Android Studio Development Essentials

Android 7 Edition

Android Studio Development Essentials – Android 7 Edition

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Chapter 1

1. Introduction

Fully updated for Android Studio 2.2 and Android 7, the goal of this book is to teach the skills necessary to develop Android based applications using the Android Studio Integrated Development Environment (IDE) and the Android 7 Software Development Kit (SDK).

Beginning with the basics, this book provides an outline of the steps necessary to set up an Android development and testing environment. An overview of Android Studio is included covering areas such as tool windows, the code editor and the Layout Editor tool. An introduction to the architecture of Android is followed by an in-depth look at the design of Android applications and user interfaces using the Android Studio environment. More advanced topics such as database management, content providers and intents are also covered, as are touch screen handling, gesture recognition, camera access and the playback and recording of both video and audio. This edition of the book also covers printing, transitions and cloud-based file storage.

The concepts of material design are also covered in detail, including the use of floating action buttons, Snackbars, tabbed interfaces, card views, navigation drawers and collapsing toolbars.

In addition to covering general Android development techniques, the book also includes Google Play specific topics such as implementing maps using the Google Maps Android API, in-app billing and submitting apps to the Google Play Developer Console.

The key new features of Android Studio and Android 7 are also covered in detail including the new layout editor, the ConstraintLayout class, direct reply notifications, Firebase remote notifications and multi-window support.

Chapters also cover advanced features of Android Studio such as Gradle build configuration and the implementation of build variants to target multiple Android device types from a single project code base.

Assuming you already have some Java programming experience, are ready to download Android Studio and the Android SDK, have access to a Windows, Mac or Linux system and ideas for some apps to develop, you are ready to get started.

1.1 Downloading the Code Samples

The source code and Android Studio project files for the examples contained in this book are available for download at:

http://www.ebookfrenzy.com/print/androidstudioA7/index.php

The steps to load a project from the code samples into Android Studio are as follows:

1. From the *Welcome to Android Studio* dialog, select the *Open an existing Android Studio* project option.
2. In the project selection dialog, navigate to and select the folder containing the project to be imported and click on OK.

1.2 Download the eBook

Thank you for purchasing the print edition of this book. If you would like to download the eBook version of this book, please email proof of purchase to *feedback@ebookfrenzy.com* and we will provide you with a download link for the book in PDF format.

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1.4 Errata

While we make every effort to ensure the accuracy of the content of this book, it is inevitable that a book covering a subject area of this size and complexity may include some errors and oversights. Any known issues with the book will be outlined, together with solutions, at the following URL:

http://www.ebookfrenzy.com/errata/androidstudioA7.html

In the event that you find an error not listed in the errata, please let us know by emailing our technical support team at *feedback@ebookfrenzy.com*. They are there to help you and will work to resolve any problems you may encounter.

Chapter 2

2. Setting up an Android Studio Development Environment

Before any work can begin on the development of an Android application, the first step is to configure a computer system to act as the development platform. This involves a number of steps consisting of installing the Java Development Kit (JDK) and the Android Studio Integrated Development Environment (IDE) which also includes the Android Software Development Kit (SDK).

This chapter will cover the steps necessary to install the requisite components for Android application development on Windows, Mac OS X and Linux based systems.

2.1 System Requirements

Android application development may be performed on any of the following system types:

- Windows 7/8/10 (32-bit or 64-bit)
- Mac OS X 10.8.5 or later (Intel based systems only)
- Linux systems with version 2.11 or later of GNU C Library (glibc)
- Minimum of 2GB of RAM (8GB is preferred)
- Approximately 4GB of available disk space
- 1280 x 800 minimum screen resolution

2.2 Installing the Java Development Kit (JDK)

The Android SDK was developed using the Java programming language. Similarly, Android applications are also developed using Java. As a result, the Java Development Kit (JDK) is the first component that must be installed.

Android Studio 2 development requires the installation of version 8 of the Standard Edition of the Java Platform Development Kit. Java is provided in both development (JDK) and runtime (JRE) packages. For the purposes of Android development, the JDK must be installed.

2.2.1 Windows JDK Installation

For Windows systems, the JDK may be obtained from Oracle Corporation's website using the following URL:

http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html

Assuming that a suitable JDK is not already installed on your system, download version 8 of the JDK package that matches the destination computer system. Once downloaded, launch the installation executable and follow the on screen instructions to complete the installation process.

2.2.2 Mac OS X JDK Installation

Java is not installed by default on recent versions of Mac OS X. To confirm the presence or otherwise of Java, open a Terminal window and enter the following command:

```
java -version
```

Assuming that Java is currently installed, output similar to the following will appear in the terminal window:

```
java version "1.8.0_77"
Java(TM) SE Runtime Environment (build 1.8.0_77-b03)
Java HotSpot(TM) 64-Bit Server VM (build 25.77-b03, mixed mode)
```

In the event that Java is not installed, issuing the "java" command in the terminal window will result in the appearance of a message which reads as follows together with a dialog on the desktop providing a More Info button which, when clicked will display the Oracle Java web page:

```
No Java runtime present, requesting install
```

On the Oracle Java web page, locate and download the Java SE 8 JDK installation package for Mac OS X.

Open the downloaded disk image (.dmg file) and double-click on the icon to install the Java package (Figure 2-1):

Figure 2-1

The Java for OS X installer window will appear and take you through the steps involved in installing the JDK. Once the installation is complete, return to the Terminal window and run the following command, at which point the previously outlined Java version information should appear:

```
java -version
```

2.3 Linux JDK Installation

First, if the chosen development system is running the 64-bit version of Ubuntu then it is essential that a 32-bit library support package be installed:

```
sudo apt-get install lib32stdc++6
```

As with Windows based JDK installation, it is possible to install the JDK on Linux by downloading the appropriate package from the Oracle web site, the URL for which is as follows:

http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html

Packages are provided by Oracle in RPM format (for installation on Red Hat Linux based systems such as Red Hat Enterprise Linux, Fedora and CentOS) and as a tar archive for other Linux distributions such as Ubuntu.

On Red Hat based Linux systems, download the .rpm JDK file from the Oracle web site and perform the installation using the *rpm* command in a terminal window. Assuming, for example, that the downloaded JDK file was named *jdk-8u77-linux-x64.rpm*, the commands to perform the installation would read as follows:

```
su
rpm -ihv jdk-8u77-linux-x64.rpm
```

To install using the compressed tar package (tar.gz) perform the following steps:

1. Create the directory into which the JDK is to be installed (for the purposes of this example we will assume */home/demo/java*).

2. Download the appropriate tar.gz package from the Oracle web site into the directory.

3. Execute the following command (where *<jdk-file>* is replaced by the name of the downloaded JDK file):

```
tar xvfz  <jdk-file>.tar.gz
```

4. Remove the downloaded tar.gz file.

5. Add the path to the *bin* directory of the JDK installation to your $PATH variable. For example, assuming that the JDK ultimately installed into */home/demo/java/jdk1.8.0_77* the following would need to be added to your $PATH environment variable:

```
/home/demo/java/jdk1.8.0_77/bin
```

This can typically be achieved by adding a command to the *.bashrc* file in your home directory (specifics may differ depending on the particular Linux distribution in use). For example, change directory to your home directory, edit the *.bashrc* file contained therein and add the following line at the end of the file (modifying the path to match the location of the JDK on your system):

```
export PATH=/home/demo/java/jdk1.8.0_77/bin:$PATH
```

Having saved the change, future terminal sessions will include the JDK in the $PATH environment variable.

2.4 Downloading the Android Studio Package

Most of the work involved in developing applications for Android will be performed using the Android Studio environment. The content and examples in this book were created based on Android Studio version 2.2.

At the time of writing, both Android Studio 2.2 and the Android 7 SDK are available in preview versions only. The location for downloading the Android Studio package will depend on whether or not the software is still in preview. Begin by checking the primary download page for Android Studio which can be found at the following URL:

https://developer.android.com/studio/index.html

If this page provides instructions for downloading Android Studio 2.2, perform the download from this page. If, on the other hand, the page provides access to Android Studio 2.1, you will need to download the latest preview edition of Android Studio 2.2 from the following web page:

http://tools.android.com/download/studio/canary/latest

From the appropriate page, select the package for your platform and operating system.

2.5 Installing Android Studio

Once downloaded, the exact steps to install Android Studio differ depending on the operating system on which the installation is being performed.

2.5.1 Installation on Windows

Locate the downloaded Android Studio installation executable file (named *android-studio-bundle-<version>.*exe) in a Windows Explorer window and double click on it to start the installation process, clicking the *Yes* button in the User Account Control dialog if it appears.

Once the Android Studio setup wizard appears, work through the various screens to configure the installation to meet your requirements in terms of the file system location into which Android Studio should be installed and whether or not it should be made available to other users of the system. When prompted to select the components to install, make sure that the *Android Studio*, *Android SDK* and *Android Virtual Device* options are all selected.

Although there are no strict rules on where Android Studio should be installed on the system, the remainder of this book will assume that the installation was performed into *C:\Program Files\Android\Android Studio* and that the Android SDK packages have been installed into the user's *AppData\Local\Android\sdk* sub-folder. Once the options have been configured, click on the *Install* button to begin the installation process.

On versions of Windows with a Start menu, the newly installed Android Studio can be launched from the entry added to that menu during the installation. The executable may be pinned to the task bar for easy access by navigating to the *Android Studio\bin* directory, right-clicking on the executable and selecting the *Pin to Taskbar* menu option. Note that the executable is provided in 32-bit (*studio*) and 64-bit (*studio64*) executable versions. If you are running a 32-bit system be sure to use the *studio* executable.

2.5.2 Installation on Mac OS X

Android Studio for Mac OS X is downloaded in the form of a disk image (.dmg) file. Once the *android-studio-ide-<version>.dmg* file has been downloaded, locate it in a Finder window and double click on it to open it as shown in Figure 2-2:

Figure 2-2

To install the package, simply drag the Android Studio icon and drop it onto the Applications folder. The Android Studio package will then be installed into the Applications folder of the system, a process which will typically take a few minutes to complete.

To launch Android Studio, locate the executable in the Applications folder using a Finder window and double click on it. When attempting to launch Android Studio, an error dialog may appear indicating that the JVM cannot be found. If this error occurs, it will be necessary to download and install the Mac OS X Java 6 JRE package on the system. This can be downloaded from Apple using the following link:

http://support.apple.com/kb/DL1572

Once the Java for OS X package has been installed, Android Studio should launch without any problems.

For future easier access to the tool, drag the Android Studio icon from the Finder window and drop it onto the dock.

