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Android® Application Development

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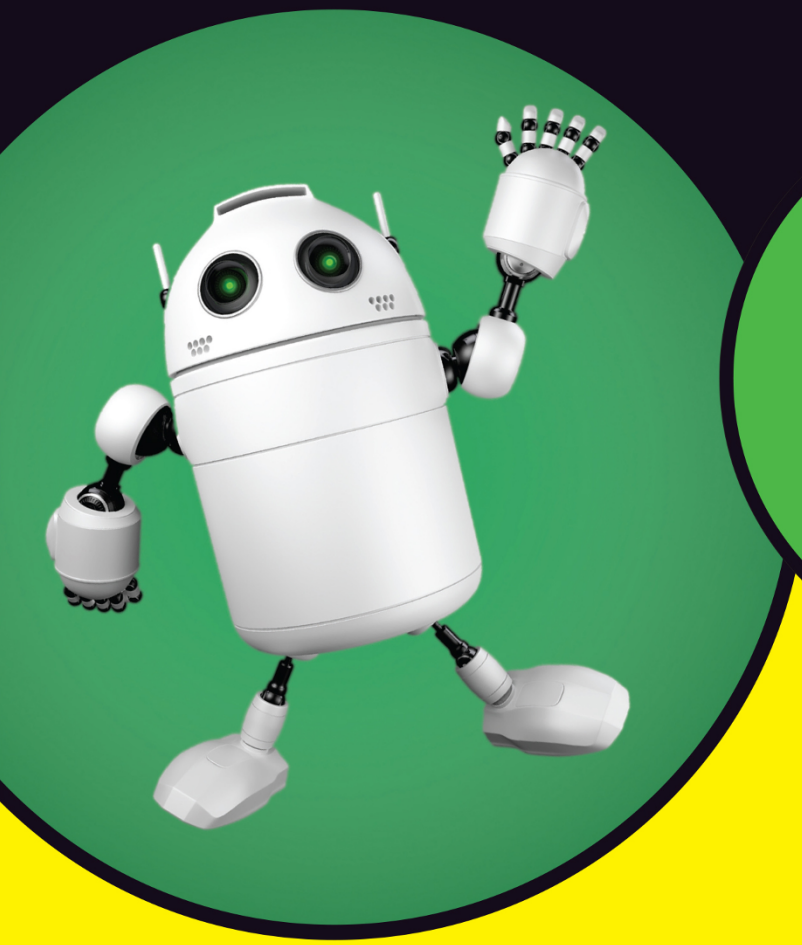

6 Books in one!

Barry Burd
Author of *Java For Dummies*

John Paul Mueller

Android® Application Development

ALL-IN-ONE

3rd Edition

by Barry Burd and John Paul Mueller

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Introduction

As the year 2019 drew to a close, Android ran on 51.8 percent of all smartphones in the United States and on 85 percent of all smartphones worldwide.[1,2] The Google Play Store had 2.57 million apps compared with only 1.84 million in Apple's App Store.[3]

Today, Android is everywhere, and experts predict that Android will dominate the global smartphone market for years to come.[4] So, if you read this book in a public place (on a commuter train, at the beach, on the dance floor at the Coyote Ugly saloon), you can read proudly, with a chip on your shoulder and with your chest held high. Android is hot stuff, and you're cool because you're reading about it.

How to Use This Book

You can attack this book in either of two ways. You can go cover to cover, or you can poke around from one chapter to another. You can even do both (start at the beginning and then jump to a section that particularly interests you). In this book, the basic topics come first, and the more involved topics follow the basics. You may already be comfortable with some basics, or you may have specific goals that don't require you to know about certain topics.

The best advice is as follows:

- If you already know something, don't bother reading about it.
- If you're curious, don't be afraid to skip ahead. You can always sneak a peek at an earlier chapter if you really need to do so.

[1] See `www.statista.com/statistics/266572/market-share-held-by-smartphone-platforms-in-the-united-states/`.

