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ANDROID™ FOR PROGRAMMERS
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Android™ for Programmers
An App-Driven Approach
Deitel® Developer Series

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PRENTICE HALL

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In memory of Daniel McCracken.
Computer science has lost one of its greatest educators.

Paul, Harvey, Abbey and Michael

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Contents

Chapters on the Web

See the Online Chapters *section of the Preface for information on downloading these chapters.*

Preface

Welcome to the dynamic world of Android smartphone and tablet app development with the Android Software Development Kit (SDK) 2.3.x and 3.x, the Java™ programming language and the Eclipse™ integrated development environment (IDE).

This book presents leading-edge mobile computing technologies for professional software developers. At the heart of the book is our *app-driven approach*. We present concepts in the context of *17 complete working Android apps*—16 developed in the native Android environment and one developed in HTML5 for the portable world of the web—rather than using code snippets. Chapters 3–19 each present one app. We begin each of these chapters with an introduction to the app, an app test-drive showing one or more sample executions and a technologies overview. Then we proceed with a detailed code walkthrough of the app's source code. The source code for all the apps is available at `www.deitel.com/books/AndroidFP/`.

Sales of Android devices and app downloads have been growing exponentially. The first-generation Android phones were released in October 2008. A study by comScore® showed that by July 2011, Android had 41.8% of the U.S. smartphone market share, compared to 27% for Apple's iPhone and 21.7% for Blackberry.[1] Billions of apps have been downloaded from Android Market. More than 500,000 Android devices are being activated daily. The opportunities for Android app developers are enormous.

The demand for mobile devices is increasing as more people rely on smartphones and tablets to stay connected and be productive while away from their personal computers. According to comScore, 234 million Americans used mobile devices in a three-month period ending in July 2011. Of those subscribers, 40.6% used apps.[2]

Fierce competition among popular mobile platforms (Android, BlackBerry, iPhone, Palm, Symbian, Windows Phone 7 and others) and among mobile carriers is leading to rapid innovation and falling prices. Competition among the dozens of Android device manufacturers is driving hardware and software innovation within the Android community. There are now over 300 different Android devices.

Android for Programmers: An App-Driven Approach was fun to write! We got to know and love Android, many of its most popular apps and the diversity of Android-based devices. We developed lots of Android apps. The book's apps were carefully designed to introduce you to a broad range of Android features and technologies, including audio, video, animation, telephony, Bluetooth®, speech recognition, the accelerometer, GPS, the compass, widgets, App Widgets, 3D graphics and more. You'll quickly learn everything you'll need to start building Android apps—beginning with a test-drive of the **Doodlz** app

1. `www.comscore.com/Press_Events/Press_Releases/2011/8/comScore_Reports_July_2011_U.S._Mobile_Subscriber_Market_Share`.
2. `www.comscore.com/Press_Events/Press_Releases/2011/8/comScore_Reports_July_2011_U.S._Mobile_Subscriber_Market_Share`.

in Chapter 1, then creating your first app in Chapter 3. Chapter 2, Android Market and App Business Issues walks you through designing great apps, uploading your apps to Google's Android Market and other online app stores, what to expect in the process, deciding whether to sell your apps or offer them for free, and marketing them using the Internet and word-of-mouth, and more.

Copyright Notice and Code License

Intended Audience

We assume that you're a Java programmer with object-oriented programming experience and that you're familiar with XML. We use only complete, working apps, so if you don't know Java and XML but have object-oriented programming experience in C#/.NET, Objective-C/Cocoa or C++ (with class libraries), you should be able to master the material quickly, learning a good amount of Java, Java-style object-oriented programming and XML along the way.

This book is *neither* a Java *nor* an XML tutorial, but it presents a significant amount of Java and XML technology in the context of Android app development. If you're interested in learning Java, check out our publications:

- *Java for Programmers, 2/e* (`www.deitel.com/books/javafp2/`)
- *Java Fundamentals: Parts I and II* LiveLessons videos (`www.deitel.com/books/LiveLessons/`).
- *Java How to Program, 9/e* (`www.deitel.com/books/jhtp9/`)

Key Features

App-Driven Approach. Each of the apps chapters (3–19) presents one app—we discuss what the app does, show screen shots of the app in action, test-drive it and overview the technologies and architecture we'll use to build it. Then we build the app, present the complete code and do a detailed code walkthrough. We discuss the programming concepts and demonstrate the functionality of the Android APIs used in the app. Figure 1 lists the book's apps and the key technologies we used to build each.

Apps	Technologies
Chapter 3, **Welcome** App	Dive-Into® Eclipse and the ADT
Chapter 4, **Tip Calculator** App	Building an Android App with Java

Fig. 1 | *Android for Programmers* apps and the technologies they introduce.

Apps	Technologies
Chapter 5, **Favorite Twitter® Searches** App	Collections, Widgets and Views
Chapter 6, **Flag Quiz** App	Intents and Menus
Chapter 7, **Cannon Game** App	Frame-By-Frame Animation and Handling User Events
Chapter 8, **Spot-On Game** App	Tweened Animation and Listening for Touches
Chapter 9, **Doodlz** App	Graphics and Accelerometer
Chapter 10, **Address Book** App	`AdapterViews` and `Adapters`
Chapter 11, **Route Tracker** App	Maps API and Compass
Chapter 12, **Slideshow** App	Photos and Audio Library Access
Chapter 13, **Enhanced Slideshow** App	Serializing Objects and Playing Video
Chapter 14, **Weather Viewer** App	Internet Enabled Applications, Web Services and App Widgets
Chapter 15, **Pizza Ordering** App	Android Telephony and Speech APIs
Chapter 16, **Voice Recorder** App	Audio Recording and Playback
Chapter 17, **Enhanced Address Book** App	Managing Persistent Data with SQLite 3 and Transferring Data Via Bluetooth
Chapter 18, **3D Art** App	3D Graphics and Animation with OpenGL ES
Chapter 19, **Favorite Twitter® Searches** App using HTML5 Technologies	Online Bonus Chapter: HTML5, CSS3 and JavaScript for Experienced Web Developers

Fig. 1 | *Android for Programmers* apps and the technologies they introduce.

Android SDK 2.x. We cover many of the new features included in the Android Software Development Kit (SDK) 2.x, including Bluetooth, Google Maps, the Camera APIs, graphics APIs and support for multiple screen sizes and resolutions.

Android SDK 3.x for Tablet Apps. We cover many of the features of the new Android SDK 3.x for developing tablet apps, including property animation, action bar, fragments, status bar notifications and drag-and-drop.

Android Maps APIs. The **Route Tracker** App uses the Android Maps APIs which allow you to incorporate Google™ Maps in your app. Before developing any app using the Maps APIs, you *must* agree to the Android Maps APIs *Terms of Service* (including the related Legal Notices and Privacy Policy) at `code.google.com/android/maps-api-tos.pdf`.

Eclipse. The free Eclipse integrated development environment (IDE) combined with the free Android SDK and the free Java Development Kit (JDK), provide everything you need to develop and test Android apps.

Multimedia. The apps use a broad range of Android multimedia capabilities, including graphics, images, frame-by-frame animation, property animation, audio, video, speech synthesis and speech recognition.

Android Best Practices. We adhere to accepted Android best practices, pointing them out in the detailed code walkthroughs. Check out our Android Best Practices Resource Center at `www.deitel.com/AndroidBestPractices/`.

Web Services. Web services allow you to use the web as a rich library of services—many of which are free. Chapter 11's **Route Tracker** app uses the built-in Android Maps APIs to interact with the Google Maps web services. Chapter 14's **Weather Viewer** app uses WeatherBug's web services.[3]

Features

Syntax Shading. For readability, we syntax shade the code, similar to Eclipse's use of syntax coloring. Our syntax-shading conventions are as follows:

```
comments appear in gray
constants and literal values appear in bold darker gray
keywords appear in bold black
all other code appears in non-bold black
```

Code Highlighting. We emphasize the key code segments in each program by enclosing them in light gray rectangles.

Using Fonts for Emphasis. We place defining occurrences of key terms in ***bold italic*** text for easy reference. We identify on-screen components in the **bold Helvetica** font (e.g., the **File** menu) and Java and Android program text in the `Lucida` font (e.g., `int x = 5;`).

In this book you'll create GUIs using a combination of visual programming (drag and drop) and writing code. We use different fonts when we refer to GUI elements in program code versus GUI elements displayed in the IDE:

- When we refer to a GUI component that we create in a program, we place its variable name and class name in a `Lucida` font—e.g., "`Button`" or "`myEditText`."
- When we refer to a GUI component that's part of the IDE, we place the component's text in a **bold Helvetica** font and use a plain text font for the component's type—e.g., "the **File** menu" or "the **Run** button."

Using the > Character. We use the **>** character to indicate selecting a menu item from a menu. For example, we use the notation **File > New** to indicate that you should select the **New** menu item from the **File** menu.

Source Code. All of the book's source code is available for download from:

```
www.deitel.com/books/AndroidFP/
www.informit.com/title/9780132121361
```

Documentation. All the Android and Java documentation you'll need to develop Android apps is available free at `developer.android.com`. The documentation for Eclipse is available at `www.eclipse.org/documentation`.

Chapter Objectives. Each chapter begins with a list of objectives.

Figures. Hundreds of tables, source code listings and Android screen shots are included.

3. `apireg.weatherbug.com/defaultAPI.aspx`.

Index. We include an extensive index for reference. The page number of the defining occurrence of each key term in the book is highlighted in the index in **bold maroon**.

Online Chapters

Chapter 1–14 are in the print book. Chapters 15–19 will be posted online as we complete them. We'll make draft versions of the chapters available first, and we'll update these drafts to the final versions once we incorporate all of the reviewers' comments. To access the online chapters, go to:

```
www.informit.com/register
```

You must register for an an InformIT account and then login. After you've logged into your account, you'll see the **Register a Product** box. Enter the book's ISBN to access the page with the online chapters.

Slides for Instructors

PDF slides containing all of the code, tables and art in the text are available *to qualified instructors only* through Pearson Education's Instructor Resource Center at:

```
www.pearsonhighered.com/irc
```

The Deitel Online Android Resource Centers

Our Android Resource Centers include links to tutorials, documentation, software downloads, articles, blogs, podcasts, videos, code samples, books, e-books and more—most of these are free. Check out the growing list of Android-related Resource Centers, including:

- Android (`www.deitel.com/android/`)
- Android Best Practices (`www.deitel.com/androidbestpractices/`)
- Java (`www.deitel.com/java/`)
- Eclipse (`www.deitel.com/Eclipse/`)
- SQLite 3 (`www.deitel.com/SQLite3/`)

We announce our latest Resource Centers in our newsletter, the *Deitel® Buzz Online* and on Twitter® and Facebook®—see below.