2.5.3 Installation on Linux

Having downloaded the Linux Android Studio package, open a terminal window, change directory to the location where Android Studio is to be installed and execute the following command:

```
unzip /<path to package>/android-studio-ide-<version>-linux.zip
```

Note that the Android Studio bundle will be installed into a sub-directory named *android-studio.* Assuming, therefore, that the above command was executed in */home/demo*, the software packages will be unpacked into */home/demo/android-studio.*

To launch Android Studio, open a terminal window, change directory to the *android-studio/bin* sub-directory and execute the following command:

```
./studio.sh
```

On Linux it may also be necessary to specify the location of the Java Development Kit using the following steps:

1. Launch Android Studio and create a new project.
2. Select the *File -> Other Settings -> Default Project Structure…* menu option.
3. Enter the full path to the directory containing the JDK into the *JDK Location* field.
4. Click *Apply* followed by *OK*.

2.6 The Android Studio Setup Wizard

The first time that Android Studio is launched after being installed, a dialog will appear providing the option to import settings from a previous Android Studio version. If you have settings from a previous version and would like to import them into the latest installation, select the appropriate option and location. Alternatively, indicate that you do not need to import any previous settings and click on the OK button to proceed.

Next, the setup wizard may appear as shown in Figure 2-3 though this dialog does not appear on all platforms:

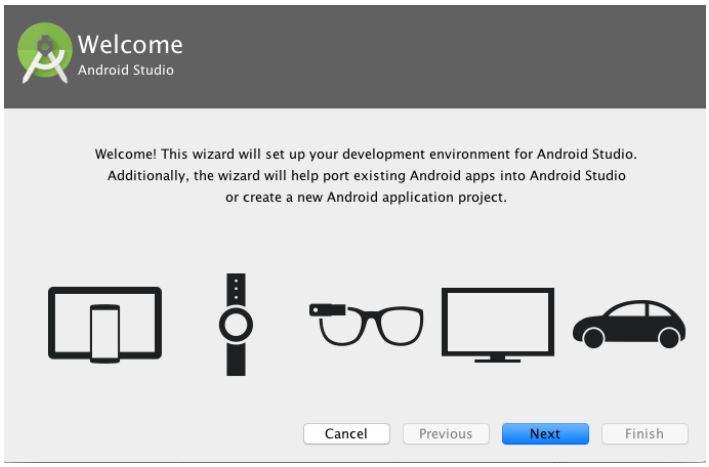

Figure 2-3

If the wizard appears, click on the Next button, choose the Standard installation option and click on Next once again.

Android Studio will proceed to download and configure the latest Android SDK and some additional components and packages. Once this process has completed, click on the *Finish* button in the *Downloading Components* dialog at which point the Welcome to Android Studio screen should then appear:

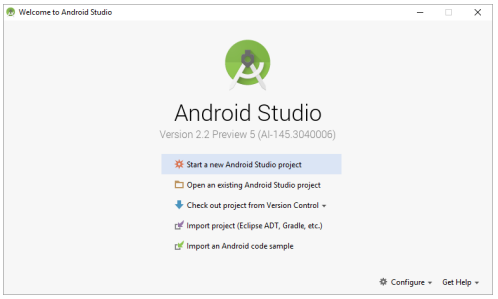

Figure 2-4

2.7 Installing Additional Android SDK Packages

The steps performed so far have installed Java, the Android Studio IDE and the current set of default Android SDK packages. Before proceeding, it is worth taking some time to verify which packages are installed and to install any missing or updated packages.

This task can be performed using the *Android SDK Settings* screen, which may be launched from within the Android Studio tool by selecting the *Configure -> SDK Manager* option from within the Android Studio welcome dialog. Once invoked, the *Android SDK* screen of the default settings dialog will appear as shown in Figure 2-5:

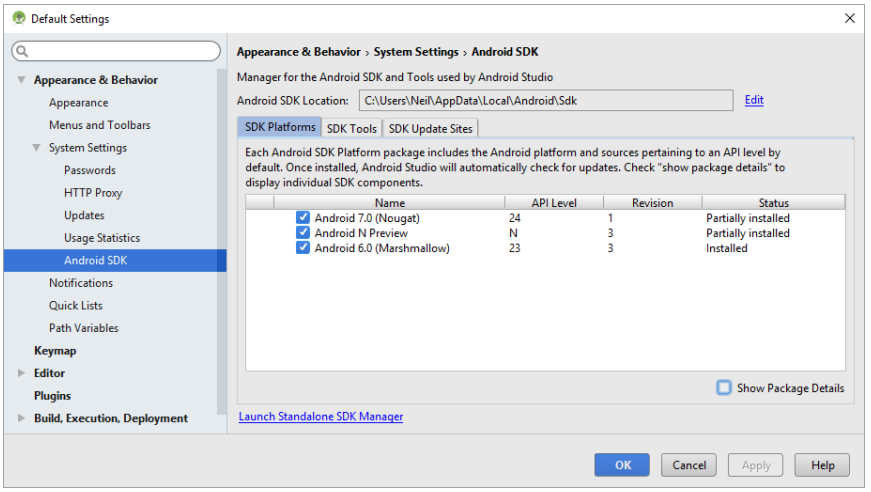

Figure 2-5

Immediately after installing Android Studio for the first time it is likely that only the latest released version of the Android SDK has been installed. To install preview or older versions of the Android SDK simply select the checkboxes corresponding to the versions and click on the *Apply* button.

It is also possible that updates will be listed as being available for the latest SDK. To access detailed information about the packages that are available for update, enable the *Show Package Details* option located in the lower right hand corner of the screen. This will display information similar to that shown in Figure 2-6:

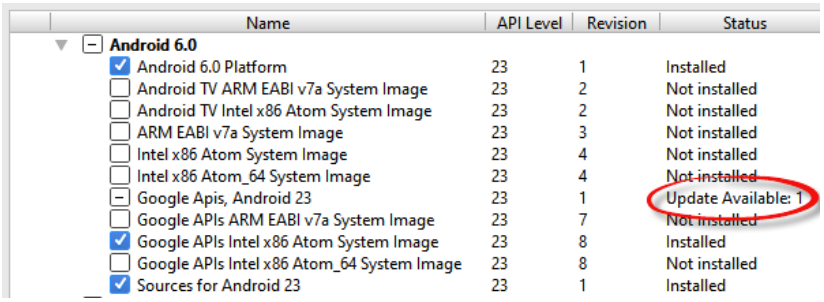

Figure 2-6

The above figure highlights the availability of an update. To install the updates, enable the checkbox to the left of the item name and click on the *Apply* button.

In addition to the Android SDK packages, a number of tools are also installed for building Android applications. To view the currently installed packages and check for updates, remain within the SDK settings screen and select the SDK Tools tab as shown in Figure 2-7:

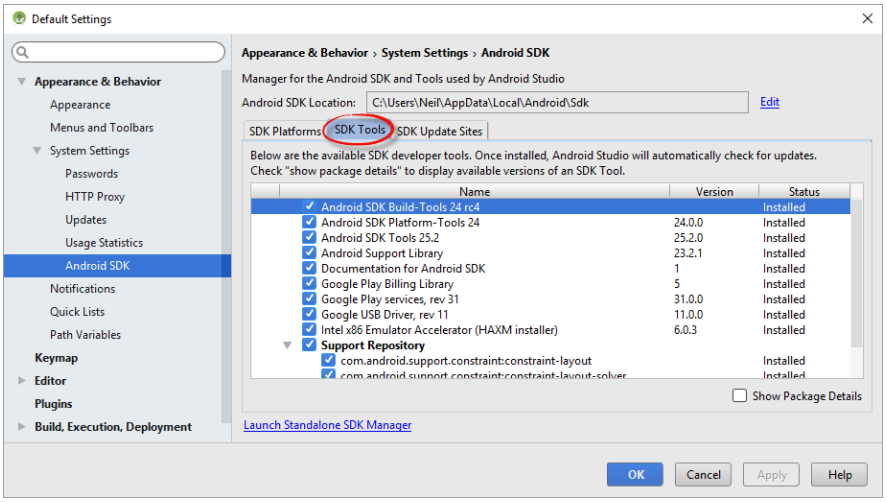

Figure 2-7

Within the Android SDK Tools screen, make sure that the following packages are listed as *Installed* in the Status column:

- Android SDK Build-tools
- Android SDK Tools
- Android SDK Platform-tools
- Android Support Repository
- Android Support Library
- Google Repository
- Google USB Driver (Windows only)
- Intel x86 Emulator Accelerator (HAXM installer)

In the event that any of the above packages are listed as *Not Installed* or requiring an update, simply select the checkboxes next to those packages and click on the *Apply* button to initiate the installation process.

Once the installation is complete, review the package list and make sure that the selected packages are now listed as *Installed* in the *Status* column. If any are listed as *Not installed,* make sure they are selected and click on the *Install packages…* button again.

An alternative to using the Android SDK settings panel is to access the *Standalone SDK Manager* which can be launched using the link in the lower left hand corner of the settings screen. The Standalone SDK Manager (Figure 2-8) provides a similar list of packages together with options to perform update and installation tasks:

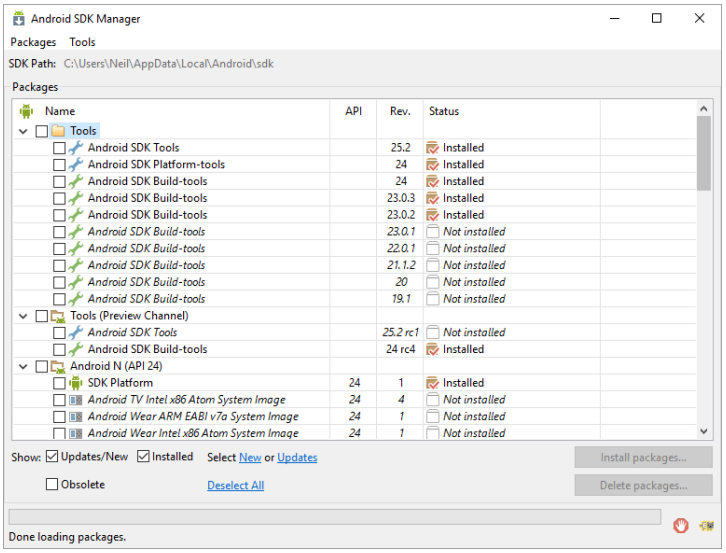

Figure 2-8

2.8 Making the Android SDK Tools Command-line Accessible

Most of the time, the underlying tools of the Android SDK will be accessed from within the Android Studio environment. That being said, however, there will also be instances where it will be useful to be able to invoke those tools from a command prompt or terminal window. In order for the operating system on which you are developing to be able to find these tools, it will be necessary to add them to the system's *PATH* environment variable.