[2] See `https://hostingtribunal.com/blog/operating-systems-market-share/#gref`.

[3] See `statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/`.

[4] See `www.idc.com/promo/smartphone-market-share/os`.

Conventions Used in This Book

Almost every technical book starts with a little typeface legend, and this book is no exception. What follows is a brief explanation of the typefaces used in this book:

- New terms are set in *italics*.
- If you need to type something that's mixed in with the regular text, the characters you type appear in bold. For example: "Type **MyNewProject** in the text field."
- You see this `computerese` font for Kotlin code, filenames, web page addresses (URLs), onscreen messages, and other such things. Also, if something you need to type is really long, it appears in `computerese` font on its own line (or lines).
- You need to change certain things when you type them on your own computer keyboard. For instance, the instructions may ask you to type

  ```
  public void Anyname
  ```

  which means that you type **public void** and then some name that you make up on your own. Words that you need to replace with your own words are set in *`italicized computerese`*.

Foolish Assumptions

This book makes a few assumptions about you, the reader. If one of these assumptions is incorrect, you're probably okay. If all these assumptions are incorrect . . . well, buy the book anyway.

The assumptions are as follows:

- You can navigate through your computer's common menus and dialog boxes. You don't have to be a Windows, Macintosh, or Linux power user, but you should be able to start a program, find a file, put a file into a certain folder . . . that sort of thing. Much of the time, when you practice the stuff in this book, you're typing code on your keyboard, not pointing and clicking your mouse.
- You can think logically. That's all there is to application development — thinking logically. If you can think logically, you have it made. If you don't believe that you can think logically, read on. You may be pleasantly surprised.

» You have some programming experience (maybe not a lot). This book should be interesting for experienced programmers, yet accessible to people who don't write code for a living. If you're a programming guru, that's great. If you're a certified Linux geek, that's great, too. But no one expects you to be able to recite the names of Kotlin's concurrency primitives in your sleep, or pipe together a chain of 14 Linux commands without reading the documentation.

By the way, if you have no experience with an object-oriented language, you can get some. Your favorite bookstore has a terrific book titled *Java For Dummies,* 7th Edition, by Barry Burd (John Wiley & Sons, Inc.). The book comes highly recommended.

Icons Used in This Book

Throughout this book, an icon in the margin marks the beginning of a little detour — a fact or tidbit that stands out for one reason or another. The paragraphs marked by icons differ in their degree of importance. Some are valuable reading, others are silly trivia, and many are somewhere in the middle.

What kinds of icons do you find in this book? Here's a list:


TIP

A Tip is an extra piece of information — something helpful that the other books may forget to tell you.


WARNING

A Warning icon describes a mistake that many people make. Don't interpret the icon to mean, "Never make this mistake." That would be unreasonable. Instead, think of the icon as a word of comfort. It says, "Like everyone else, you'll probably make this mistake. When you do, remember that you once read about it here. Return to this section if you feel so inclined."


REMEMBER

Question: What's stronger than a Tip, but not as strong as a Warning?

Answer: A Remember icon.


TECHNICAL STUFF

Each Technical Stuff icon introduces an interesting fact. Some of these facts help you understand the reasoning behind the design of Android. You don't have to read all the Technical Stuff icons, but you may find them useful. They're especially helpful if you plan to read other (geekier) books about Android app development.

Beyond the Book

You've read the *Android All-in-One* book, seen the *Android All-in-One* movie, worn the *Android All-in-One* T-shirt, and eaten the *Android All-in-One* candy. What more is there to do?

That's easy. Just visit this book's website — `www.allmycode.com/Android`. At the website, you can find updates, comments, additional information, and lots of downloadable code. (You can also get there by visiting `www.dummies.com` and searching for *Android Application Development All-in-One For Dummies,* 3rd Edition.