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```
www.deitel.com/newsletter/subscribe.html
```

follow us on Twitter

```
@deitel
```

and Facebook

```
www.deitel.com/deitelfan/
```

Contacting the Authors

As you read the book, we'd sincerely appreciate your comments, criticisms, corrections and suggestions for improvement. Please address all correspondence to:

```
deitel@deitel.com
```

We'll respond promptly, and post corrections and clarifications on:

```
www.deitel.com/books/AndroidFP/
```

and on Facebook and Twitter.

Acknowledgments

We're fortunate to have worked on this project with the dedicated publishing professionals at Prentice Hall/Pearson. We appreciate the extraordinary efforts and 16-year mentorship of our friend and professional colleague Mark L. Taub, Editor-in-Chief of Pearson Technology Group. Olivia Basegio did a great job recruiting distinguished members of the Android community and managing the review process. Chuti Prasertsith designed the cover with creativity and precision—we gave him our vision for the cover and he made it happen. John Fuller does a superb job managing the production of all of our Deitel Developer Series books.

We'd like to thank our friend, Rich Wong (Partner, Accel Partners), who provided us with valuable contacts in the Android and mobile app development communities.

We'd like to thank AWS Convergence Technologies, Inc., owners of WeatherBug (`weather.weatherbug.com/`), for giving us permission to use their web services in Chapter 14's **Weather Viewer** app.

We'd also like to thank our colleague, Eric Kern, co-author of our related book, *iPhone for Programmers: An App-Driven Approach*, on which many of the apps in *Android for Programmers: An App-Driven Approach* are based.

Reviewers

We wish to acknowledge the efforts of our reviewers. Adhering to a tight time schedule, the reviewers scrutinized the manuscript, providing constructive suggestions for improving the accuracy and completeness of the presentation:

- Paul Beusterien, Principal, Mobile Developer Solutions
- Eric J. Bowden, COO, Safe Driving Systems, LLC
- Ian G. Clifton, Independent Contractor and Android App Developer
- Daniel Galpin, Android Advocate and author of *Intro to Android Application Development*
- Douglas Jones, Senior Software Engineer, Fullpower Technologies
- Sebastian Nykopp, Chief Architect, Reaktor
- Ronan "Zero" Schwarz, CIO, OpenIntents

Well, there you have it! *Android for Programmers: An App-Driven Approach* will quickly get you developing Android apps. We hope you enjoy reading the book as much as we enjoyed writing it!

Paul, Harvey and Abbey Deitel, and Michael Morgano, October 2011

About the Authors

Paul J. Deitel, CEO and Chief Technical Officer of Deitel & Associates, Inc., is a graduate of MIT, where he studied Information Technology. Through Deitel & Associates, Inc., he has delivered hundreds of Java, C++, C, C#, Visual Basic and Internet programming courses to industry clients, including Cisco, IBM, Siemens, Sun Microsystems, Dell, Lucent Technologies, Fidelity, NASA at the Kennedy Space Center, the National Severe Storm Laboratory, White Sands Missile Range, Rogue Wave Software, Boeing, SunGard Higher Education, Stratus, Cambridge Technology Partners, One Wave, Hyperion Software, Adra Systems, Entergy, CableData Systems, Nortel Networks, Puma, iRobot, Invensys and many more. He and his co-author, Dr. Harvey M. Deitel, are the world's best-selling programming-language textbook and professional book authors.

Dr. Harvey M. Deitel, Chairman and Chief Strategy Officer of Deitel & Associates, Inc., has 50 years of experience in the computer field. Dr. Deitel earned B.S. and M.S. degrees from MIT and a Ph.D. from Boston University. He has extensive college teaching experience, including earning tenure and serving as the Chairman of the Computer Science Department at Boston College before founding Deitel & Associates, Inc., with his son, Paul J. Deitel. He and Paul are the co-authors of dozens of books and LiveLessons video packages and they are writing many more. The Deitels' texts have earned international recognition, with translations published in Japanese, German, Russian, Chinese, Spanish, Korean, French, Polish, Italian, Portuguese, Greek, Urdu and Turkish. Dr. Deitel has delivered hundreds of professional programming seminars to major corporations, academic institutions, government organizations and the military.

Abbey Deitel, President of Deitel & Associates, Inc., is a graduate of Carnegie Mellon University's Tepper School of Management where she received a B.S. in Industrial Management. Abbey has been managing the business operations of Deitel & Associates, Inc. for 14 years. She has contributed to numerous Deitel & Associates publications and, together with Paul and Harvey, is the co-author of *iPhone for Programmers: An App-Driven Approach* and *Internet & World Wide Web How to Program, 5/e*.

Michael Morgano, Android Developer at Imerj™, is a graduate of Northeastern University where he received a B.S. and M.S. degrees in Computer Science. Michael is the co-author of *iPhone for Programmers: An App-Driven Approach*.

Corporate Training from Deitel & Associates, Inc.

Deitel & Associates, Inc., founded by Paul Deitel and Harvey Deitel, is an internationally recognized authoring, corporate training and software development organization specializing in Android and iPhone app development, computer programming languages, object technology and Internet and web software technology. The company offers instructor-led training courses delivered at client sites worldwide on major programming languages and platforms, such as Android app development, Objective-C and iPhone app development, Java™, C, C++, Visual C++®, Visual C#®, Visual Basic®, XML®, Python®, object technology, Internet and web programming, and a growing list of additional programming and software development courses. The company's clients include many of the world's largest companies, government agencies, branches of the military, and academic institutions.

Through its 36-year publishing partnership with Prentice Hall/Pearson, Deitel & Associates, Inc., publishes leading-edge programming professional books, college text-

books, and *LiveLessons* DVD- and web-based video courses. Deitel & Associates, Inc. and the authors can be reached at:

```
deitel@deitel.com
```

To learn more about Deitel's *Dive Into® Series* Corporate Training curriculum, visit:

```
www.deitel.com/training/
```

To request a proposal for on-site, instructor-led training at your company or organization, e-mail `deitel@deitel.com`.

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Before You Begin

This section contains information and instructions you should review to ensure that your computer is set up properly for use with this book. We'll post updates (if any) to the Before You Begin section on the book's website:

```
www.deitel.com/books/AndroidFP/
```

Font and Naming Conventions

We use fonts to distinguish between on-screen components (such as menu names and menu items) and Java code or commands. Our convention is to show on-screen components in a sans-serif bold **Helvetica** font (for example, **Project** menu) and to show file names, Java code and commands in a sans-serif `Lucida` font (for example, the keyword `public` or class `Activity`).

Software and Hardware System Requirements

To develop Android apps you need a Windows®, Linux or Mac OS X system. To view the latest operating-system requirements visit:

```
developer.android.com/sdk/requirements.html
```

We developed the apps in this book using the following software:

- Java SE 6 Software Development Kit
- Eclipse 3.6.2 (Helios) IDE for Java Developers
- Android SDK versions 2.2, 2.3.3 and 3.x
- ADT (Android Development Tools) Plugin for Eclipse

We tell you where to get each of these in the next section.

Installing the Java Development Kit (JDK)

Android requires the *Java Development Kit (JDK)* version 5 or 6 (JDK 5 or JDK 6). *We used JDK 6.* To download the JDK for Linux or Windows, go to

```
www.oracle.com/technetwork/java/javase/downloads/index.html
```

You need only the JDK. Be sure to follow the installation instructions at

```
www.oracle.com/technetwork/java/javase/index-137561.html
```

Recent versions of Mac OS X come with Java SE 6. Be sure to get the latest version by using the Apple menu feature to check for software updates.

Installing the Eclipse IDE

Eclipse is the recommended integrated development environment (IDE) for Android development, though it's possible to use other IDEs, text editors and command-line tools. To download the *Eclipse IDE for Java Developers*, go to

```
www.eclipse.org/downloads/
```

This page will allow you to download the latest version of Eclipse—3.7.1 at the time of this writing. To use the same version we used when developing this book (3.6.2), click the **Older Versions** link above the list of downloads. Select the appropriate version for your operating system (Windows, Mac or Linux). To install Eclipse, you simply extract the archive's contents to your hard drive. On our Windows 7 system, we extracted the contents to `C:\Eclipse`. For more Eclipse installation information, see

```
bit.ly/InstallingEclipse
```

Important: To ensure that the book's examples compile correctly, configure Eclipse to use JDK 6 by performing the following steps:

1. Locate the Eclipse folder on your system and double click the Eclipse () icon to open Eclipse.
2. When the **Workspace Launcher** window appears, click **OK**.
3. Select **Window > Preferences** to display the **Preferences** window.
4. Expand the **Java** node and select the **Compiler** node. Under **JDK Compliance**, set **Compiler compliance level** to 1.6.
5. Close Eclipse.

Installing the Android SDK

The *Android Software Development Kit (SDK)* provides the tools you need to develop, test and debug Android apps. You can download the Android SDK from

```
developer.android.com/sdk/index.html
```

Click the link for your platform—Windows, Mac OS X or Linux—to download the SDK's archive file. Once you've downloaded the archive, simply extract its contents to a directory of your choice on your computer. The SDK *does not* include the Android platform—you'll download this separately using the tools in the Android SDK.

Installing the ADT Plugin for Eclipse

The *Android Development Tools (ADT) Plugin* for Eclipse enables you to use the Android SDK tools to develop Android applications in the Eclipse IDE. To install the ADT Plugin, go to