Regardless of operating system, the PATH variable needs to be configured to include the following paths (where *<path_to_android_sdk_installation>* represents the file system location into which the Android SDK was installed):

```
<path_to_android_sdk_installation>/sdk/tools
<path_to_android_sdk_installation>/sdk/platform-tools
```

The location of the SDK on your system can be identified by launching the Standalone SDK Manager and referring to the *Android SDK Location:* field located at the top of the settings panel as highlighted in Figure 2-9:

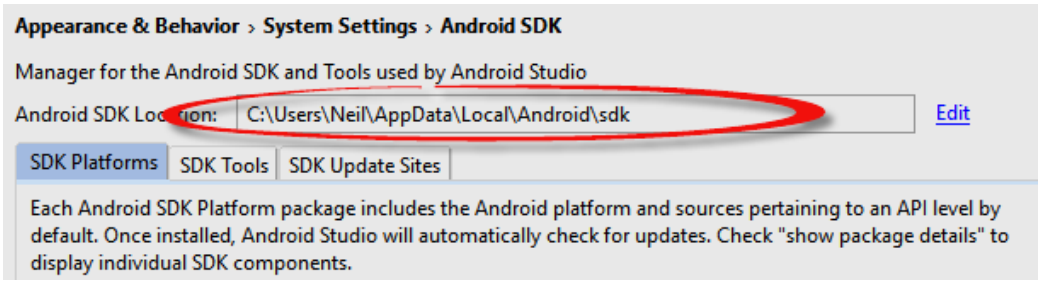

Figure 2-9

Once the location of the SDK has been identified, the steps to add this to the PATH variable are operating system dependent:

2.8.1 Windows 7

1. Right-click on *Computer* in the desktop start menu and select *Properties* from the resulting menu.
2. In the properties panel, select the *Advanced System Settings* link and, in the resulting dialog, click on the *Environment Variables…* button.
3. In the Environment Variables dialog, locate the *Path* variable in the *System variables* list, select it and click on *Edit…*. Locate the end of the current variable value string and append the path to the Android platform tools to the end, using a semicolon to separate the path from the preceding values. For example, assuming the Android SDK was installed into

C:\Users\demo\AppData\Local\Android\sdk, the following would be appended to the end of the current Path value:

```
;C:\Users\demo\AppData\Local\Android\sdk\platform-
tools;C:\Users\demo\AppData\Local\Android\sdk\tools
```

4. Click on OK in each dialog box and close the system properties control panel.

Once the above steps are complete, verify that the path is correctly set by opening a *Command Prompt* window (*Start -> All Programs -> Accessories -> Command Prompt*) and at the prompt enter:

```
echo %Path%
```

The returned path variable value should include the paths to the Android SDK platform tools folders. Verify that the *platform-tools* value is correct by attempting to run the *adb* tool as follows:

```
adb
```

The tool should output a list of command line options when executed.

Similarly, check the *tools* path setting by attempting to launch the Android SDK Manager:

```
android
```

In the event that a message similar to the following message appears for one or both of the commands, it is most likely that an incorrect path was appended to the Path environment variable:

```
'adb' is not recognized as an internal or external command,
operable program or batch file.
```

2.8.2 Windows 8.1

1. On the start screen, move the mouse to the bottom right hand corner of the screen and select *Search* from the resulting menu. In the search box, enter *Control Panel*. When the Control Panel icon appears in the results area, click on it to launch the tool on the desktop.
2. Within the Control Panel, use the *Category* menu to change the display to *Large Icons.* From the list of icons select the one labeled *System*.
3. Follow the steps outlined for Windows 7 starting from step 2 through to step 4.

Open the command prompt window (move the mouse to the bottom right hand corner of the screen, select the Search option and enter *cmd* into the search box). Select *Command Prompt* from the search results.

Within the Command Prompt window, enter:

```
echo %Path%
```

The returned path variable value should include the paths to the Android SDK platform tools folders. Verify that the *platform-tools* value is correct by attempting to run the *adb* tool as follows:

```
adb
```

The tool should output a list of command line options when executed.

Similarly, check the *tools* path setting by attempting to launch the Android SDK Manager:

```
android
```

In the event that a message similar to the following message appears for one or both of the commands, it is most likely that an incorrect path was appended to the Path environment variable:

```
'adb' is not recognized as an internal or external command,
operable program or batch file.
```

2.8.3 Windows 10

Right-click on the Start menu, select *System* from the resulting menu and click on the *Advanced system settings* option in the System window. Follow the steps outlined for Windows 7 starting from step 2 through to step 4.

2.8.4 Linux

On Linux this will involve once again editing the *.bashrc* file. Assuming that the Android SDK bundle package was installed into */home/demo/Android/sdk*, the export line in the *.bashrc* file would now read as follows:

```
export
PATH=/home/demo/java/jdk1.7.0_10/bin:/home/demo/Android/sdk/platform-
tools:/home/demo/Android/sdk/tools:/home/demo/android-studio/bin:$PATH
```

Note also that the above command adds the *android-studio/bin* directory to the PATH variable. This will enable the *studio.sh* script to be executed regardless of the current directory within a terminal window.

2.8.5 Mac OS X

A number of techniques may be employed to modify the $PATH environment variable on Mac OS X. Arguably the cleanest method is to add a new file in the */etc/paths.d* directory containing the paths to be added to $PATH. Assuming an Android SDK installation location of */Users/demo/Library/Android/sdk*, the path may be configured by creating a new file named *android-sdk* in the */etc/paths.d* directory containing the following lines:

```
/Users/demo/Library/Android/sdk/tools
/Users/demo/Library/Android/sdk/platform-tools
```

Note that since this is a system directory it will be necessary to use the *sudo* command when creating the file. For example:

```
sudo vi /etc/paths.d/android-sdk
```

2.9 Updating the Android Studio and the SDK

From time to time new versions of Android Studio and the Android SDK are released. New versions of the SDK are installed using the Android SDK Manager. Android Studio will typically notify you when an update is ready to be installed.

To manually check for Android Studio updates, click on the *Configure -> Check for Updates* menu option within the Android Studio welcome screen, or use the *Help -> Check for Update* menu option accessible from within the Android Studio main window.

2.10 Summary

Prior to beginning the development of Android based applications, the first step is to set up a suitable development environment. This consists of the Java Development Kit (JDK), Android SDKs, and Android Studio IDE. In this chapter, we have covered the steps necessary to install these packages on Windows, Mac OS X and Linux.

Chapter 3

3. Creating an Example Android App in Android Studio

The preceding chapters of this book have covered the steps necessary to configure an environment suitable for the development of Android applications using the Android Studio IDE. Before moving on to slightly more advanced topics, now is a good time to validate that all of the required development packages are installed and functioning correctly. The best way to achieve this goal is to create an Android application and compile and run it. This chapter will cover the creation of a simple Android application project using Android Studio. Once the project has been created, a later chapter will explore the use of the Android emulator environment to perform a test run of the application.

3.1 Creating a New Android Project

The first step in the application development process is to create a new project within the Android Studio environment. Begin, therefore, by launching Android Studio so that the "Welcome to Android Studio" screen appears as illustrated in Figure 3-1:

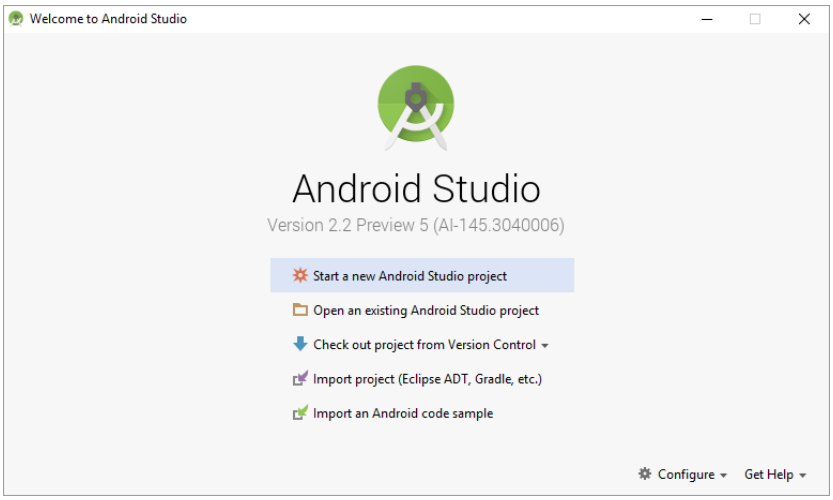

Figure 3-1

Once this window appears, Android Studio is ready for a new project to be created. To create the new project, simply click on the *Start a new Android Studio project* option to display the first screen of the *New Project* wizard as shown in Figure 3-2:

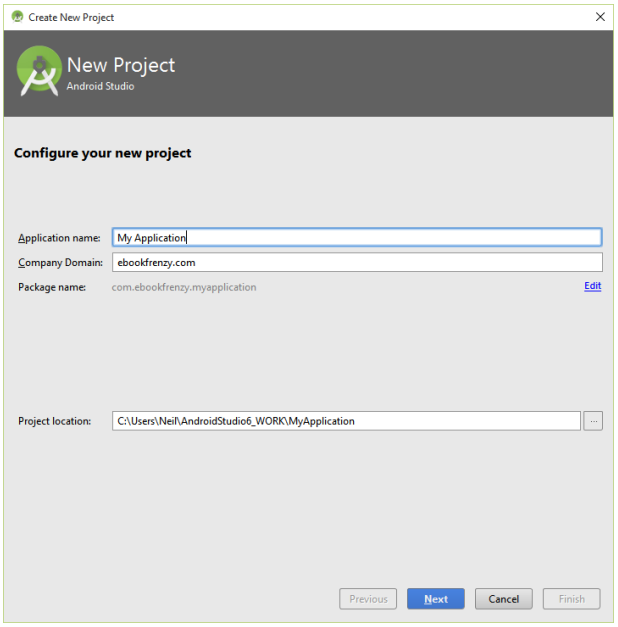

Figure 3-2

3.2 Defining the Project and SDK Settings

In the *New Project* window, set the *Application name* field to *AndroidSample*. The application name is the name by which the application will be referenced and identified within Android Studio and is also the name that will be used when the completed application goes on sale in the Google Play store.

The *Package Name* is used to uniquely identify the application within the Android application ecosystem. Although this can be set to any string that uniquely identifies your app, it is traditionally based on the reversed URL of your domain name followed by the name of the application. For example, if your domain is *www.mycompany.com*, and the application has been named *AndroidSample*, then the package name might be specified as follows:

```
com.mycompany.androidsample
```

If you do not have a domain name you can enter any other string into the Company Domain field, or you may use *ebookfrenzy.com* for the purposes of testing, though this will need to be changed before an application can be published:

```
com.ebookfrenzy.androidsample
```

The *Project location* setting will default to a location in the folder named *AndroidStudioProjects* located in your home directory and may be changed by clicking on the button to the right of the text field containing the current path setting.