Also on this book's page at `www.dummies.com` is the Cheat Sheet, which provides you with hints you need for nearly every Android app, such as parts of an Android app and the contents of that all important `.apk` file. You also get quick reminders about navigation classes, parts of a notification, and user interface elements.

Where to Go from Here

If you've gotten this far, you're ready to start reading about Android application development. Think of us (this book's authors) as your guides, your hosts, your personal assistants. We do everything we can to keep things interesting and, most important, help you understand.

If you experience any problems at all with this book, please contact either or both of us: Barry (`android@allmycode.com`) or John (`John@JohnMuellerBooks.com`) for assistance. We want you to be truly happy with your purchase and will help in any way we can with book-specific questions. You can also contact Barry on Twitter (`@allmycode`) and Facebook (`www.facebook.com/allmycode`).

Occasionally, we have updates to our technology books. If this book does have technical updates, they will be posted at this book's page at `www.dummies.com` and at `http://allmycode.com/android`.

1

Getting Started with Android Application Development

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IN THIS CHAPTER

- Your take on Android (depending on who you are)
- A tour of Android technologies

Chapter 1
All about Android

Until the mid-2000s, the word "Android" stood for a mechanical humanlike creature — a rootin' tootin' officer of the law with built-in machine guns, or a hyperlogical space traveler who can do everything except speak using contractions. But in 2005, Google purchased Android, Inc. — a 22-month-old company creating software for mobile phones. That move changed everything.

In 2007, a group of 34 companies formed the Open Handset Alliance. The Alliance's task was (and still is) "to accelerate innovation in mobile and offer consumers a richer, less expensive, and better mobile experience." The Alliance's primary project is *Android* — an open, free operating system based on the Linux operating system kernel.

HTC released the first commercially available Android phone near the end of 2008, but the public's awareness of Android and its potential didn't surface until early 2010. By the mid-2010s, the world had more than 400 Android device manufacturers with 500 mobile carriers using Android and 1.5 million Android activations each day (`https://expandedramblings.com/index.php/android-statistics/`). By mid-2019, more than 2.5 billion active devices ran the Android operating system (`https://venturebeat.com/2019/05/07/android-passes-2-5-billion-monthly-active-devices/`). (We know. By the time you read this book, the year 2019 is old news. That's okay.)

This chapter introduces Android. The chapter examines Android from a few different angles.

The Consumer Perspective

A consumer considers the mobile phone alternatives.

Possibility #1: No mobile phone.

- **Advantages:** Inexpensive. No junk calls. No interruptions. No GPS tracking or snooping by businesses or other agencies.
- **Disadvantages:** No instant contact with friends and family. No calls to services in case of an emergency. No hand-held games, no tweeting, tooting, hooting, homing, roaming, or booping. And worst of all, to break up with your boyfriend or girlfriend, you can't simply send a text message.

Possibility #2: A feature phone — a mobile phone that's not a smartphone.

- **Advantages:** Cheaper than a smartphone.
- **Disadvantages:** Not as versatile as a smartphone. Not nearly as cool as a smartphone. Nowhere near as much fun as a smartphone.

There's no official rule defining the boundary between feature phones and smartphones. But generally, a feature phone is one with an inflexible menu of home-screen options. A feature phone's menu items relate mostly to traditional mobile phone functions, such as dialing, texting, and maybe some limited web surfing and gaming. In contrast, a smartphone's home screen provides access to the underlying file system and has icons, customizable skins, and many other features that used to be available only to general-purpose computer operating systems.

Don't write off feature phones. As late as March 2019, Counterpoint Research predicted that people will buy a billion feature phones between 2019 and 2022 (`https://www.counterpointresearch.com/more-than-a-billion-feature-phones-to-be-sold-over-next-three-years/`). This fact may shock you if you live in a country where feature phones are passé. But in 2019, the worldwide feature phone continued to grow.

Possibility #3: An iPhone.