```
developer.android.com/sdk/eclipse-adt.html
```

and *carefully* follow the instructions for downloading and installing the ADT Plugin. If you have any trouble with the installation, be sure to read the troubleshooting tips further down the web page.

Installing the Android Platform(s)

You must now install the Android platform(s) that you wish to use for app development. In this book, we used Android 2.2, 2.3.3 and 3.x. Perform the following steps to install the Android platform(s) and additional SDK tools:

1. Open Eclipse ( ).
2. When the **Workspace Launcher** window appears, specify where you'd like your apps to be stored, then click **OK**.
3. Select **Window > Preferences** to display the **Preferences** window. In the window, select the Android node, then specify the location where you placed the Android SDK on your system in the **SDK Location** field. On our Windows system, we extracted it at `c:\android-sdk-windows`. Click **OK**.
4. Select **Window > Android SDK Manager** to display the **Android SDK Manager** window (Fig. 1).

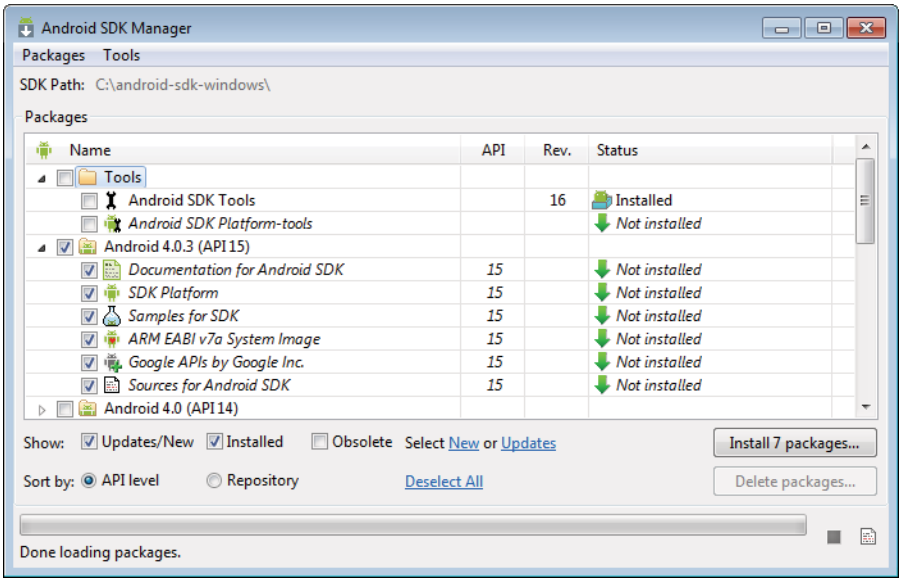


Fig. 1 | **Android SDK Manager** window.

5. The **Name** column of the window shows all of the tools, Android platform versions and extras that you can install. For use with this book, you need the items that are checked in Fig. 2. [*Note:* Most items in the **Extras** node are optional. The **Google USB Driver package** is necessary only for testing Android apps on actual devices using Windows. The **Google Market Licensing package** is necessary only if you intend to develop apps that query the Android Market to determine if a user has a proper license for an app before allowing the app to be used. The **Google Market Billing package** is necessary only if you intend to sell digital content through your app.]

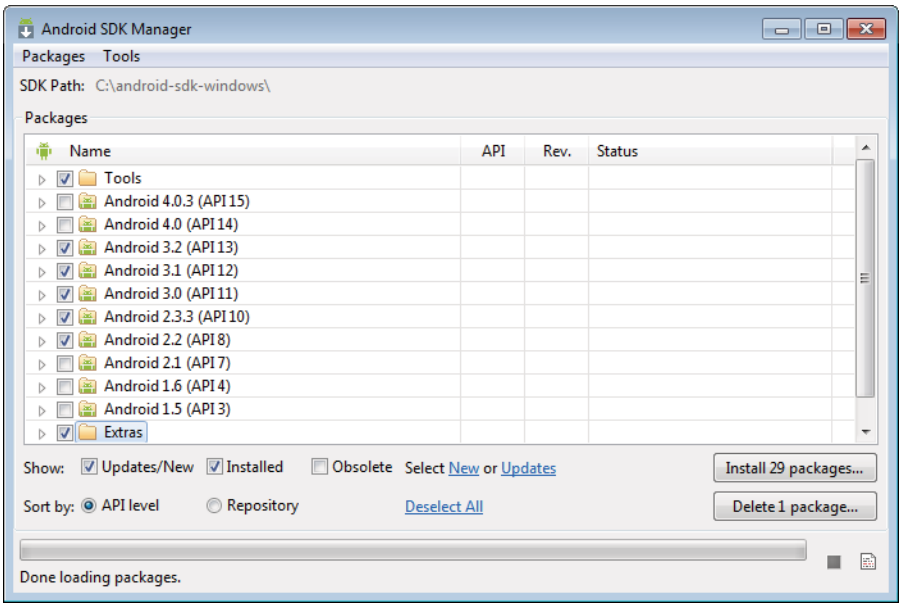


Fig. 2 | Selecting items to install.

6. Click the **Install** button to display the **Choose Packages to Install** window (Fig. 3). In this window, you can read the license agreements for each item. When you're done, click the **Accept All** radio button, then click the **Install** button. The status of the installation process will be displayed in the **Android SDK Manager** window. When the installation is complete, you should close and reopen Eclipse.

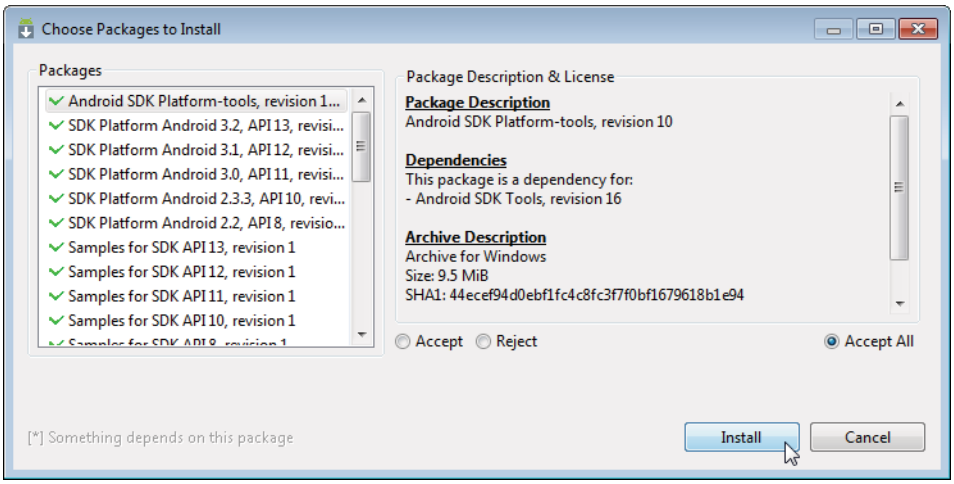


Fig. 3 | **Choose Packages to Install** window.

Creating Android Virtual Devices (AVDs) for Use in the Android Emulator

The *Android emulator*, included in the Android SDK, allows you to run Android apps in a simulated environment on your computer rather than on an actual Android device. Before running an app in the emulator, you must create an *Android Virtual Device (AVD)* which defines the characteristics of the device on which you want to test, including the screen size in pixels, the pixel density, the physical size of the screen, size of the SD card for data storage and more. If you want to test your apps for multiple Android devices, you can create separate AVDs that emulate each unique device. To do so, perform the following steps:

1. Open Eclipse.
2. Select **Window > AVD Manager** to display the **Android Virtual Device Manager** window (Fig. 4).

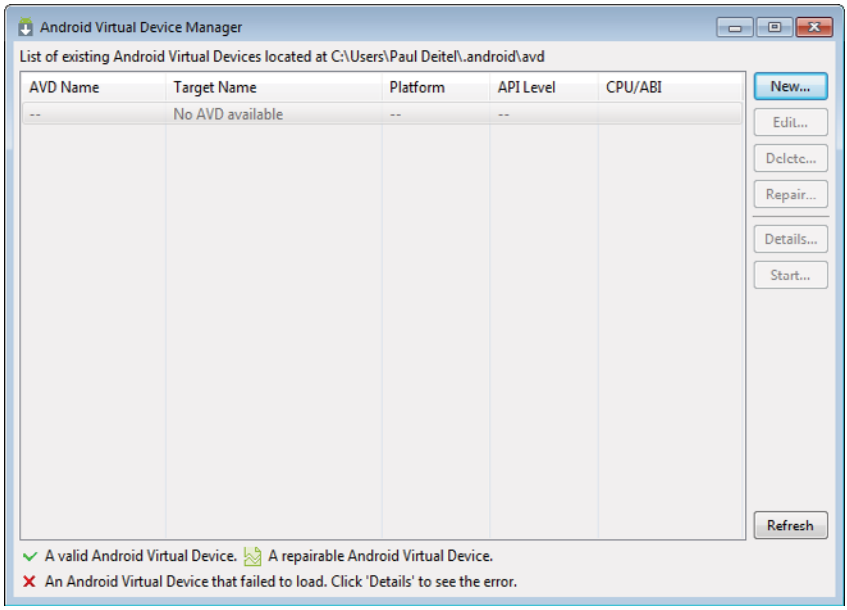


Fig. 4 | **Android AVD Manager** window.

3. Click **New...** to display the **Create new Android Virtual Device (AVD)** window (Fig. 5), then configure the options as shown and click **Create AVD**. These settings simulate the primary Android phone that we used for testing—the original Samsung Nexus S, which was running Android 2.3.3 at the time of this writing. Each AVD you create has many other options specified in its `config.ini`. You can modify this file as described at

```
developer.android.com/guide/developing/devices/
   managing-avds.html
```

to more precisely match the hardware configuration of your device.

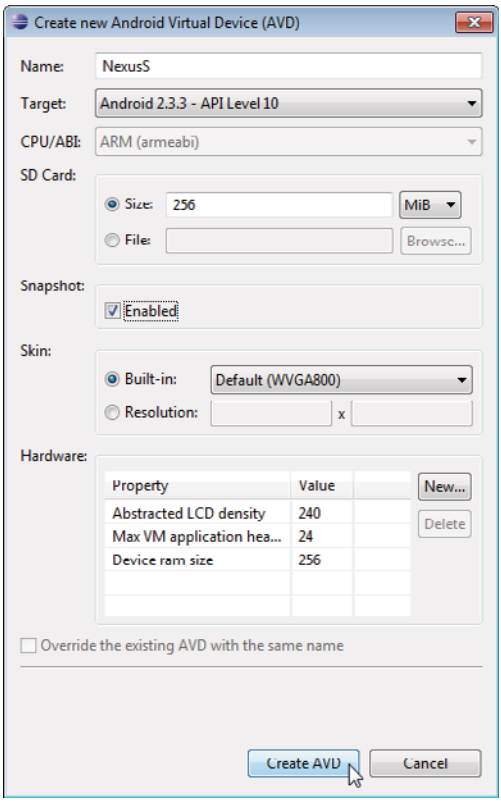


Fig. 5 | **Create new Android Virtual Device (AVD)** window.

4. We also configured an AVD that represents the Motorola Xoom tablet running Android 3.1 so we could test our tablet apps. Its settings are shown in Fig. 6.

AVD Performance

At the time of this writing, AVD performance was quite slow. To improve AVD load time, ensure that the **Enabled** checkbox in the Snapshot section is checked.

(Optional) Setting Up an Android Device for Development

Eventually, you might want to execute your apps on actual Android devices. To do so, follow the instructions at

```
developer.android.com/guide/developing/device.html
```

If you're developing on Microsoft Windows, you'll also need the Windows USB driver for Android devices, which we included as one of the checked items in Fig. 2. In some cases, you may also need device-specific USB drivers. For a list of USB driver sites for various device brands, visit:

```
developer.android.com/sdk/oem-usb.html
```

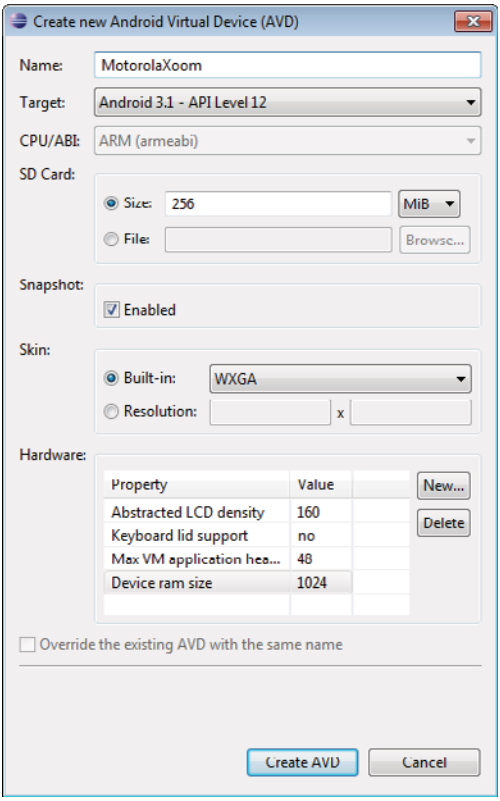


Fig. 6 | **Create new Android Virtual Device (AVD)** window.

(Optional) Other IDEs for Developing Android Apps

We developed all the apps in this book using the Eclipse IDE. Though this is the most popular IDE for Android development, there are other IDEs and tools available. Many early Android developers prefered to work with the command-line tools and some phone vendors (such as Motorola) provide their own Android development tools. The site

```
developer.android.com/guide/developing/projects/
   projects-cmdline.html
```

includes information you'd need to develop Android apps using the command-line tools. Some of the tools for command-line development are summarized in (Fig. 7).

Tool	URL	Description
`android`	`developer.android.com/guide/developing/tools/index.html`	Used to create, view and delete AVDs; create and update Android projects; and update your Android SDK.

Fig. 7 | Tools for developing Android apps in IDEs other than Eclipse.

Tool	URL	Description
Android Emulator	`developer.android.com/guide/developing/tools/emulator.html`	Allows you to develop and test Android apps on a computer.
Android Debug Bridge (adb)	`developer.android.com/guide/developing/tools/adb.html`	Allows you to manage the state of a device or the emulator.
Apache Ant	`ant.apache.org/`	Application build tool.
Keytool and Jarsigner (or similar signing tool)	`developer.android.com/guide/publishing/app-signing.html`	Included in the JDK. Keytool generates a private key for digitally signing your Android apps. Jarsigner is used to sign the apps.

Fig. 7 | Tools for developing Android apps in IDEs other than Eclipse.

Obtaining the Code Examples

The examples for *Android for Programmers* are available for download at

```
www.deitel.com/books/androidFP/
```

If you're not already registered at our website, go to `www.deitel.com` and click the **Register** link below our logo in the upper-left corner of the page. Fill in your information. There's no charge to register, and we do not share your information with anyone. We send you only account-management e-mails unless you register separately for our free, double-opt-in *Deitel® Buzz Online* e-mail newsletter at

```
www.deitel.com/newsletter/subscribe.html
```

After registering for our website, you'll receive a confirmation e-mail with your verification code—please verify that you entered your email address correctly. *You'll need to click the verification link in the email to sign in at `www.deitel.com` for the first time*. Configure your e-mail client to allow e-mails from `deitel.com` to ensure that the verification e-mail is not filtered as junk mail.

Next, visit `www.deitel.com` and sign in using the **Login** link below our logo in the upper-left corner of the page. Go to `www.deitel.com/books/androidFP/`. Click the **Examples** link to download the `Examples.zip` file to your computer. Double click `Examples.zip` to unzip the archive.

You're now ready to begin developing Android apps with *Android for Programmers: An App-Driven Approach*. Enjoy!

If you're not already registered at our website, go to `www.deitel.com` and click the **Register** link below our logo in the upper-left corner of the page. Fill in your information. There's no charge to register, and we do not share your information with anyone. We send you only account-management e-mails unless you register separately for our free, double-opt-in *Deitel® Buzz Online* e-mail newsletter at