Click Next to proceed. On the form factors screen, enable the *Phone and Tablet* option and set the minimum SDK setting to API 11: Android 3.0 (Honeycomb). The reason for selecting an older SDK release is that this ensures that the finished application will be able to run on the widest possible range of Android devices. The higher the minimum SDK selection, the more the application will be restricted to newer Android devices. A useful chart (Figure 3-3) can be viewed by clicking on the *Help me choose* link. This outlines the various SDK versions and API levels available for use and the percentage of Android devices in the marketplace on which the application will run if that SDK is used as the minimum level. In general it should only be necessary to select a more recent SDK when that release contains a specific feature that is required for your application.

To help in the decision process, selecting an API level from the chart will display the features that are supported at that level.

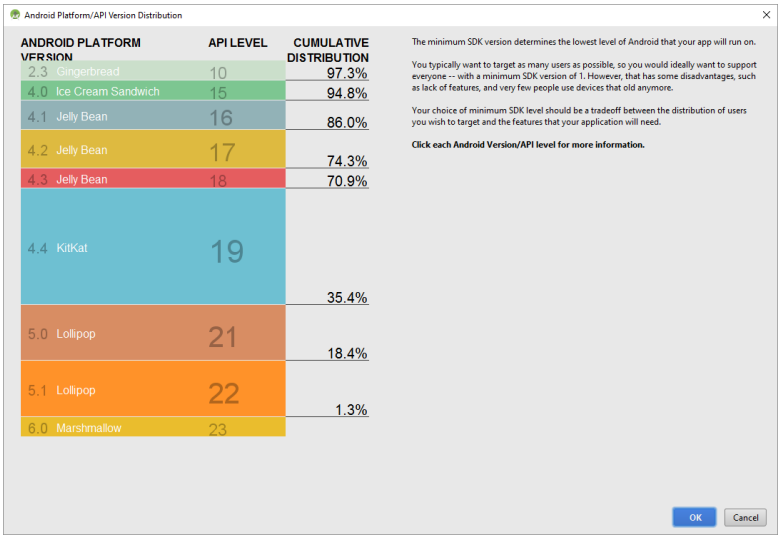

Figure 3-3

Since the project is not intended for Google TV, Android Auto or wearable devices, leave the remaining options disabled before clicking *Next.*

3.3 **Creating an Activity**

The next step is to define the type of initial activity that is to be created for the application. A range of different activity types is available when developing Android applications. The *Empty*, *Master/Detail Flow*, *Google Maps* and *Navigation Drawer* options will be covered extensively in later chapters. For

the purposes of this example, however, simply select the option to create a *Basic Activity.* The Basic Activity option creates a template user interface consisting of an app bar, menu, content area and a single floating action button.

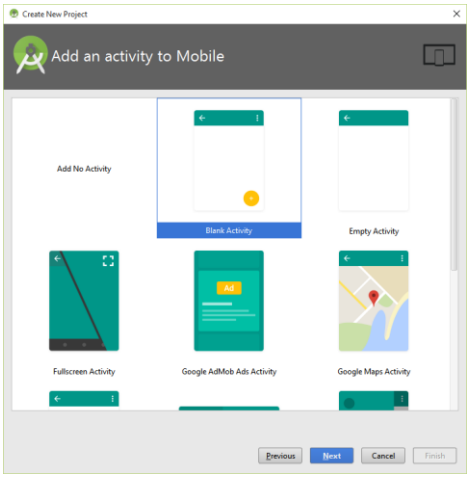

Figure 3-4

With the Basic Activity option selected, click *Next.* On the final screen (Figure 3-5) name the activity and title *AndroidSampleActivity*. The activity will consist of a single user interface screen layout which, for the purposes of this example, should be named *activity_android_sample* as shown in Figure 3-5 and with a menu resource named *menu_android_sample*:

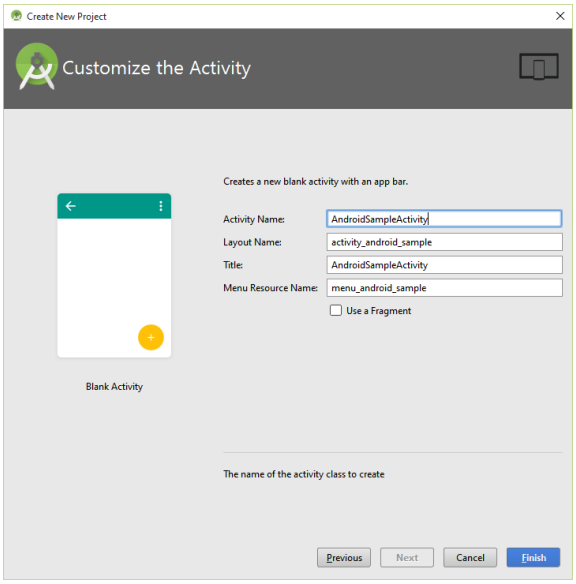

Figure 3-5

Finally, click on *Finish* to initiate the project creation process.

3.4 Modifying the Example Application

At this point, Android Studio has created a minimal example application project and opened the main window.

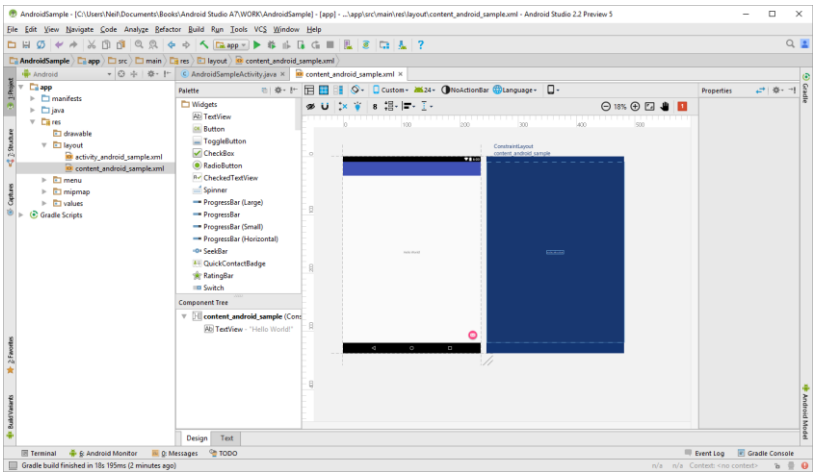

Figure 3-6

The newly created project and references to associated files are listed in the *Project* tool window located on the left hand side of the main project window. The Project tool window has a number of modes in which information can be displayed. By default, this panel will be in *Android* mode. This setting is controlled by the menu at the top of the panel as highlighted in Figure 3-7. If the panel is not currently in Android mode, use the menu to switch mode:

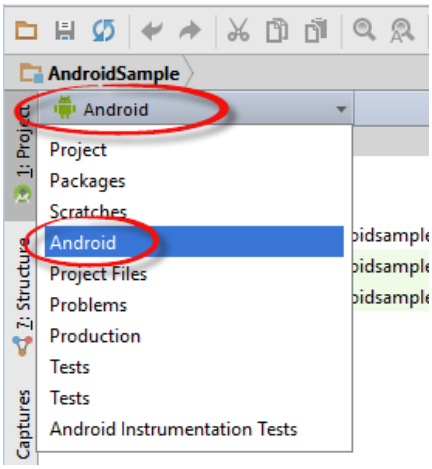

Figure 3-7

The example project created for us when we selected the option to create an activity consists of a user interface containing a label that will read “Hello World!” when the application is executed.

The next step in this tutorial is to modify the user interface of our application so that it displays a larger text view object with a different message to the one provided for us by Android Studio.

The user interface design for our activity is stored in a file named *activity_android_sample.xml* which, in turn, is located under *app -> res -> layout* in the project file hierarchy. This layout file includes the app bar (also known as an action bar) that appears across the top of the device screen (marked A in Figure 3-8) and the floating action button (the email button marked B). In addition to these items, the *activity_android_sample.xml* layout file contains a reference to a second file containing the content layout (marked C):

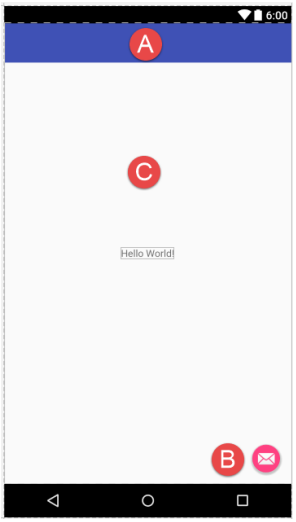

Figure 3-8

By default, the content layout is contained within a file named *content_android_sample.xml* and it is within this file that changes to the layout of the activity are made. Using the Project tool window, locate this file as illustrated in Figure 3-9:

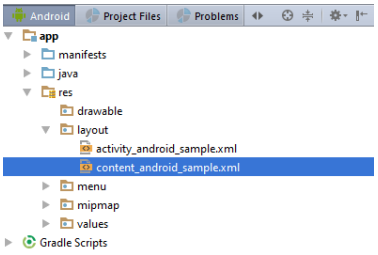

Figure 3-9

Once located, double click on the file to load it into the user interface Layout Editor tool which will appear in the center panel of the Android Studio main window:

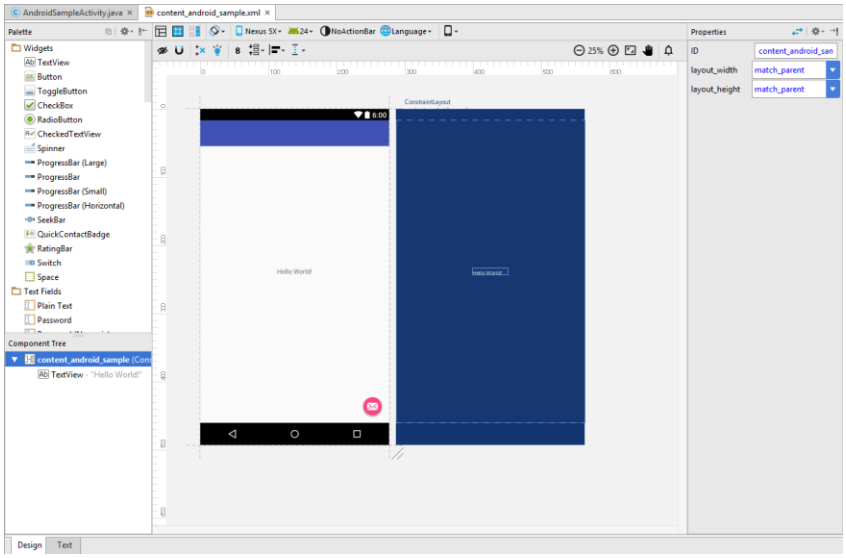

Figure 3-10

In the toolbar across the top of the Layout Editor window is a menu currently set to *Nexus 5X* in the above figure which is reflected in the visual representation of the device within the Layout Editor panel. A wide range of other device options are available for selection by clicking on this menu.

To change the orientation of the device representation between landscape and portrait simply use the drop down menu immediately to the right of the device selection menu showing the  icon.