- **Advantages:** Great graphics.
- **Disadvantages:** Little or no flexibility with the single-vendor iOS operating system. Only a handful of different models to choose from. No sanctioned "rooting," "modding," or "jailbreaking" the phone. And then there is the potential cost of an iPhone when compared to Android phones.

Possibility #4: An Ubuntu Touch phone, a Harmony OS phone, or some other non-Android, non-Apple smartphone.

- **Advantages:** Having a smartphone without belonging to a crowd.
- **Disadvantages:** Relatively difficult to get technical support. Not nearly as many apps as Android phones and Apple phones. Smaller selection of hardware to choose from.

Possibility #5: An Android phone.

- **Advantages:** Using an open platform. Using a popular platform with lots of industry support and with powerful market momentum. Writing your own software and installing the software on your own phone (without having to deal with Apple as an intermediary). Access to a broad range of hardware and price points. Publishing software without facing the challenging approval process used by Apple, plus you can choose not to use the Google Play Store (see `https://www.knowband.com/blog/mobile-app/alternatives-for-publishing-android-app-on-google-play-store/` for alternative ideas).
- **Disadvantages:** Security concerns when using an open platform. Confusion about the variety of manufacturers, each with different hardware and with some changes to the Android platform. Dismay when iPhone users make fun of your phone.

Android's advantages far outweigh the possible disadvantages. And you're reading a paragraph from *Android Application Development All-in-One For Dummies,* 3rd Edition, so you're likely to agree.

Having decided to go with an Android phone, the consumer asks, "Which phone?" And the salesperson says, "This phone comes with Android 10." (If you read between the lines, what the salesperson really means is "This phone comes with Android 9, which will eventually be upgraded to Android 10, or so claims the vendor.") So the consumer asks, "What are the differences among all the Android versions?"

The Versions of Android

Android comes with a few different notions of "version." Android has platform numbers, API levels, codenames, and probably some other versioning schemes. (The acronym *API* stands for *A*pplication *P*rogramming *I*nterface — a library full of prewritten programs available for use by a bunch of programmers. In this case, the "bunch" consists of all Android developers.)

To complicate matters, the versioning schemes don't increase in lockstep. For example, Android 8 (codenamed Oreo) has two API levels — levels 26 and 27. But Android 9 (codenamed Pie) has only one API level — level 28.

An Android version may have variations. For example, you can develop for plain old API Level 29 with an established set of features. To plain old API Level 29, you can add the Google APIs (thus adding Google Maps functionality) and still be using platform API Level 29. You can also add a special set with features tailored for a particular device manufacturer or a particular mobile service provider.