```
www.deitel.com/newsletter/subscribe.html
```

After registering for our website, you'll receive a confirmation e-mail with your verification code—please verify that you entered your email address correctly. *You'll need the verification code to sign in at `www.deitel.com` for the first time*. Configure your e-mail client to allow e-mails from `deitel.com` to ensure that the verification e-mail is not filtered as junk mail.

Next, visit `www.deitel.com` and sign in using the **Login** link below our logo in the upper-left corner of the page. Go to `www.deitel.com/books/androidFP/`. Click the **Examples** link to download the `Examples.zip` file to your computer. Double click `Examples.zip` to unzip the archive.

You're now ready to begin developing Android apps with *Android for Programmers: An App-Driven Approach*. Enjoy!

3

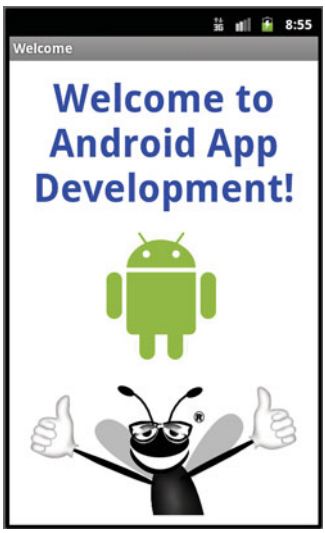
Welcome App

Dive-Into® Eclipse and the ADT Plugin

Objectives

In this chapter you'll:

- Learn the basics of the Eclipse IDE for writing, running and debugging your Android apps.
- Create an Eclipse project to develop a new app.
- Design a GUI visually (without programming) using the ADT (Android Development Tools) visual layout editor.
- Edit the properties of GUI components.
- Build a simple Android app and execute it on an Android Virtual Device (AVD).



Outline

3.1 Introduction

In this chapter, you'll build the **Welcome** app—a simple app that displays a welcome message and two images—*without writing any code*. You'll use the Eclipse IDE with the ADT (Android Development Tools) Plugin—the most popular tools for creating and testing Android apps. We'll overview Eclipse and show you how to create a simple Android app (Fig. 3.1) using the ADT's Visual Layout Editor, which allows you to build GUIs using drag-and-drop techniques. Finally, you'll execute your app on an Android Virtual Device (AVD).

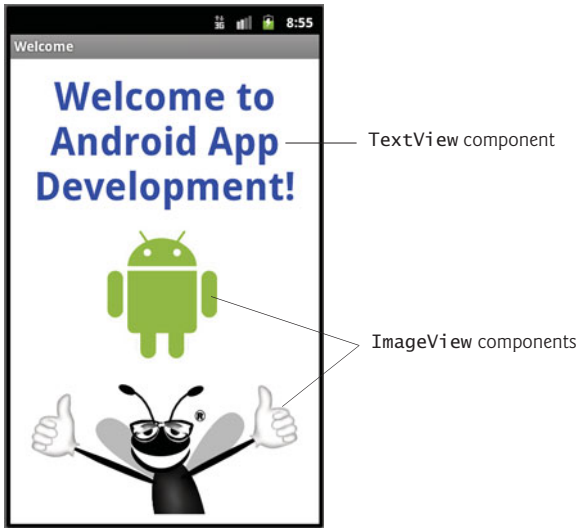


Fig. 3.1 | **Welcome** app.

3.2 Technologies Overview

This chapter introduces the Eclipse IDE and ADT Plugin. You'll learn how to navigate Eclipse and create a new project. With the ADT Visual Layout Editor, you'll display pictures in **`ImageViews`** and display text in a **`TextView`**. You'll see how to edit GUI component properties (e.g., the `Text` property of a `TextView` and the `Src` property of an `ImageView`) in Eclipse's **Properties** tab and you'll run your app on an Android Virtual Device (AVD).

3.3 Eclipse IDE

This book's examples were developed using the versions of the Android SDK that were most current at the time of this writing (versions 2.3.3 and 3.0), and the Eclipse IDE with the ADT (Android Development Tools) Plugin. In this chapter, we assume that you've already set up the Java SE Development Kit (JDK), the Android SDK and the Eclipse IDE, as discussed in the Before You Begin section that follows the Preface.

Introduction to Eclipse

Eclipse enables you to manage, edit, compile, run and debug applications. The ADT Plugin for Eclipse gives you the additional tools you'll need to develop Android apps. You can also use the ADT Plugin to manage multiple Android platform versions, which is important if you're developing apps for many devices with different Android versions installed. When you start Eclipse for the first time, the **Welcome** tab (Fig. 3.2) is displayed. This contains several icon links, which are described in Fig. 3.3. Click the **Workbench** button to display the Java **development perspective**, in which you can begin developing Android apps. Eclipse supports development in many programming languages. Each set of Eclipse tools you install is represented by a separate development perspective. Changing perspectives reconfigures the IDE to use the tools for the corresponding language.

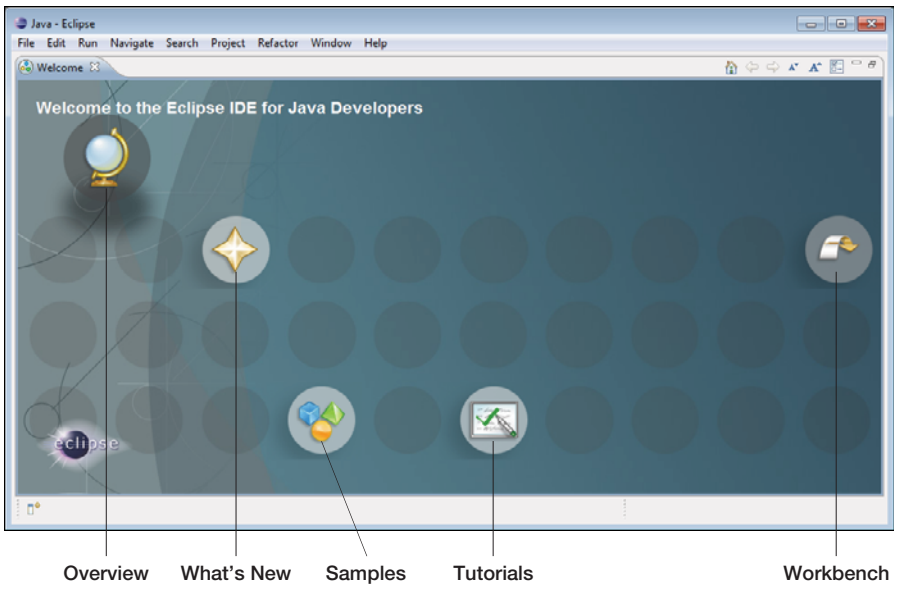


Fig. 3.2 | **Welcome to the Eclipse IDE for Java Developers** tab in the **Eclipse** window.

Link	Description
Overview	Provides an overview of the IDE and its features.

Fig. 3.3 | Links on the Eclipse IDE's **Welcome** tab. (Part 1 of 2.)

Link	Description
What's New	Provides information about what's new in the installed version of Eclipse as well as links to the online Eclipse community and updates for the IDE.
Samples	Provides links to samples for the Eclipse configuration you downloaded.
Tutorials	Provides tutorials to help you get started with Java development in Eclipse and to help you use various Eclipse capabilities.
Workbench	Takes you to the development perspective.

Fig. 3.3 | Links on the Eclipse IDE's **Welcome** tab. (Part 2 of 2.)

3.4 Creating a New Project

To begin programming with Android in Eclipse, select **File > New > Project...** to display the **New Project** dialog. Expand the **Android** node, select **Android Project** and click **Next >** to display the **New Android Project dialog** (Fig. 3.4). You can also do this with the **New** ( ) toolbar buttons's drop-down list. After you create your first project, the **Android Project** option will appear in the **File > New** menu and in the **New** ( ) button's drop-down list.

A **project** is a group of related files, such as the code files and any images that make up an app. Using the **New Android Project** dialog, you can create a project from scratch or you can use existing source code—such as the code examples from this book.

In this dialog, specify the following information:

1. In the **Project name:** field, enter `Welcome`. This will be the name of the project's root node in Eclipse's **Package Explorer** tab.
2. In the **Contents** section, ensure that **Create new project in workspace** is selected to create a new project from scratch. The **Create project from existing source** option allows you to create a new project and incorporate existing Java source-code files.
3. In the **Build Target** section, select the Android version you wish to use. For most of this book's examples, we use version 2.3.3; however, it's recommended that you select the minimum version that your app requires so that it can run on the widest variety of devices.

In the **Properties** section of the dialog, specify the following information:

1. In the **Application name:** field, enter `Welcome`. We typically give our applications the same name as their projects, but this is not required. This name appears in a bar at the top of the app, if that bar is not *explicitly* hidden by the app.
2. Android uses conventional Java package-naming conventions and requires a minimum of two parts in the package name (e.g., `com.deitel`). In the **Package name:** field, enter `com.deitel.welcome`. We use our domain `deitel.com` in reverse followed by the app's name. All the classes and interfaces that are created as part of your app will be placed in this Java package. Android and the Android Market use the package name as the app's unique identifier.
3. In the **Create Activity:** field, enter `Welcome`. This will become the name of a class that controls the app's execution. Starting in the next chapter, we'll modify this class to implement an app's functionality.

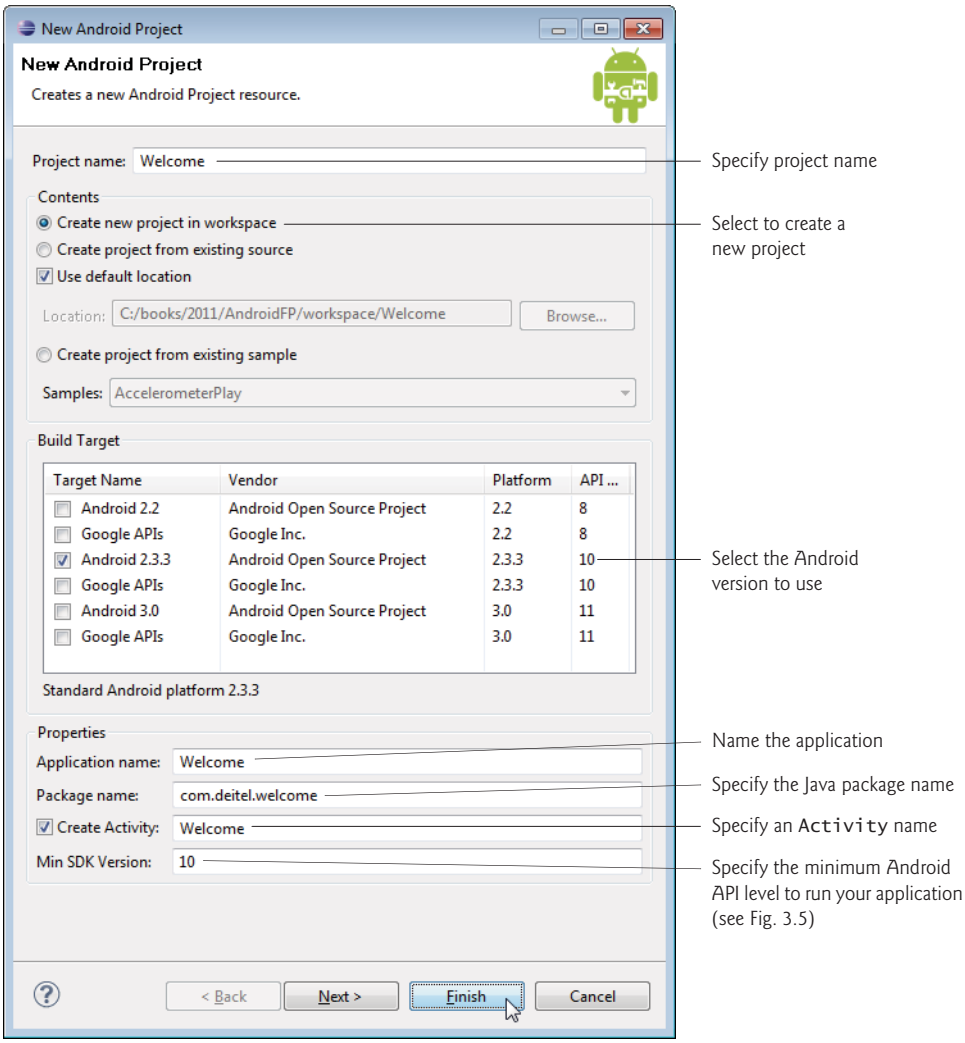


Fig. 3.4 | **New Android Project** dialog.

4. In the **Min SDK Version:** field, enter the minimum API level that's required to run your app. This allows your app to execute on devices at that API level and higher. In this book, we typically use the API level 10, which corresponds to Android 2.3.3, or API level 11, which corresponds to Android 3.0. To run your app on Android 2.2 and higher, select API level 8. *In this case, you must ensure that your app does not use features that are specific to more recent versions of Android.* Figure 3.5 shows the Android SDK versions and API levels. *Other versions of the SDK are now deprecated and should not be used.* The following webpage shows the current percentage of Android devices running each platform version:

