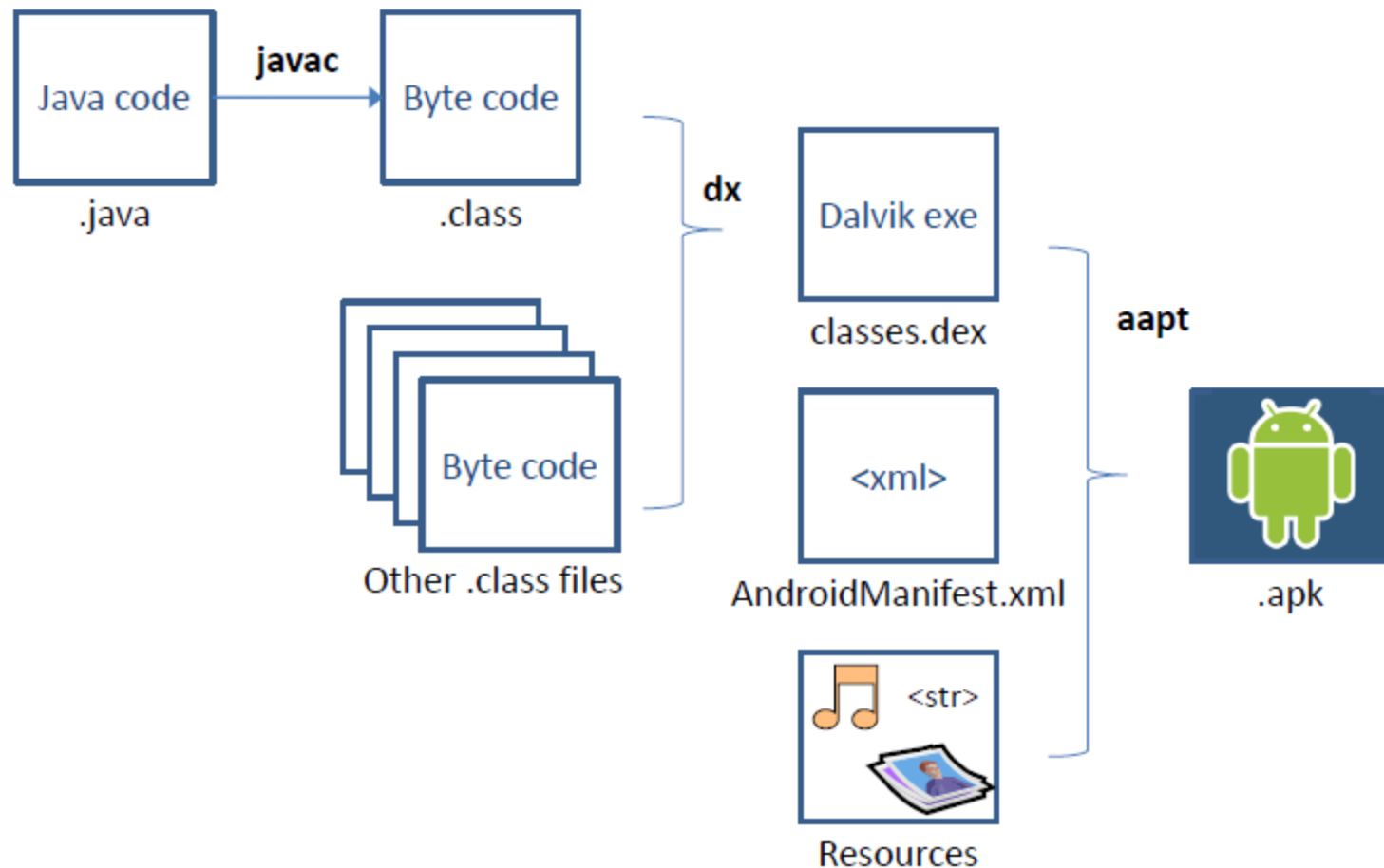
Other DevTools

- Android Debug Bridge

- Part of SDK

- command line tool to communicate with an emulator or connected Android device

- –check devices attached / running

- –install apk's, **Android PacKagefiles, "executables", can find samples on places besides Google Play (security?)**

- –and more!

- https://developer.android.com/studio/command-line/adb.html

iPhone vs. Android