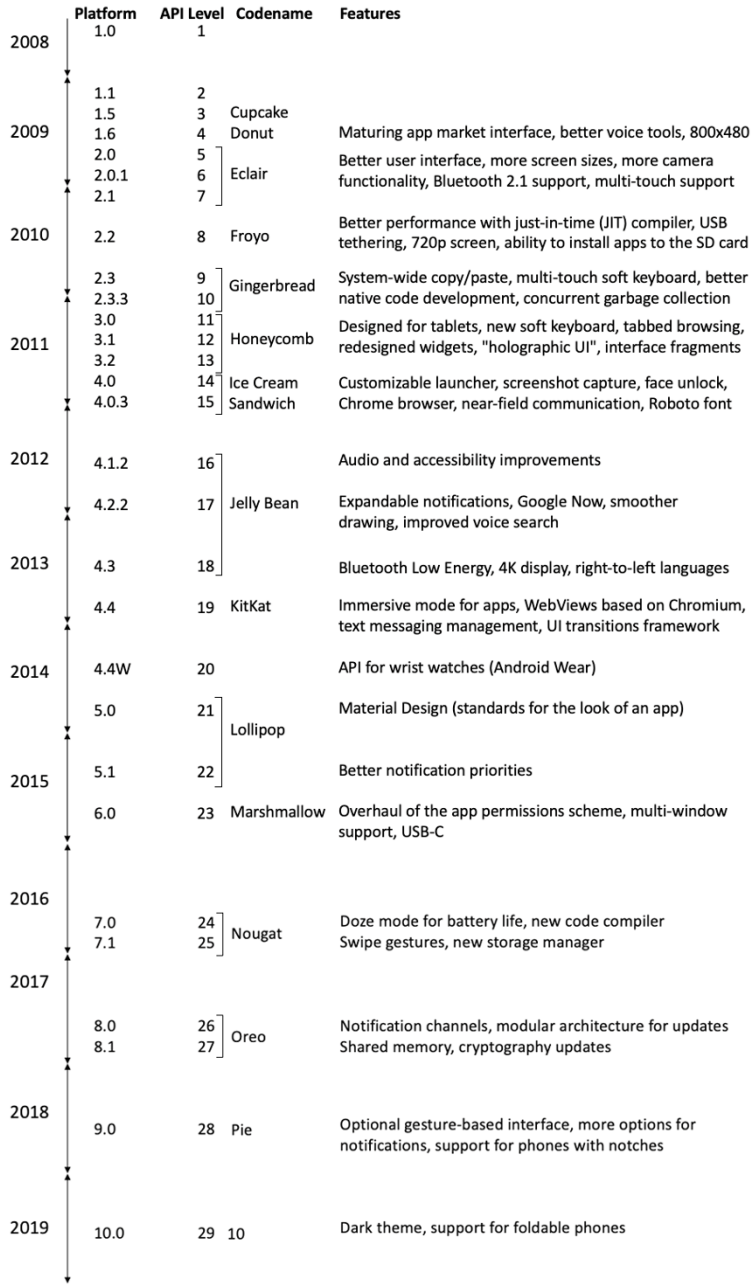
API levels 3 through 28 had tasty dessert codenames, and the names came in alphabetical order. For example, after Lollipop came Marshmallow; after Marshmallow came Nougat. Sad to say, the last-ever Android dessert codename was Pie, released in August 2018. About a year later, Google released a newer version simply named Android 10. The number 10 doesn't taste good the way lollipops and pies do.

Figure 1-1 has a summary of Android's API versions from 2008 to 2019.

A few notes on Figure 1-1 are in order:

- **The platform number is of interest to the consumer and to the company that sells the hardware.** If you're buying a phone with Android 9.0, for example, you might want to know whether the vendor will upgrade your phone to Android 10.0.
- **The API level (also known as the SDK version) is of interest to the Android app developer.** For example, in API level 8.1, the word `Build.SERIAL` stands for the phone's serial number. So, you might be tempted to type **Build.SERIAL** in code that uses API level 9.0. But in API level 9.0, `Build.SERIAL` doesn't help you get a phone's serial number. In API level 9.0, the value of `Build.SERIAL` is `"UNKNOWN"`.
- **The codename is of interest to the creators of Android.** A *codename* (also known as the *version code*) refers to the work done by the creators of Android to bring Android to the next level. Picture Google's engineers working for months behind closed doors on Project Oreo, and you'll be on the right track.

Since 2016, a new version of Android has come roughly once a year. Google released Nougat in 2016, Oreo in 2017, Pie in 2018, and the sugarless Android 10 in 2019. As a developer, your job is to balance portability with feature richness. When you create an app, you specify a minimum Android version. (You can read more about specifying a minimum version in Chapter 4 of this minibook.) The higher the version, the more features your app can have. But the higher the version, the fewer the devices that can run your app.