```
developer.android.com/resources/dashboard/platform-versions.html
```

Android SDK version	API level
3.0	11
2.3.3	10
2.2	8
2.1	7
1.6	4
1.5	3

Fig. 3.5 | Android SDK versions and API levels. (`developer.android.com/sdk/index.html`)

5. Click **Finish** to create the project. [*Note:* You might see project errors while Eclipse loads the Android SDK.]

Package Explorer Window

Once you create (or open) a project, the **Package Explorer** window at the left of the IDE provides access to all of the project's files. Figure 3.6 shows the project contents for the **Welcome** app. The **Welcome** node represents the project. You can have many projects open in the IDE at once—each will have its own top-level node.

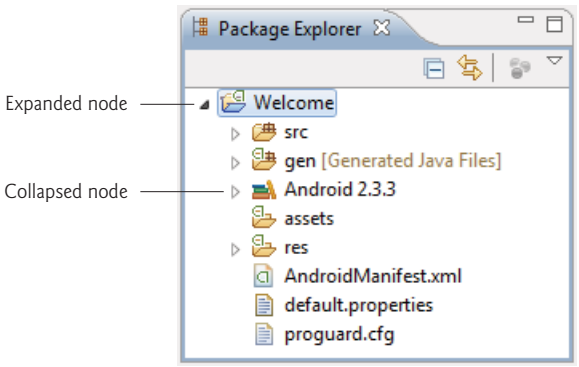


Fig. 3.6 | **Package Explorer** window.

Within a project's node the project's contents are organized into various files and folders, including:

- **src**—A folder containing the project's Java source files.
- **gen**—A folder containing the Java files generated by the IDE.
- **Android 2.3.3**—A folder containing the Android framework version you selected when you created the app.
- **res**—A folder containing the **resource files** associated with your app, such as GUI layouts and images used in your app.

We discuss the other files and folders as necessary throughout the book.

3.5 Building the Welcome App's GUI with the ADT's Visual Layout Editor

Next, you'll create the GUI for the **Welcome** app. The ADT's **Visual Layout Editor** allows you to build your GUI by dragging and dropping GUI components, such as `Button`s, `TextView`s, `ImageView`s and more, onto an app. For an Android app that you create with Eclipse, the *GUI layout is stored in an XML file called* **`main.xml`**, by default. Defining the GUI in XML allows you to easily separate your app's logic from its presentation. Layout files are considered app *resources* and are stored in the project's **`res`** folder. GUI layouts are placed within that folder's `layout` subfolder. When you double click the `main.xml` file in your app's `/res/layout` folder, the Visual Layout Editor view is displayed by default (Fig. 3.7). To view the XML contents of the file (Fig. 3.8), click the tab with the name of the layout file (**main.xml** in this case). You can switch back to the Visual Layout Editor by clicking the **Graphical Layout** tab. We'll present the layout's XML in Section 3.6.

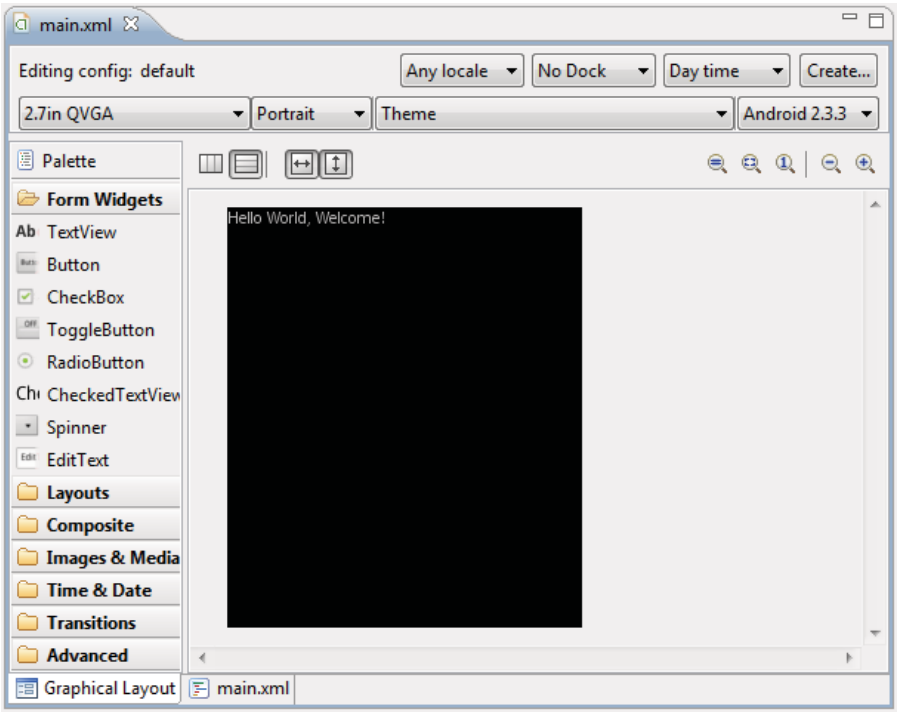


Fig. 3.7 | Visual Layout Editor view of the app's default GUI.

The Default GUI

The default GUI for a new Android app consists of a `LinearLayout` with a black background and contains a `TextView` with the text `"Hello World, Welcome!"` (Fig. 3.7). A **`LinearLayout`** arranges GUI components in a line horizontally or vertically. A **`TextView`** allows you to display text. If you were to execute this app in an AVD or on a device, you'd see the default black background and text.

Fig. 3.8 | XML view of the app's default GUI.

Figure 3.9 lists some of the layouts from the **`android.widget`** package.[1] We'll cover many more GUI components that can be placed in layouts—for a complete list, visit:

```
developer.android.com/reference/android/widget/package-summary.html
```

Look-and-Feel Observation 3.1

To support devices of varying screen sizes and densities, it's recommended that you use `RelativeLayout` and `TableLayout` in your GUI designs.

Layout	Description
`FrameLayout`	Allocates space for a single component. You can add more than one component to this layout, but each will be displayed from the layout's upper-left corner. The last component added will appear on top.
`LinearLayout`	Arranges components horizontally in one row or vertically in one column.
`RelativeLayout`	Arranges components relative to one another or relative to their parent container.
`TableLayout`	Arranges components into a table of rows. You can then use the `TableRow` layout (a subclass of `LinearLayout`) to organize the columns.

Fig. 3.9 | Android layouts (package `android.widget`).

Configuring the Visual Layout Editor to use the Appropriate Android SDK

If you've installed multiple Android SDKs, the ADT Plugin selects the most recent one as the default for design purposes in the **Graphical Layout** tab—regardless of the SDK you selected when you created the project. In Fig. 3.7, we selected Android 2.3.3 from the

1. Earlier Android SDKs also have an `AbsoluteLayout` in which each component specifies its exact position. This layout is now deprecated. According to `developer.android.com/reference/android/widget/AbsoluteLayout.html`, you should use `FrameLayout`, `RelativeLayout` or a custom layout instead.

SDK selector drop-down list at the top-right side of the **Graphic Layout** tab to indicate that we're designing a GUI for an Android 2.3.3 device.

Deleting and Recreating the `main.xml` File

For this application, you'll replace the default `main.xml` file with a new one that uses a `RelativeLayout`, in which components are arranged relative to one another. Perform the following steps to replace the default `main.xml` file:

1. Make sure `main.xml` is closed, then right click it in the project's `/res/layout` folder and select **Delete** to delete the file.
2. Right click the layout folder and select **New > Other...** to display the **New** dialog.
3. In the **Android** node, select **Android XML File** and click **Next >** to display the **New Android XML File** dialog.
4. Configure the file name, location and root layout for the new `main.xml` file as shown in Fig. 3.10, then click **Finish**.

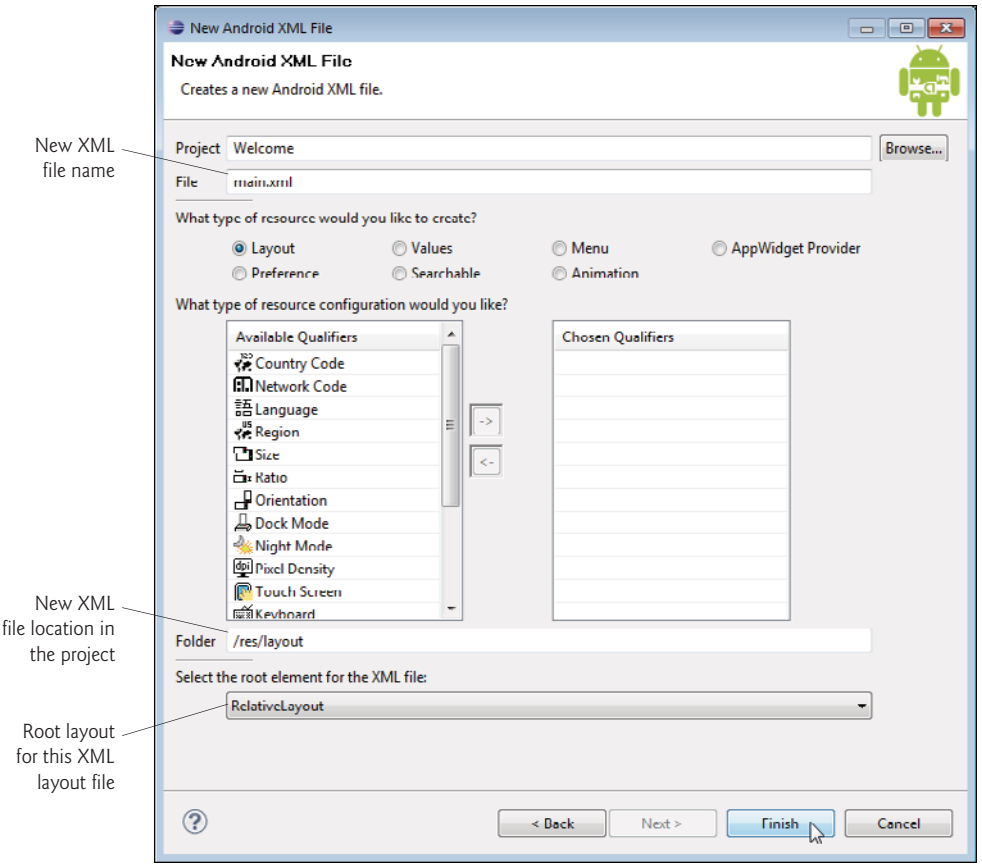


Fig. 3.10 | Creating a new `main.xml` file in the **New Android XML File** dialog.

Configuring the Visual Layout Editor's Size and Resolution

Figure 3.11 shows the new `main.xml` file in the Visual Layout Editor. Android runs on a wide variety of devices, so the Visual Layout Editor comes with several device configurations that represent various screen sizes and resolutions. These can be selected from the Device Configurations drop-down list at the top-left side of the **Graphic Layout** tab (Fig. 3.11). If these predefined configurations do not match the device you wish to target, you can create your own device configurations from scratch, or by copying and modifying the existing ones.

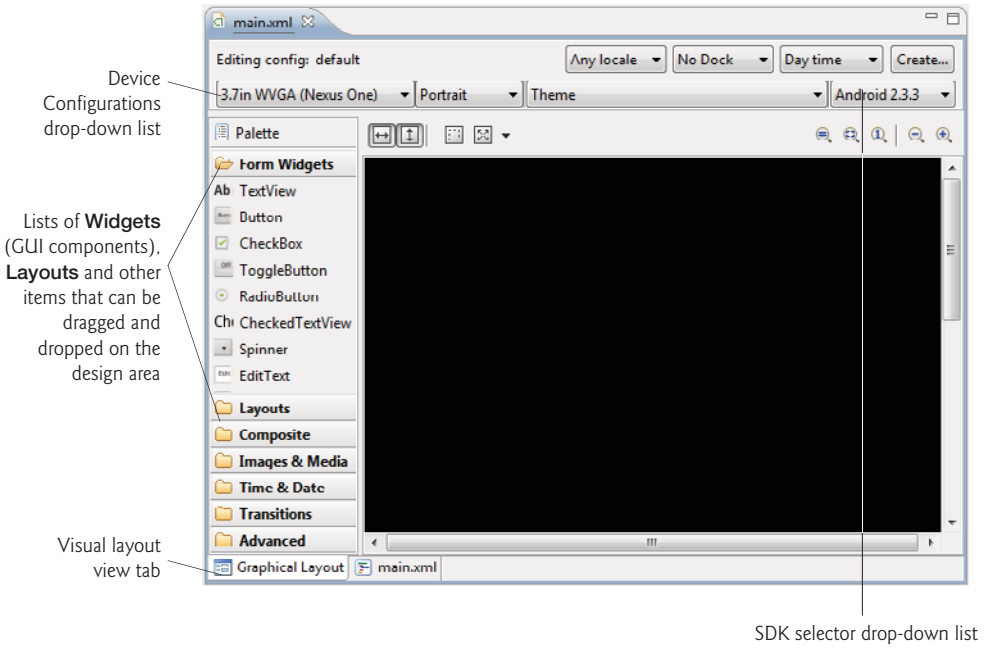


Fig. 3.11 | Visual Layout Editor view of the app's default GUI.

Our primary testing device for this book was the Samsung Nexus S, which has a 4-inch screen with 480-by-800 (WVGA) resolution. When designing an Android GUI, you typically want it to be *scalable* so that it displays properly on various devices. For this reason, the Visual Layout Editor's design area does not need to precisely match your actual device's. Instead, you can choose a similar device configuration. In Fig. 3.11, we selected the **3.7in WVGA (Nexus One)** option—this device has the same WVGA resolution as the Nexus S, but a slightly smaller screen size. Many of today's smartphones have 480-by-800 or 480-by-854 resolution.

Images and Screen Sizes/Resolutions

Because Android devices have various screen sizes, resolutions and pixel densities (that is, dots per inch or DPI), Android allows you to provide separate images (and other resources) that the operating system chooses based on the actual device's pixel density. For this reason your project's `res` folder contains three subfolders for images—`drawable-hdpi` (high den-

sity), `drawable-mdpi` (medium density) and `drawable-ldpi` (low density). These folders store images with different pixel densities (Fig. 3.12).

Density	Description
`ldpi`	Low density—approximately 120 dots-per-inch.
`mdpi`	Medium density—approximately 160 dots-per-inch.
`hdpi`	High density—approximately 240 dots-per-inch.
`xhdpi`	Extra high density—approximately 320 dots-per-inch.
`nodpi`	Indicates that a resource should not be scaled regardless of screen density.

Fig. 3.12 | Android pixel densities.

Images for devices that are similar in pixel density to our testing device are placed in the folder `drawable-hdpi`. Images for medium- and low-density screens are placed in the folders `drawable-mdpi` and `drawable-ldpi`, respectively. As of Android 2.2, you can also add a `drawable-xhdpi` subfolder to the app's `res` folder to represent screens with extra high pixel densities. Android will scale images up and down to different densities as necessary.

Look-and-Feel Observation 3.2

For detailed information on supporting multiple screens and screen sizes in Android, visit `developer.android.com/guide/practices/screens_support.html`.

Look-and-Feel Observation 3.3

For images to render nicely, a high-pixel-density device needs higher-resolution images than a low-pixel-density device. Low-resolution images do not scale well.

Step 1: Adding Images to the Project

You'll now begin designing the **Welcome** app. In this chapter, we'll use the Visual Layout Editor and the **Outline** window to build the app, then we'll explain the generated XML in detail. In subsequent chapters, we'll also edit the XML directly.

Look-and-Feel Observation 3.4

Many Android professionals prefer to create their GUIs directly in XML and use the Visual Layout Editor to preview the results. As you type in the XML view, Eclipse provides auto-complete capabilities showing you component names, attribute names and values that match what you've typed so far. These help you write the XML quickly and correctly.

For this app, you'll need to add the Deitel bug image (`bug.png`) and the Android logo image (`android.png`) to the project—we've provided these in the `images` folder with the book's examples. Perform the following steps to add the images to this project:

1. In the **Package Explorer** window, expand the project's `res` folder.
2. Locate and open the `images` folder provided with the book's examples, then drag the images in the folder onto the `res` folder's `drawable-hdpi` subfolder.

These images can now be used in the app.

Step 2: Changing the `Id` Property of the `RelativeLayout`

You can use the **Properties** window to configure the properties of the selected layout or component without editing the XML directly. If the **Properties** window is not displayed, you can display it by double clicking the `RelativeLayout` in the **Outline** window. You can also select **Window > Show View > Other...**, then select **Properties** from the **General** node in the **Show View** dialog. To select a layout or component, you can either click it in the Visual Layout Editor or select its node in the **Outline** window (Fig. 3.13). The **Properties** window cannot be used when the layout is displayed in XML view.

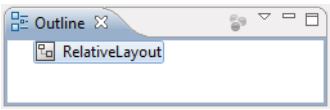


Fig. 3.13 | Hierarchical GUI view in the **Outline** window.

You should rename each layout and component with a relevant name, especially if the the layout or component will be manipulated programmatically (as we'll do in later apps). Each object's name is specified via its **Id property**. The `Id` can be used to access and modify component without knowing its exact location in the XML. As you'll see shortly, the `id` can also be used to specify the relative positioning of components in a `RelativeLayout`.

Select the `RelativeLayout`, then scroll to the **Id property** in the **Properties** window and set its value to

```
@+id/welcomeRelativeLayout
```

The `+` in the syntax `@+id` indicates that a new `id` (that is, a variable name) should be created with the identifier to the right of the `/`. The **Properties** and **Outline** windows should now appear as in Fig. 3.14.

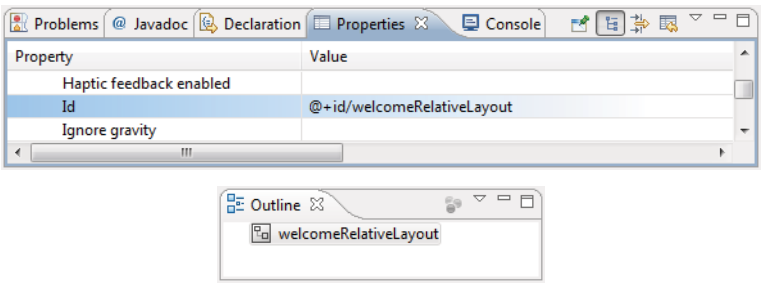


Fig. 3.14 | **Properties** window after changing the `RelativeLayout`'s **Id** property.

Step 3: Changing the `Background` Property of the `RelativeLayout`

The layout's default background color is black, but we'd like it to be white. Every color can be created from a combination of red, green and blue components called **RGB values**—each is an integer in the range 0–255. The first value defines the amount of red in the color, the second the amount of green and the third the amount of blue. When using

the IDE to specify a color you typically use hexadecimal format. In this case, the RGB components are represented as values in the range 00–FF.

To change the background color, locate the **Background property** in the **Properties** window and set its value to `#FFFFFF` (Fig. 3.15). This represents white in the hexadecimal format `#RRGGBB`—the pairs of hexadecimal digits represent the red, green and blue color components, respectively. Android also supports alpha (transparency) values in the range 0–255, where 0 represents completely transparent and 255 represents completely opaque. If you wish to use alpha values, you can specify the color in the format `#AARRGGBB`, where the first two hexadecimal digits represent the alpha value. For cases in which both digits of each component of the color are the same, you can use the formats `#RGB` or `#ARGB`. For example, `#FFF` will be treated as `#FFFFFF`.

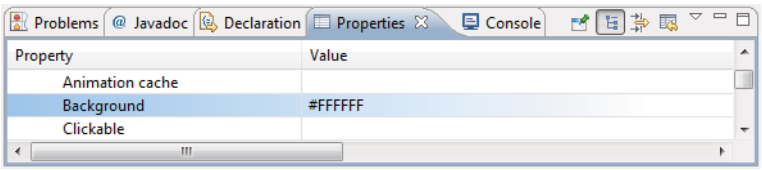


Fig. 3.15 | **Properties** window after changing the `RelativeLayout`'s **Background** property.

Step 4: Adding a `TextView`

Next, we'll add a `TextView` to the user interface. In the **Form Widgets** list at the left of the Visual Layout Editor window, locate `TextView` and drag it onto the design area (Fig. 3.16). When you add a new component to the user interface, it's automatically selected and its properties are displayed in the **Properties** window.

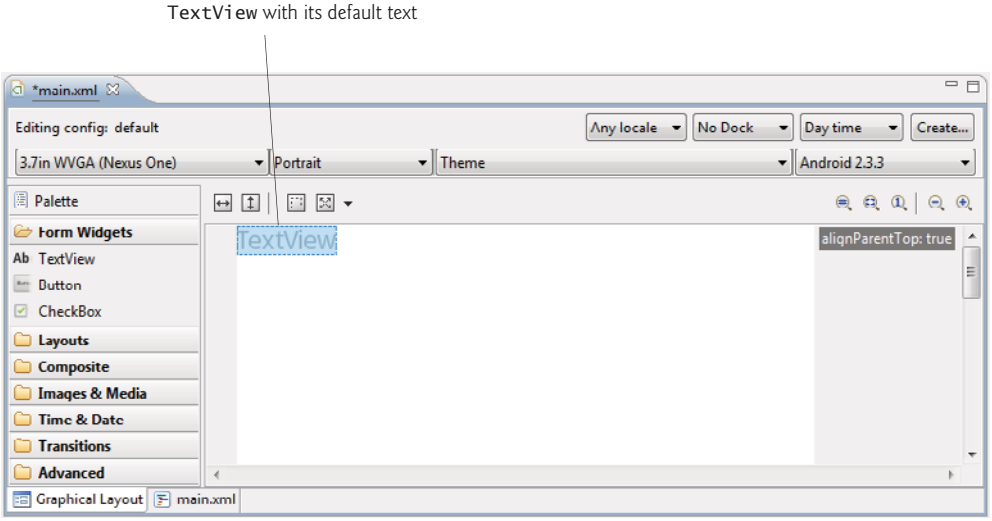


Fig. 3.16 | `TextView` with its default text.

Step 5: Configuring the `TextView`'s `Text` Property Using a String Resource

According to the Android documentation for application resources