As can be seen in the device screen, the content layout already includes a label that displays a “Hello World!” message. Running down the left hand side of the panel is a palette containing different categories of user interface components that may be used to construct a user interface, such as buttons, labels and text fields. It should be noted, however, that not all user interface components are obviously visible to the user. One such category consists of *layouts*. Android supports a variety of layouts that provide different levels of control over how visual user interface components are positioned and managed on the screen. Though it is difficult to tell from looking at the visual representation of the user interface, the current design has been created using a ConstraintLayout. This can be confirmed by reviewing the information in the *Component Tree* panel which, by default, is located in the lower left-hand corner of the Layout Editor panel and is shown in Figure 3-11:

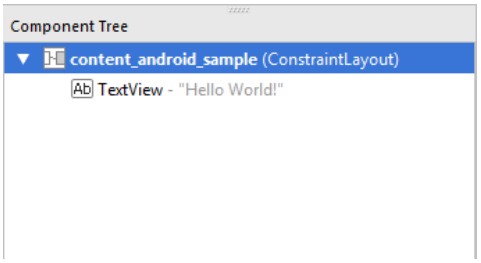

Figure 3-11

As we can see from the component tree hierarchy, the user interface layout consists of a ConstraintLayout parent with a single child in the form of a TextView object.

The first step in modifying the application is to delete the TextView component from the design. Begin by clicking on the TextView object within the user interface view so that it appears with a blue border around it. Once selected, press the Delete key on the keyboard to remove the object from the layout.

In the Palette panel, locate the *Widgets* category. Click and drag the *Button* object and drop it in the center of the user interface design when the marker lines appear to indicate the center of the display:

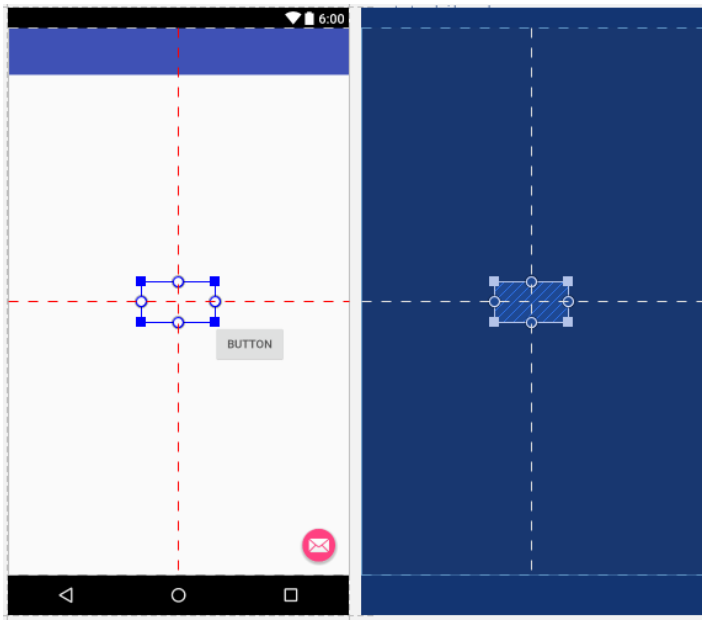

Figure 3-12

The next step is to change the text that is currently displayed by the Button component. The panel located to the right of the design area is the Properties panel. This panel displays the properties

assigned to the currently selected component in the layout. Within this panel, locate the *text* property and change the current value from “Button” to “Demo” as shown in Figure 3-13:

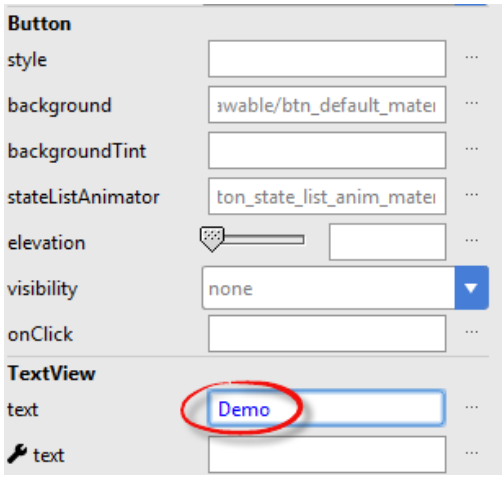

Figure 3-13

The second text property with a wrench next to it allows a text property to be set which only appears within the Layout Editor tool but is not shown at runtime. This is useful for testing the way in which a visual component and the layout will behave with different settings without having to run the app repeatedly.

At this point it is important to explain the red button located in the top right-hand corner of the Layout Editor tool as indicated in Figure 3-14. Obviously, this is indicating potential problems with the layout. For details on any problems, click on the button:

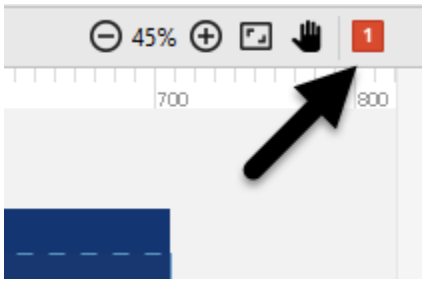

Figure 3-14

When clicked, a panel (Figure 3-15) will appear describing the nature of the problems and offering some possible corrective measures:

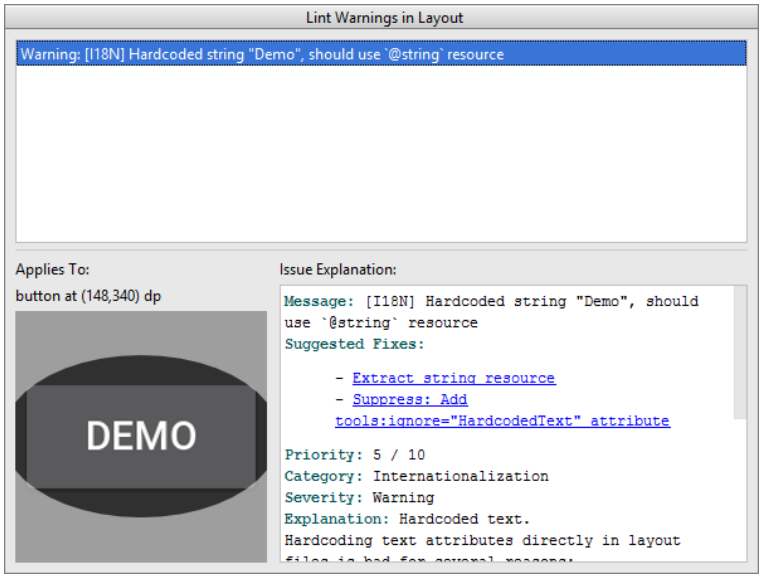

Figure 3-15

Currently, the only warning listed reads as follows:

```
Warning: [I18N] Hardcoded string "Demo", should use '@string' resource
```

This I18N message is informing us that a potential issue exists with regard to the future internationalization of the project ("I18N" comes from the fact that the word "internationalization" begins with an "I", ends with an "N" and has 18 letters in between). The warning is reminding us that when developing Android applications, attributes and values such as text strings should be stored in the form of *resources* wherever possible. Doing so enables changes to the appearance of the application to be made by modifying resource files instead of changing the application source code. This can be especially valuable when translating a user interface to a different spoken language. If all of the text in a user interface is contained in a single resource file, for example, that file can be given to a translator who will then perform the translation work and return the translated file for inclusion in the application. This enables multiple languages to be targeted without the necessity for any source code changes to be made. In this instance, we are going to create a new resource named *demostring* and assign to it the string "Demo".

Click on the *Extract string resource* link in the Issue Explanation panel to display the *Extract Resource* panel (Figure 3-16). Within this panel, change the resource name field to *demostring* and leave the resource value set to *Demo* before clicking on the OK button.

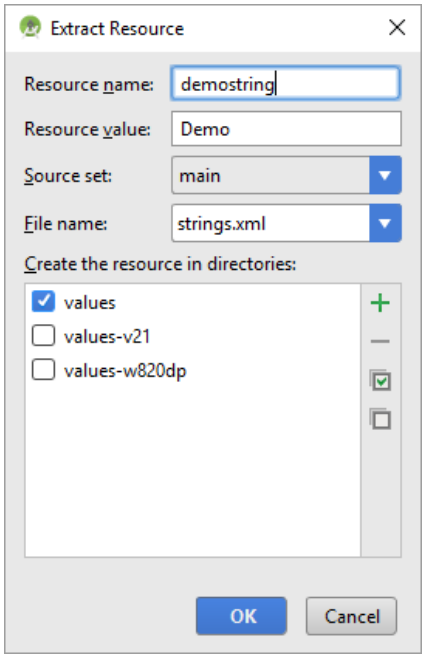

Figure 3-16

It is also worth noting that the string could also have been assigned to a resource when it was entered into the Properties panel. This involves clicking on the button displaying three dots to the right of the property field in the Properties panel and selecting the *Add new resource -> New String Value…* menu option from the resulting Resources dialog. In practice, however, it is often quicker to simply set values directly into the Properties panel fields for any widgets in the layout, then work sequentially through the list in the warnings dialog to extract any necessary resources when the layout is complete.

3.5 Reviewing the Layout and Resource Files

Before moving on to the next chapter, we are going to look at some of the internal aspects of user interface design and resource handling. In the previous section, we made some changes to the user interface by modifying the *content_android_sample.xml* file using the Layout Editor tool. In fact, all that the Layout Editor was doing was providing a user-friendly way to edit the underlying XML content of the file. In practice, there is no reason why you cannot modify the XML directly in order to make user interface changes and, in some instances, this may actually be quicker than using the Layout Editor tool. At the bottom of the Layout Editor panel are two tabs labeled *Design* and *Text* respectively. To switch to the XML view simply select the *Text* tab as shown in Figure 3-17:

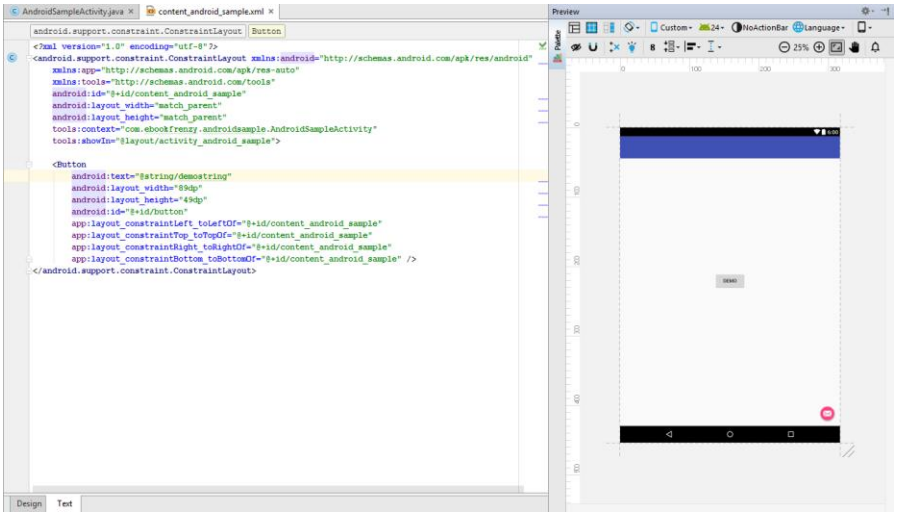

Figure 3-17

As can be seen from the structure of the XML file, the user interface consists of the ConstraintLayout component, which in turn, is the parent of the Button object. We can also see that the *text* property of the Button is set to our *demostring* resource. Although varying in complexity and content, all user interface layouts are structured in this hierarchical, XML based way.