	Platform	API Level	Codename	Features
2008	1.0	1		
	1.1	2		
	1.5	3	Cupcake	
2009	1.6	4	Donut	Maturing app market interface, better voice tools, 800x480
	2.0	5	Eclair	Better user interface, more screen sizes, more camera functionality, Bluetooth 2.1 support, multi-touch support
	2.0.1	6		
	2.1	7		
2010	2.2	8	Froyo	Better performance with just-in-time (JIT) compiler, USB tethering, 720p screen, ability to install apps to the SD card
	2.3	9	Gingerbread	System-wide copy/paste, multi-touch soft keyboard, better native code development, concurrent garbage collection
	2.3.3	10		
	3.0	11	Honeycomb	Designed for tablets, new soft keyboard, tabbed browsing, redesigned widgets, "holographic UI", interface fragments
2011	3.1	12		
	3.2	13		
	4.0	14	Ice Cream Sandwich	Customizable launcher, screenshot capture, face unlock, Chrome browser, near-field communication, Roboto font
	4.0.3	15		
2012	4.1.2	16	Jelly Bean	Audio and accessibility improvements
	4.2.2	17		Expandable notifications, Google Now, smoother drawing, improved voice search
2013	4.3	18		Bluetooth Low Energy, 4K display, right-to-left languages
	4.4	19	KitKat	Immersive mode for apps, WebViews based on Chromium, text messaging management, UI transitions framework
2014	4.4W	20		API for wrist watches (Android Wear)
	5.0	21	Lollipop	Material Design (standards for the look of an app)
2015	5.1	22		Better notification priorities
	6.0	23	Marshmallow	Overhaul of the app permissions scheme, multi-window support, USB-C
2016	7.0	24	Nougat	Doze mode for battery life, new code compiler
	7.1	25		Swipe gestures, new storage manager
2017	8.0	26	Oreo	Notification channels, modular architecture for updates
	8.1	27		Shared memory, cryptography updates
2018	9.0	28	Pie	Optional gesture-based interface, more options for notifications, support for phones with notches
2019	10.0	29	10	Dark theme, support for foldable phones

FIGURE 1-1: Android version history.

This book contains tips and tricks for striking a happy medium between whiz-bang features and universal use, and Google has some nifty tools to help you sort out the differences among Android versions. In Chapter 3 of this minibook, you use Android Studio to create your first app. During the app setup, a drop-down

box gives you a choice of Android versions for your app. Beneath that drop-down box is an innocent-looking Help Me Choose link. If you click this link, you see a page with the title Android Platform/API Version Distribution. This interactive page lists several of the most recent Android versions along with the percentage of phones that can run each version. And, when you click one of the Android versions, the page provides information about that version's features.

Storks and fairies don't install updates on your Android devices. The updates come via Wi-Fi or phone service through your carrier or device manufacturer. But by downloading and installing an independently developed Android release, you can break free of the corporate giants. For information about these independently developed releases, visit `http://forum.xda-developers.com/custom-roms`.

The Developer Perspective

Android is a multifaceted beast. When you develop for Android, you use many tool sets. This section gives you a brief rundown of those tool sets.

Java and Kotlin

James Gosling from Sun Microsystems created the Java programming language in the mid-1990s. (Sun Microsystems has since been bought out by Oracle.) Java's meteoric rise in use came from the elegance of the language and the well-conceived platform architecture. After a brief blaze of glory with applets and the web, Java settled into being a solid, general-purpose language with special strength in servers and middleware.

In the meantime, Java was quietly seeping into embedded processors.

An *embedded processor* is a computer chip that's hidden from the user as part of some special-purpose device. The chips in today's cars are embedded processors, and the silicon that powers your photocopier at work is an embedded processor. Pretty soon, the flowerpots on your windowsill will probably have embedded processors. By 2002, Sun Microsystems was developing Java ME (*M*obile *E*dition) for creating *MIDlets* based on the Mobile Information Device Profile (MIDP) to run on mobile phones in a manner similar to applets on a web page (see `https://www.techopedia.com/definition/116/midlet` for details). Java became a major technology in Blu-ray disc players, parking meters, teller machines, and other devices. So, the decision to make Java the primary development language for Android apps was no big surprise.