```
developer.android.com/guide/topics/resources/index.html
```

it's considered a good practice to "externalize" strings, string arrays, images, colors, font sizes, dimensions and other app resources so that you, or someone else on your team, can manage them separately from your application's code. For example, if you externalize color values, all components that use the same color can be updated to a new color simply by changing the color value in a central resource file.

If you wish to localize your app in several different languages, storing the strings separately from the app's code allows you to change them easily. In your project's `res` folder, the subfolder `values` contains a `strings.xml` file that's used to store strings. To provide localized strings for other languages, you can create separate `values` folders for each language. For example, the folder `values-fr` would contain a `strings.xml` file for French and `values-es` would contain a `strings.xml` file for Spanish. You can also name these folders with region information. For example, `values-en-rUS` would contain a `strings.xml` file for U.S. English and `values-en-rGB` would contain a `strings.xml` file for United Kingdom English. For more information on localization, see

```
developer.android.com/guide/topics/resources/
   providing-resources.html#AlternativeResources
developer.android.com/guide/topics/resources/localization.html
```

To set the `TextView`'s **`Text` property**, we'll create a new string resource in the `strings.xml` file.

1. Ensure that the `TextView` is selected.
2. Locate its **Text** property in the **Properties** window, click its default value, then click the ellipsis button (…) at the right size of the property's value field to display the **Resource Chooser** dialog.
3. In the **Resource Chooser** dialog, click the **New String…** button to display the **Create New Android String** dialog (Fig. 3.17).
4. Fill the **String** and **New R.string** fields as shown in Fig. 3.17, then click **OK** to dismiss the **Create New Android String** dialog and return to the **Resource Chooser** dialog.
5. The new string resource named `welcome` is automatically selected. Click **OK** to select this resource.

In the **Properties** window, the **Text** property should now appear as shown in Fig. 3.18. The syntax `@string` indicates that an existing string resource will be selected from the `strings.xml` file, and the name `welcome` indicates which string resource to select.

A key benefit of defining your string values this way is that you can easily *localize* your app by creating additional XML resource files for string resources in other languages. In each file, you use the same name in the **New R.string** field and provide the internationalized string in the **String** field. Android can then choose the appropriate resource file based on the device user's preferred language. For more information on localization, visit

```
developer.android.com/guide/topics/resources/localization.html
```

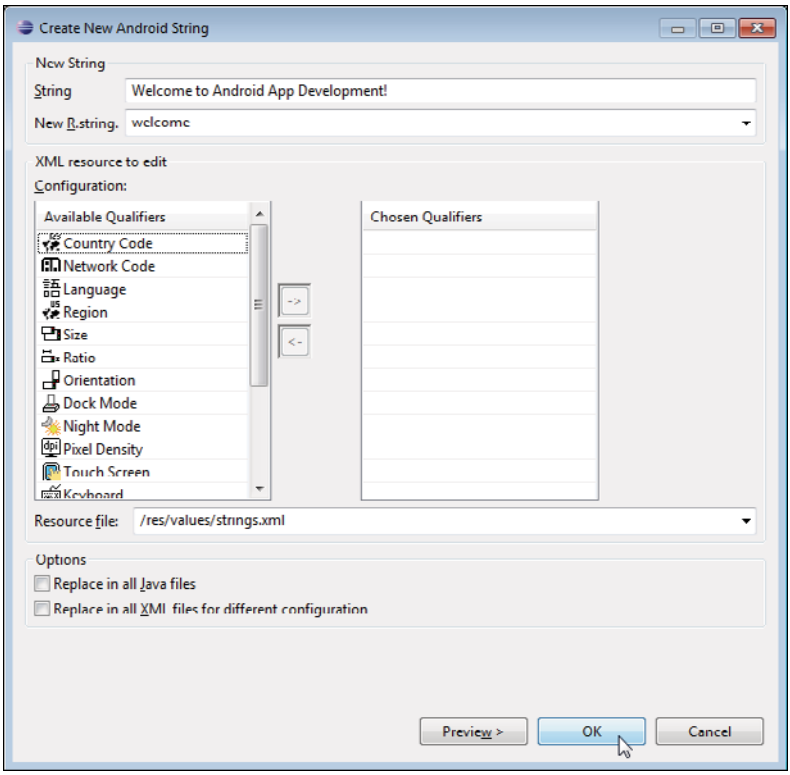


Fig. 3.17 | **Create New Android String** window.

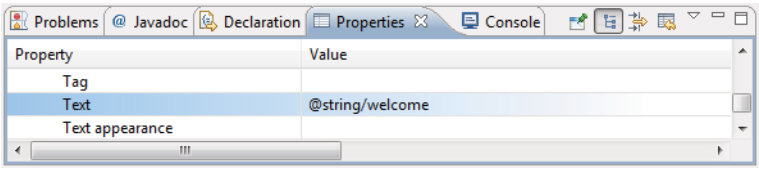


Fig. 3.18 | **Properties** window after changing the `TextView`'s **Text** property.

Step 6: Configuring the `TextView`'s Text size and Padding top Properties—Scaled Pixels and Density-Independent Pixels

The sizes of GUI components and text in Android can be specified in several different units (Fig. 3.19). The documentation for supporting multiple screen sizes

```
developer.android.com/guide/practices/screens_support.html
```

recommends that you use density-independent pixels for the dimensions of GUI components and other screen elements and scale-independent pixels for font sizes.

Defining your GUIs with **density-independent pixels** enables the Android platform to automatically scale the GUI, based on the pixel density of the actual device's screen.

Unit	Description
`px`	pixel
`dp` or `dip`	density-independent pixel
`sp`	scale-independent pixel
`in`	inches
`mm`	millimeters

Fig. 3.19 | Measurement units.

One density-independent pixel is equivalent to one pixel on a screen with 160 dpi (dots per inch). On a screen with 240 dpi, each density-independent pixel will be scaled by a factor of 240/160 (i.e., 1.5). So, a component that's 100 density-independent pixels wide will be scaled to 150 actual pixels wide. On a screen with 120 dpi, each density-independent pixel is scaled by a factor of 120/160 (i.e., .75). So, the same component that's 100 density-independent pixels wide will be 75 actual pixels wide. ***Scale-independent pixels*** are scaled like density-independent pixels, and they're also scaled by the user's preferred font size specified on the device. [*Note:* At the time of this writing, users cannot yet change the preferred font size on Android devices, but this feature is expected in the future.]

You'll now increase the size of the `TextView`'s font and add some padding above the `TextView` to separate the text from the edge of the device's screen.

1. To change the font size, ensure that the **TextView** is selected, then change its **Text size property** to `40sp`.
2. To add some space between the top edge of the layout and the `TextView`, set the **Layout margin top property** in the **Misc** section of the **Properties** window to `10dp`.

Step 7: Configuring Additional `TextView` Properties

Configure the following additional `TextView`'s properties as well:

1. Set its **Id** property to `@+id/welcomeTextView`.
2. Set its **Text color property** to `#00F` (blue).
3. Set its **Text style property** to `bold`. To do so, click the **Value** field for this property, then click the ellipsis button (…) to display the dialog for selecting the font style. Click the **bold** checkbox, then click **OK** to set the text style.
4. To center the text in the `TextView` if it wraps to multiple lines, set its **Gravity property** to `center`. To do so, click the **Value** field for this property, then click the ellipsis button to display a dialog with the **Gravity** property's options (Fig. 3.20). Click the **center** checkbox, then click **OK** to set the value.

The Visual Layout Editor window should now appear as shown in Fig. 3.21.

Step 8: Adding `ImageViews` to Display the Android Logo and the Deitel Bug Logo

Next, you'll add two `ImageViews` to the GUI to display the images that you added to the project in *Step 1*. When you first drag an `ImageView` onto the Visual Layout Editor, nothing appears. For this reason, we'll use the **Outline** window to add the `ImageViews`. Perform the following steps:

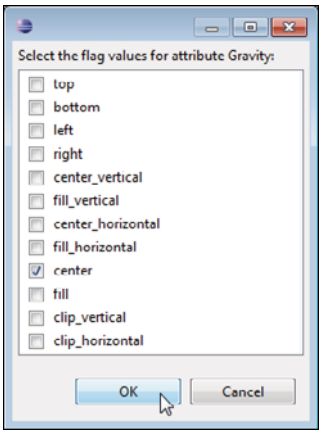


Fig. 3.20 | Options for the `gravity` attribute of an object.

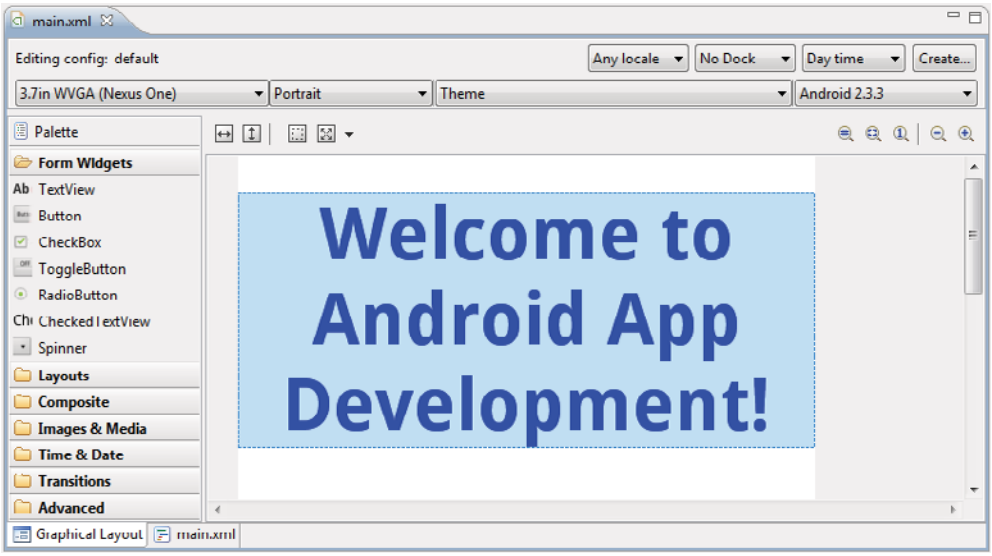


Fig. 3.21 | Visual Layout Editor window after completing the `TextView`'s configuration.

1. Drag an `ImageView` from the **Images & Media** category in the Visual Layout Editor's **Palette** and drop it onto the **Outline** window as shown in Fig. 3.22. The new `ImageView` appears below the `welcomeTextView` node. This *does not* indicate that this component will appear below the `TextView` in the GUI. This requires setting the **Layout below** property, which we'll do in a moment. [*Note:* If you drag the `ImageView` over the `welcomeTextView` and hover for a moment, a green rectangle with sections will appear around the `welcomeTextView`. If you then drag the `ImageView` over one of those sections and drop it, the Visual Layout Editor can set the relative positioning for you.]

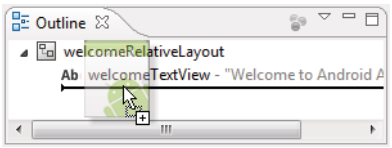


Fig. 3.22 | Dragging and dropping an `ImageView` onto the **Outline** window.

2. Set the `ImageView`'s **Id** property to `@+id/droidImageView`. The **Outline** window now shows the object's name as `droidImageView`.
3. Set the `droidImageView`'s **Layout below** property to `@id/welcomeTextView` to position the `ImageView` below the `welcomeTextView`. To do so, click the **Value** field for this property, then click the ellipsis button to display the **Reference Chooser** dialog (Fig. 3.23). The **ID** node contains the names of the objects in the GUI. Expand the **ID** node and select `welcomeTextView`.

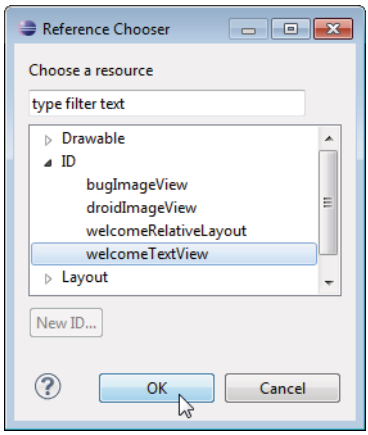


Fig. 3.23 | Selecting the value for the `droidImageView`'s **Layout below** property.

4. Set the `droidImageView`'s **Layout center horizontal** property to `true` to center the `ImageView` in the layout.
5. Set the `droidImageView`'s **Src property** to the image that should be displayed. To do so, click the **Value** field for this property, then click the ellipsis button to display the **Reference Chooser** dialog (Fig. 3.24). The **Drawable** node contains the resources in your app's `drawable` folders within the `res` folder. In the dialog, expand the **Drawable** node and select `android`, which represents the `android.png` image.
6. Repeat items 1–5 above to create the `bugImageView`. For this component, set its **Id** property to `@+id/bugImageView`, its **Src** property to `bug` and its Layout below property to `droidImageView`.

The Visual Layout Editor window should now appear as shown in Fig. 3.25.

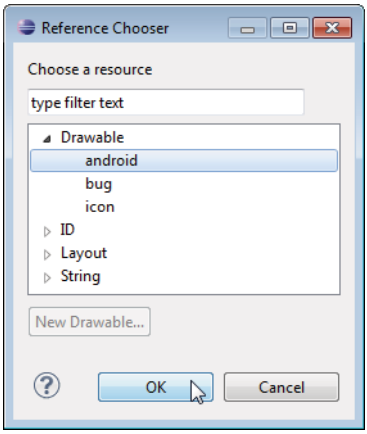


Fig. 3.24 | Selecting the value for the `droidImageView`'s **Src** property.

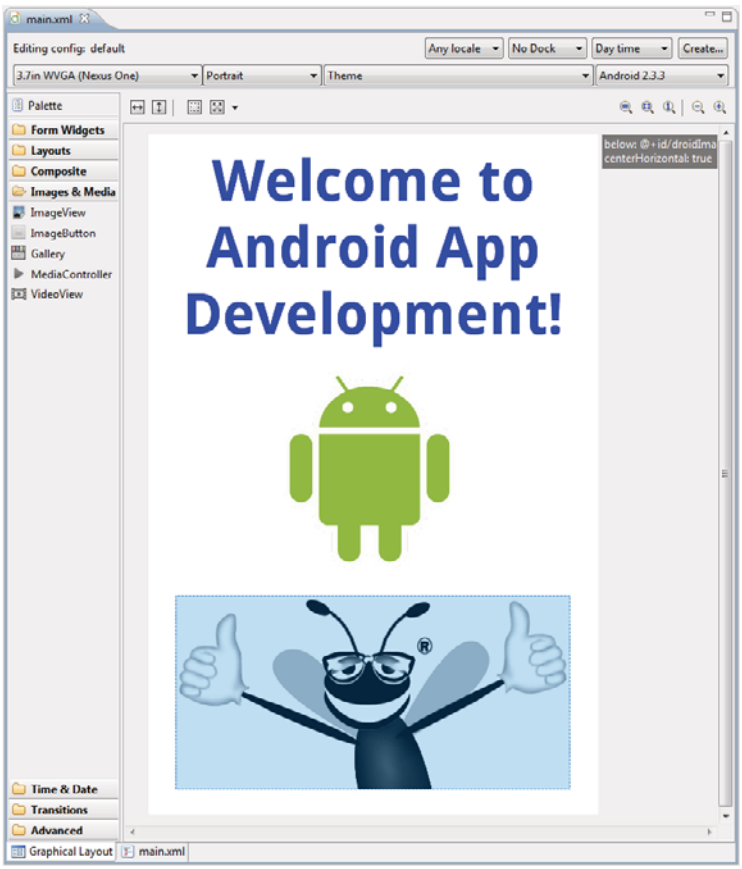


Fig. 3.25 | Visual Layout Editor window after completing the GUI configuration.

3.6 Examining the main.xml File

XML is a natural way to express a GUI's contents. It allows you, in a human- and computer-readable form, to say which layouts and components you wish to use, and to specify their attributes, such as size, position and color. The ADT Plugin can then parse the XML and generate the code that produces the actual GUI. Figure 3.26 shows the final `main.xml` file after you perform the steps in Section 3.5. We reformatted the XML and added some comments to make the XML more readable. (Eclipse's **Source > Format** command can help you with this.) As you read the XML, notice that each XML attribute name that contains multiple words does not contain spaces, whereas the corresponding properties in the **Properties** window do. For example, the XML attribute `android:paddingTop` corresponds to the property **Padding top** in the **Properties** window. When the IDE displays property names, it displays the multiword names as separate words for readability.