One of the more powerful features of Android Studio can be found to the right hand side of the XML editing panel. If the panel is not visible, display it by selecting the *Preview* button located along the right hand edge of the Android Studio window. This is the Preview panel and shows the current visual state of the layout. As changes are made to the XML layout, these will be reflected in the preview panel. The layout may also be modified visually from within the Preview panel with the changes appearing in the XML listing. To see this in action, modify the XML layout to change the background color of the ConstraintLayout to a shade of red as follows:

```
<?xml version="1.0" encoding="utf-8"?>
android.support.constraint.ConstraintLayout
xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:id="@+id/content_android_sample"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
 tools:context="com.ebookfrenzy.androidsample.AndroidSampleActivity"
    tools:showIn="@layout/activity_android_sample"
    android:background="#ff2438" >
.
.
```

```
.
</android.support.constraint.ConstraintLayout>
```

Note that the color of the preview changes in real-time to match the new setting in the XML file. Note also that a small red square appears in the left-hand margin (also referred to as the *gutter*) of the XML editor next to the line containing the color setting. This is a visual cue to the fact that the color red has been set on a property. Change the color value to #a0ff28 and note that both the small square in the margin and the preview change to green.

Finally, use the Project view to locate the *app -> res -> values -> strings.xml* file and double click on it to load it into the editor. Currently the XML should read as follows:

```
<resources>
    <string name="app_name">AndroidSample</string>
    <string name="action_settings">Settings</string>
    <string name="demostring">Demo</string>
</resources>
```

As a demonstration of resources in action, change the string value currently assigned to the *demostring* resource to “Hello” and then return to the Layout Editor tool by selecting the tab for the layout file in the editor panel. Note that the layout has picked up the new resource value for the welcome string.

There is also a quick way to access the value of a resource referenced in an XML file. With the Layout Editor tool in Text mode, click on the “@string/demostring” property setting so that it highlights and then press Ctrl+B on the keyboard. Android Studio will subsequently open the *strings.xml* file and take you to the line in that file where this resource is declared. Use this opportunity to revert the string resource back to the original “Demo” text.

Resource strings may also be edited using the Android Studio Translations Editor. To open this editor, right-click on the *app -> res -> values -> strings.xml* file and select the *Open Editor* menu option. This will display the Translation Editor in the main panel of the Android Studio window:

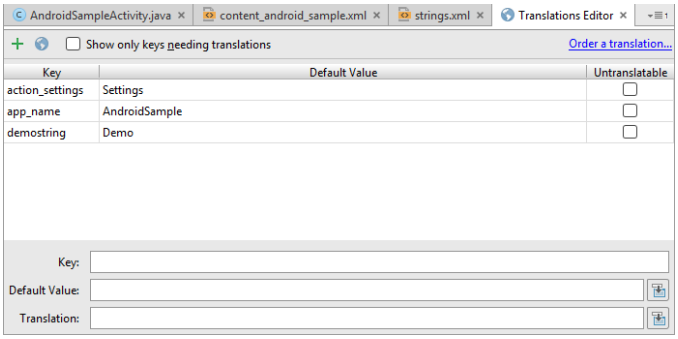

Figure 3-18

This editor allows the strings assigned to resource keys to be edited and for translations for multiple languages to be managed. The *Order a translation…* link may also be used to order a translation of the strings contained within the application to other languages. The cost of the translations will vary depending on the number of strings involved.

3.6 Summary

While not excessively complex, a number of steps are involved in setting up an Android development environment. Having performed those steps, it is worth working through a simple example to make sure the environment is correctly installed and configured. In this chapter, we have created a simple application and then used the Android Studio Layout Editor tool to modify the user interface layout. In doing so, we explored the importance of using resources wherever possible, particularly in the case of string values, and briefly touched on the topic of layouts. Finally, we looked at the underlying XML that is used to store the user interface designs of Android applications.

While it is useful to be able to preview a layout from within the Android Studio Layout Editor tool, there is no substitute for testing an application by compiling and running it. In a later chapter entitled *Creating an Android Virtual Device (AVD) in Android Studio*, the steps necessary to set up an emulator for testing purposes will be covered in detail. Before running the application, however, the next chapter will take a small detour to provide a guided tour of the Android Studio user interface.

Chapter 4

4. A Tour of the Android Studio User Interface

While it is tempting to plunge into running the example application created in the previous chapter, doing so involves using aspects of the Android Studio user interface which are best described in advance.

Android Studio is a powerful and feature rich development environment that is, to a large extent, intuitive to use. That being said, taking the time now to gain familiarity with the layout and organization of the Android Studio user interface will considerably shorten the learning curve in later chapters of the book. With this in mind, this chapter will provide an initial overview of the various areas and components that make up the Android Studio environment.

4.1 The Welcome Screen

The welcome screen (Figure 4-1) is displayed any time that Android Studio is running with no projects currently open (open projects can be closed at any time by selecting the *File -> Close Project* menu option). If Android Studio was previously exited while a project was still open, the tool will by-pass the welcome screen next time it is launched, automatically opening the previously active project.

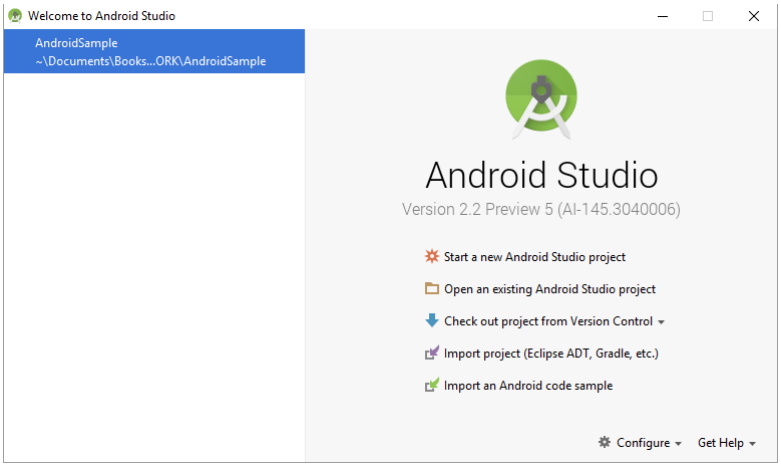

Figure 4-1

In addition to a list of recent projects, the Quick Start menu provides a range of options for performing tasks such as opening, creating and importing projects along with access to projects currently under version control. In addition, the *Configure* menu at the bottom of the window provides access to the SDK Manager along with a vast array of settings and configuration options. A review of these options will quickly reveal that there is almost no aspect of Android Studio that cannot be configured and tailored to your specific needs.

The Configure menu also includes an option to check if updates to Android Studio are available for download.

4.2 The Main Window

When a new project is created, or an existing one opened, the Android Studio *main window* will appear. When multiple projects are open simultaneously, each will be assigned its own main window. The precise configuration of the window will vary depending on which tools and panels were displayed the last time the project was open, but will typically resemble that of Figure 4-2.

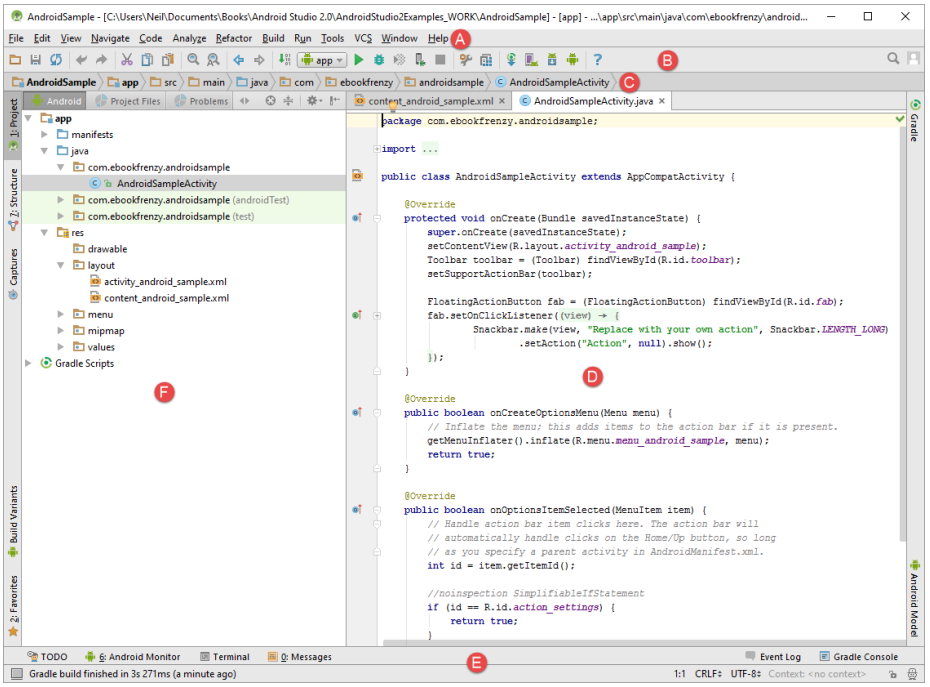

Figure 4-2

The various elements of the main window can be summarized as follows:

A – Menu Bar – Contains a range of menus for performing tasks within the Android Studio environment.

B – Toolbar – A selection of shortcuts to frequently performed actions. The toolbar buttons provide quicker access to a select group of menu bar actions. The toolbar can be customized by right-clicking on the bar and selecting the *Customize Menus and Toolbars…* menu option.

C – Navigation Bar – The navigation bar provides a convenient way to move around the files and folders that make up the project. Clicking on an element in the navigation bar will drop down a menu listing the subfolders and files at that location ready for selection. This provides an alternative to the Project tool window.

D – Editor Window – The editor window displays the content of the file on which the developer is currently working. What gets displayed in this location, however, is subject to context. When editing code, for example, the code editor will appear. When working on a user interface layout file, on the other hand, the user interface Layout Editor tool will appear. When multiple files are open, each file is represented by a tab located along the top edge of the editor as shown in Figure 4-3.