```
1  <?xml version="1.0" encoding="utf-8"?>
2  <!-- main.xml -->
3  <!-- Welcome App's XML layout. -->
4
5  <!-- RelativeLayout that contains the App's GUI components. -->
6  <RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
7     android:layout_width="match_parent"
8     android:layout_height="match_parent"
9     android:id="@+id/welcomeRelativeLayout" android:background="#FFFFFF">
10
11    <!-- TextView that displays "Welcome to Android App Development!" -->
12    <TextView android:layout_width="wrap_content"
13       android:layout_height="wrap_content"
14       android:text="@string/welcome"
15       android:textSize="40sp" android:id="@+id/welcomeTextView"
16       android:textColor="#00F" android:textStyle="bold"
17       android:layout_centerHorizontal="true" android:gravity="center"
18       android:layout_marginTop="10dp"></TextView>
19
20    <!-- ImageView that displays the Android logo -->
21    <ImageView android:layout_height="wrap_content"
22       android:layout_width="wrap_content" android:id="@+id/droidImageView"
23       android:layout_centerHorizontal="true"
24       android:src="@drawable/android"
25       android:layout_below="@id/welcomeTextView"></ImageView>
26
27    <!-- ImageView that displays the Deitel bug logo -->
28    <ImageView android:layout_height="wrap_content"
29       android:layout_width="wrap_content" android:id="@+id/bugImageView"
30       android:src="@drawable/bug"
31       android:layout_below="@id/droidImageView"
32       android:layout_centerHorizontal="true"></ImageView>
33 </RelativeLayout>
```

Fig. 3.26 | **Welcome** App's XML layout.

welcomeRelativeLayout

The welcomeRelativeLayout (lines 6–33) contains all of the app's GUI components.

- Its opening XML tag (lines 6–9) sets various RelativeLayout attributes.
- Line 6 uses the xmlns attribute to indicate that the elements in the document are all part of the android XML namespace. This is required and auto-generated by the IDE when you create any layout XML file.
- Lines 7–8 specify the value match_parent for both the android:layout_width and android:layout_height attributes, so the layout occupies the entire width and height of layout's parent element—that is, the one in which this layout is nested. In this case, the RelativeLayout is the *root node* of the XML document, so the layout occupies the *entire screen* (excluding the status bar).
- Line 9 specifies the values for the welcomeRelativeLayout's android:id and android:background attributes.

welcomeTextView

The first element in the welcomeRelativeLayout is the welcomeTextView (lines 12–18).

- Lines 12 and 13 set the android:layout_width and android:layout_height attributes to wrap_content. This value indicates that the view should be just large enough to fit its content, including its padding values that specify the spacing around the content.
- Line 14 sets the android:text attribute to the string resource named welcome that you created in Section 3.5, Step 5.
- Line 15 sets the android:textSize attribute to 40sp and the android:id attribute to "@+id/welcomeTextView".
- Line 16 sets the android:textColor attribute to "#00F" (for blue text) and the android:textStyle attribute to "bold".
- Line 17 sets the android:layout_centerHorizontal attribute to "true", which centers the component horizontally in the layout, and sets the android:gravity attribute to "center" to center the text in the TextView. The android:gravity attribute specifies how the text should be positioned with respect to the width and height of the TextView if the text is smaller than the TextView.
- Line 18 sets the android:marginTop attribute to 10dp so that there's some space between the top of the TextView and the top of the screen.

droidImageView

The last two elements nested in the welcomeRelativeLayout are the droidImageView (lines 21–25) and the bugImageView (lines 28–32). We set the same attributes for both ImageViews, so we discuss only the droidImageView's attributes here.

- Lines 21 and 22 set the android:layout_width and android:layout_height attributes to wrap_content. Line 22 also sets the android:id attribute to "@+id/droidImageView".
- Line 23 sets the android:layout_centerHorizontal attribute to "true" to centers the component in the layout.

- Line 24 sets the `android:src` attribute to the drawable resource named `android`, which represents the `android.png` image.
- Line 25 sets the `android:layout_below` attribute to `"@id/welcomeTextView"`. The `RelativeLayout` specifies each component's position relative to other components. In this case, the `ImageView` follows the `welcomeTextView`.

3.7 Running the Welcome App

To run the app in an Android Virtual Device (AVD), right click the app's root node in the **Package Explorer** window and select **Run As > Android Application**. Figure 3.27 shows the running app.

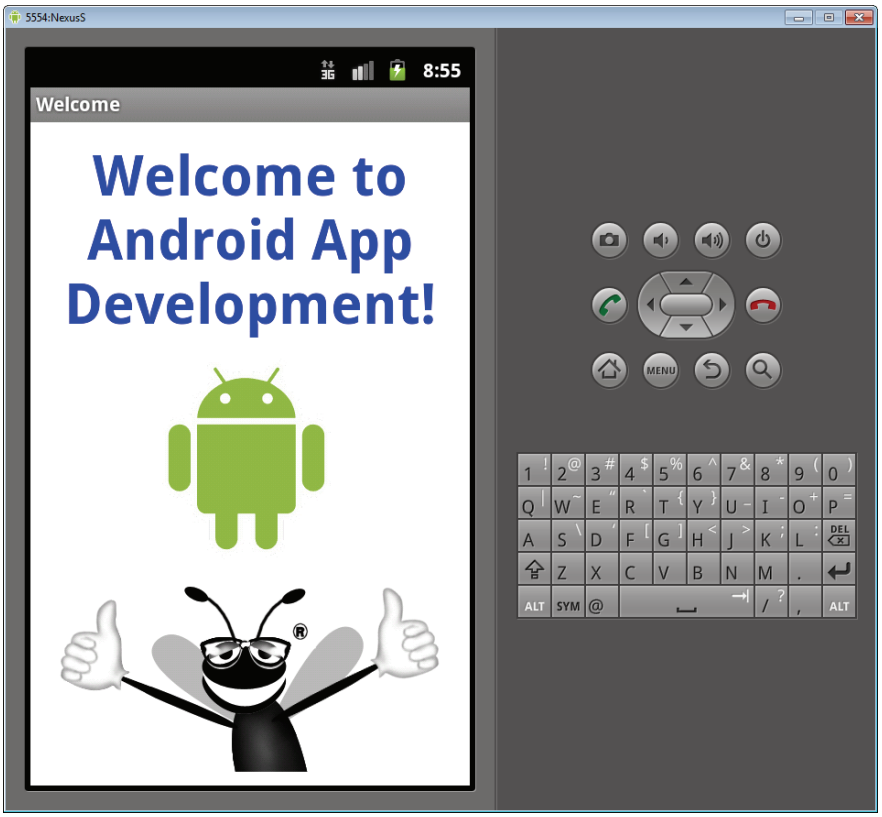


Fig. 3.27 | **Welcome** app running in an AVD.

3.8 Wrap-Up

This chapter introduced key features of the Eclipse IDE and the ADT Visual Layout Editor. You used the Visual Layout Editor to create a working Android app without writing any code. You used the `TextView` and `ImageView` GUI components to display text and im-

ages, respectively, and you arranged these components in a `RelativeLayout`. You edited the properties of GUI components to customize them for your app. You then tested the app in an Android Virtual Device (AVD). Finally, we presented a detailed walkthrough of the XML markup that generates the GUI.

In the next chapter we introduce how to program Android apps using Java. Android development is a combination of GUI design, and Java and XML coding. Java allows you to specify the behavior of your apps. You'll develop the **Tip Calculator** app, which calculates a range of tip possibilities when given a restaurant bill amount. You'll design the GUI and add Java code to specify how the app should process user inputs and display the results of its calculations.

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