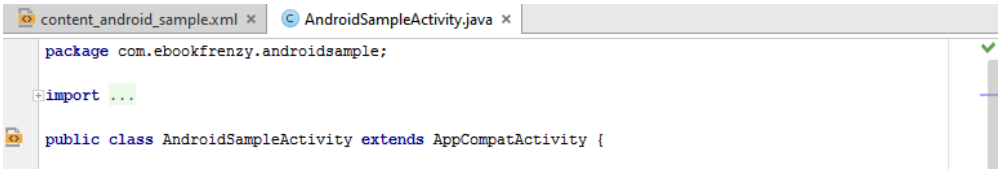

Figure 4-3

E – Status Bar – The status bar displays informational messages about the project and the activities of Android Studio together with the tools menu button located in the far left corner. Hovering over items in the status bar will provide a description of that field. Many fields are interactive, allowing the user to click to perform tasks or obtain more detailed status information.

F – Project Tool Window – The project tool window provides a hierarchical overview of the project file structure allowing navigation to specific files and folders to be performed. The toolbar can be used to display the project in a number of different ways. The default setting is the *Android* view which is the mode primarily used in the remainder of this book.

The project tool window is just one of a number of tool windows available within the Android Studio environment.

4.3 The Tool Windows

In addition to the project view tool window, Android Studio also includes a number of other windows which, when enabled, are displayed along the bottom and sides of the main window. The tool window quick access menu can be accessed by hovering the mouse pointer over the button located in the far left hand corner of the status bar (Figure 4-4) without clicking the mouse button.

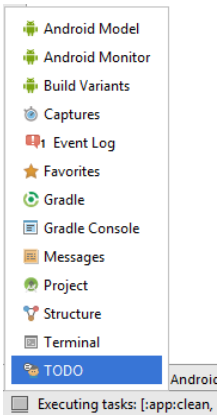

Figure 4-4

Selecting an item from the quick access menu will cause the corresponding tool window to appear within the main window.

Alternatively, a set of *tool window bars* can be displayed by clicking on the quick access menu icon in the status bar. These bars appear along the left, right and bottom edges of the main window (as indicated by the arrows in Figure 4-5) and contain buttons for showing and hiding each of the tool windows. When the tool window bars are displayed, a second click on the button in the status bar will hide them.

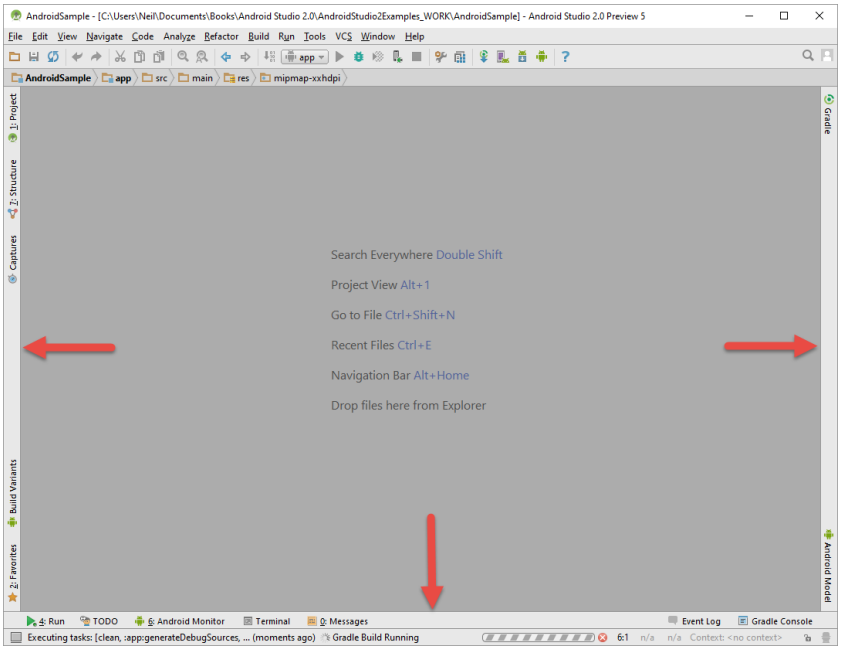

Figure 4-5

Clicking on a button will display the corresponding tool window while a second click will hide the window. Buttons prefixed with a number (for example 1: Project) indicate that the tool window may also be displayed by pressing the Alt key on the keyboard (or the Command key for Mac OS X) together with the corresponding number.

The location of a button in a tool window bar indicates the side of the window against which the window will appear when displayed. These positions can be changed by clicking and dragging the buttons to different locations in other window tool bars.

Each tool window has its own toolbar along the top edge. The buttons within these toolbars vary from one tool to the next, though all tool windows contain a settings option, represented by the cog icon, which allows various aspects of the window to be changed. Figure 4-6 shows the settings menu for the project view tool window. Options are available, for example, to undock a window and to allow it to float outside of the boundaries of the Android Studio main window and to move and resize the tool panel.

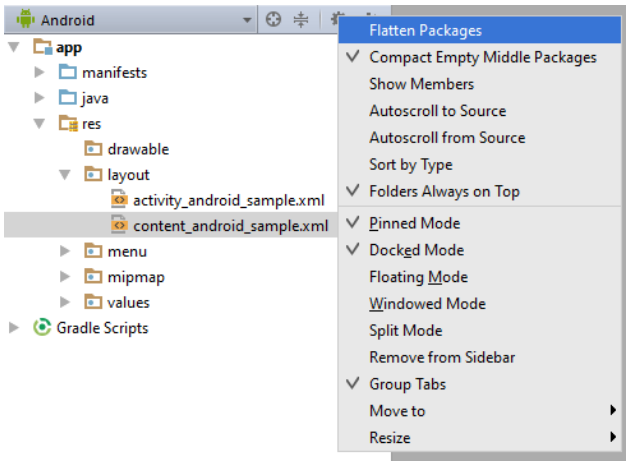

Figure 4-6

All of the windows also include a far right button on the toolbar providing an additional way to hide the tool window from view. A search of the items within a tool window can be performed simply by giving that window focus by clicking in it and then typing the search term (for example the name of a file in the Project tool window). A search box will appear in the window's tool bar and items matching the search highlighted.

Android Studio offers a wide range of window tool windows, the most commonly used of which are as follows:

Project – The project view provides an overview of the file structure that makes up the project allowing for quick navigation between files. Generally, double clicking on a file in the project view will cause that file to be loaded into the appropriate editing tool.

Structure – The structure tool provides a high level view of the structure of the source file currently displayed in the editor. This information includes a list of items such as classes, methods and variables in the file. Selecting an item from the structure list will take you to that location in the source file in the editor window.

Captures – The captures tool window provides access to performance data files that have been generated by the monitoring tools contained within the Android Monitor tool window.

Favorites – A variety of project items can be added to the favorites list. Right-clicking on a file in the project view, for example, provides access to an *Add to Favorites* menu option. Similarly, a method in a source file can be added as a favorite by right-clicking on it in the Structure tool window. Anything added to a Favorites list can be accessed through this Favorites tool window.

Build Variants – The build variants tool window provides a quick way to configure different build targets for the current application project (for example different builds for debugging and release versions of the application, or multiple builds to target different device categories).

TODO – As the name suggests, this tool provides a place to review items that have yet to be completed on the project. Android Studio compiles this list by scanning the source files that make up the project to look for comments that match specified TODO patterns. These patterns can be reviewed and changed by selecting the *File -> Settings…* menu option and navigating to the *TODO* page listed under *Editor*.

Messages – The messages tool window records output from the Gradle build system (Gradle is the underlying system used by Android Studio for building the various parts of projects into runnable applications) and can be useful for identifying the causes of build problems when compiling application projects.

Android Monitor – The Android Monitor tool window provides access to the Android debugging system. Within this window tasks such as monitoring log output from a running application, taking screenshots and videos of the application, stopping a process and performing basic debugging tasks can be performed. The tool also includes real-time GPU, networking, memory and CPU usage monitors.

Android Model – The Android Model tool window provides a single location in which to view an exhaustive list of the different options and settings configured within the project. These can range from the more obvious settings such as the target Android SDK version to more obscure values such as build configuration rules.

Terminal – Provides access to a terminal window on the system on which Android Studio is running. On Windows systems this is the Command Prompt interface, while on Linux and Mac OS X systems this takes the form of a Terminal prompt.

Run – The run tool window becomes available when an application is currently running and provides a view of the results of the run together with options to stop or restart a running process. If an application is failing to install and run on a device or emulator, this window will typically provide diagnostic information relating to the problem.

Event Log – The event log window displays messages relating to events and activities performed within Android Studio. The successful build of a project, for example, or the fact that an application is now running will be reported within this tool window.

Gradle Console – The Gradle console is used to display all output from the Gradle system as projects are built from within Android Studio. This will include information about the success or otherwise of the build process together with details of any errors or warnings.

Gradle – The Gradle tool window provides a view onto the Gradle tasks that make up the project build configuration. The window lists the tasks that are involved in compiling the various elements of the project into an executable application. Right-click on a top level Gradle task and select the *Open Gradle Config* menu option to load the Gradle build file for the current project into the editor. Gradle will be covered in greater detail later in this book.

4.4 Android Studio Keyboard Shortcuts

Android Studio includes an abundance of keyboard shortcuts designed to save time when performing common tasks. A full keyboard shortcut keymap listing can be viewed and printed from within the Android Studio project window by selecting the *Help -> Default Keymap Reference* menu option.

4.5 Switcher and Recent Files Navigation

Another useful mechanism for navigating within the Android Studio main window involves the use of the *Switcher*. Accessed via the *Ctrl-Tab* keyboard shortcut, the switcher appears as a panel listing both the tool windows and currently open files (Figure 4-7).

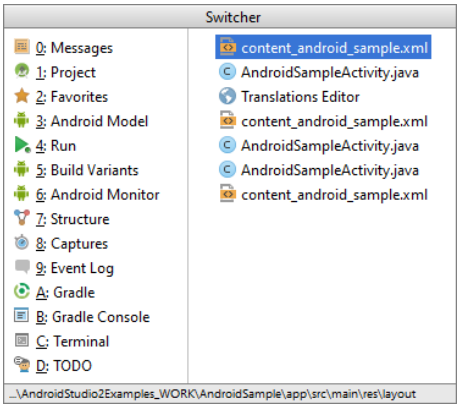

Figure 4-7

Once displayed, the switcher will remain visible for as long as the Ctrl key remains depressed. Repeatedly tapping the Tab key while holding down the Ctrl key will cycle through the various selection options, while releasing the Ctrl key causes the currently highlighted item to be selected and displayed within the main window.

In addition to the switcher, navigation to recently opened files is provided by the Recent Files panel (Figure 4-8). This can be accessed using the Ctrl-E keyboard shortcut (Cmd-E on Mac OS X). Once displayed, either the mouse pointer can be used to select an option or, alternatively, the keyboard arrow keys can be used to scroll through the file name and tool window options. Pressing the Enter key will select the currently highlighted item.

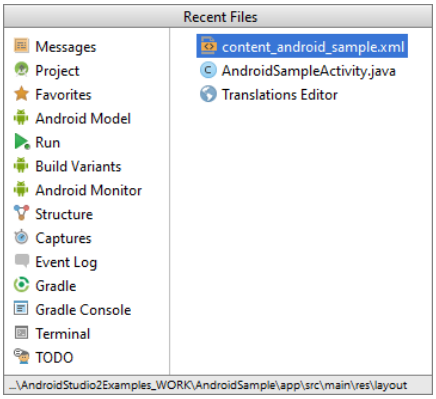

Figure 4-8

4.6 Changing the Android Studio Theme

The overall theme of the Android Studio environment may be changed either from the welcome screen using the *Configure -> Settings* option, or via the *File -> Settings…* menu option of the main window.

Once the settings dialog is displayed, select the *Appearance* option in the left hand panel and then change the setting of the *Theme* menu before clicking on the *Apply* button. The themes currently available consist of IntelliJ, Windows and Darcula. Figure 4-9 shows an example of the main window with the Darcula theme selected:

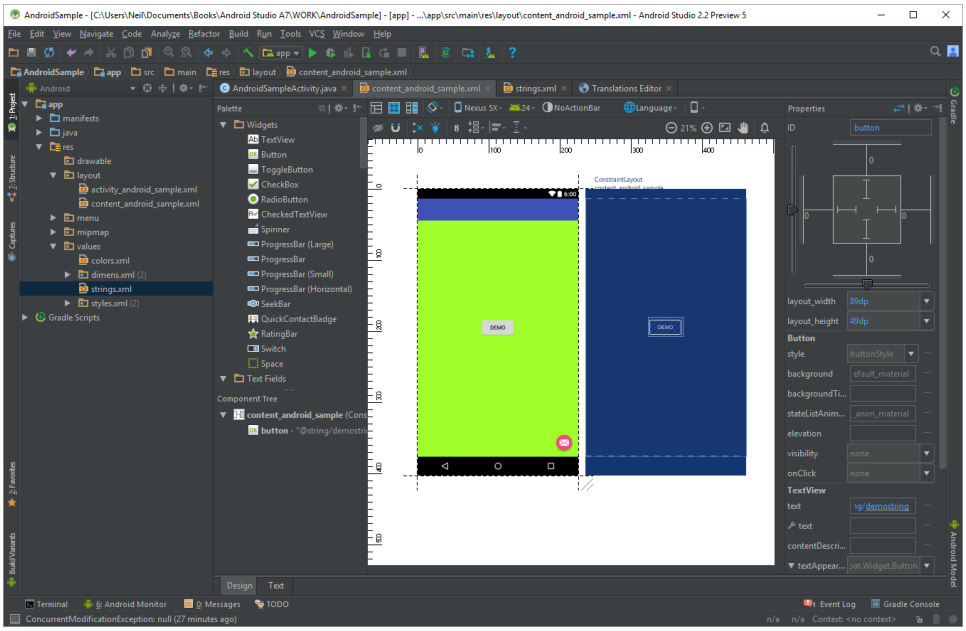

Figure 4-9

4.7 Summary

The primary elements of the Android Studio environment consist of the welcome screen and main window. Each open project is assigned its own main window which, in turn, consists of a menu bar, toolbar, editing and design area, status bar and a collection of tool windows. Tool windows appear on the sides and bottom edges of the main window and can be accessed either using the quick access menu located in the status bar, or via the optional tool window bars.

There are very few actions within Android Studio which cannot be triggered via a keyboard shortcut. A keymap of default keyboard shortcuts can be accessed at any time from within the Android Studio main window.

Chapter 5

5. Creating an Android Virtual Device (AVD) in Android Studio

In the course of developing Android apps in Android Studio it will be necessary to compile and run an application multiple times. An Android application may be tested by installing and running it either on a physical device or in an *Android Virtual Device (AVD)* emulator environment. Before an AVD can be used, it must first be created and configured to match the specification of a particular device model. The goal of this chapter, therefore, is to work through the steps involved in creating such a virtual device using the Nexus 9 tablet as a reference example.

5.1 About Android Virtual Devices

AVDs are essentially emulators that allow Android applications to be tested without the necessity to install the application on a physical Android based device. An AVD may be configured to emulate a variety of hardware features including options such as screen size, memory capacity and the presence or otherwise of features such as a camera, GPS navigation support or an accelerometer. As part of the standard Android Studio installation, a number of emulator templates are installed allowing AVDs to be configured for a range of different devices. Additional templates may be loaded or custom configurations created to match any physical Android device by specifying properties such as processor type, memory capacity and the size and pixel density of the screen. Check the online developer documentation for your device to find out if emulator definitions are available for download and installation into the AVD environment.

When launched, an AVD will appear as a window containing an emulated Android device environment. Figure 5-1, for example, shows an AVD session configured to emulate the Google Nexus 9 model.

New AVDs are created and managed using the Android Virtual Device Manager, which may be used either in command-line mode or with a more user-friendly graphical user interface.

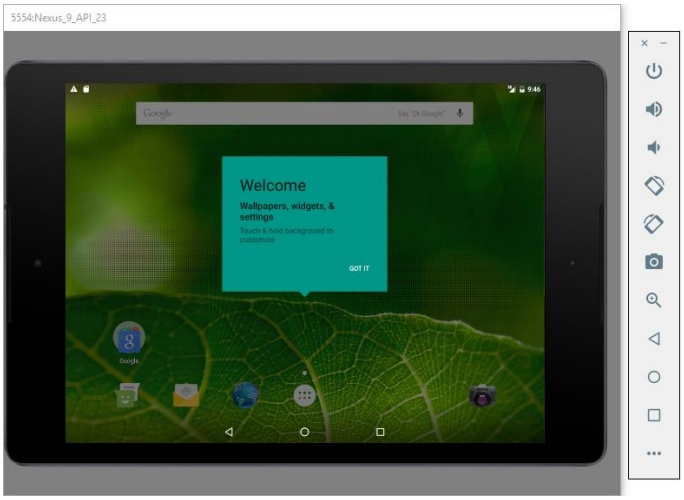

Figure 5-1

5.2 Creating a New AVD

In order to test the behavior of an application in the absence of a physical device, it will be necessary to create an AVD for a specific Android device configuration.

To create a new AVD, the first step is to launch the AVD Manager. This can be achieved from within the Android Studio environment by selecting the *Tools -> Android -> AVD Manager* menu option from within the main window. Alternatively, the tool may be launched from a terminal or command-line prompt using the following command:

```
android avd
```

Once launched, the tool will appear as outlined in Figure 5-2. Assuming a new Android Studio installation, only a Nexus 5 AVD will currently be listed:

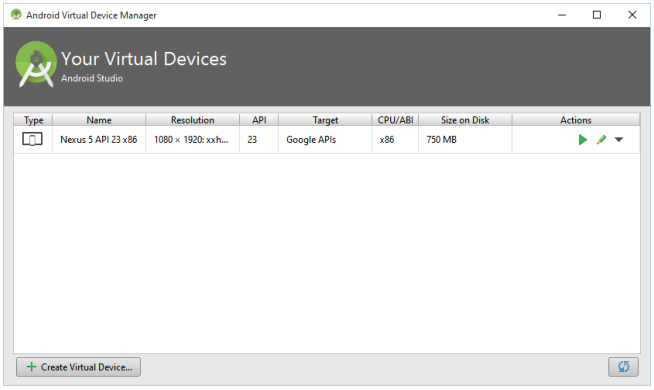

Figure 5-2

To add an additional AVD, begin by clicking on the *Create Virtual Device* button in order to invoke the *Virtual Device Configuration* dialog:

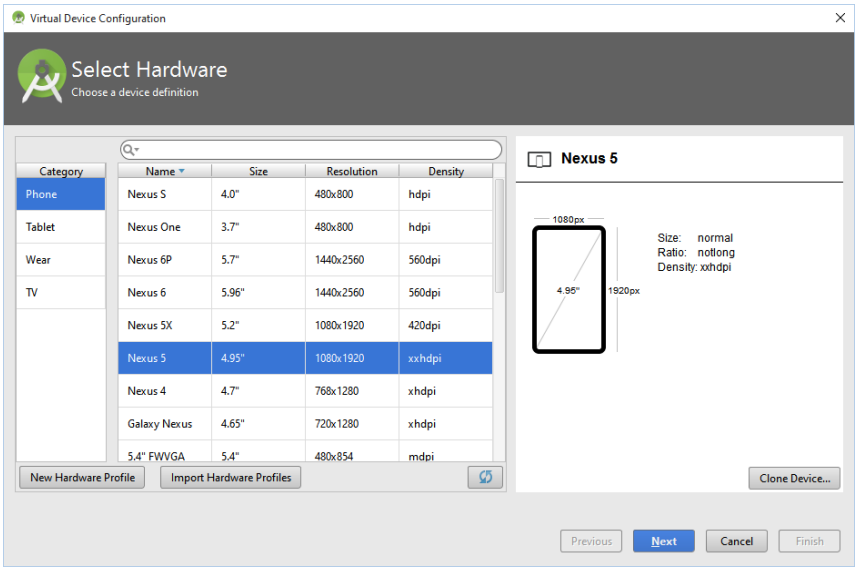

Figure 5-3

Within the dialog, perform the following steps to create a Nexus 9 compatible emulator:

1. From the *Category* panel, select the *Tablet* option to display the list of available Android tablet AVD templates.
2. Select the *Nexus 9* device option and click *Next*.
3. On the System Image screen, select the latest version of Android (at time of writing this is Nougat, API level 24, Android 7.0) for the *x86_64* ABI. Note that if the system image has not yet been installed a *Download* link will be provided next to the Release Name. Click this link to download and install the system image before selecting it. If the image you need is not listed, click on the *x86 images* and *Other images* tabs to view alternative lists.
4. Click *Next* to proceed and enter a descriptive name (for example *Nexus 9 API 24*) into the name field or simply accept the default name.
5. Click *Finish* to create the AVD.

With the AVD created, the AVD Manager may now be closed. If future modifications to the AVD are necessary, simply re-open the AVD Manager, select the AVD from the list and click on the pencil icon in the *Actions* column of the device row in the AVD Manager.

5.3 Starting the Emulator

To perform a test run of the newly created AVD emulator, simply select the emulator from the AVD Manager and click on the launch button (the green triangle in the Actions column). The emulator will

appear in a new window and, after a short period of time, the "android" logo will appear in the center of the screen. The amount of time it takes for the emulator to start will depend on the configuration of both the AVD and the system on which it is running. In the event that the startup time on your system is considerable, do not hesitate to leave the emulator running. The system will detect that it is already running and attach to it when applications are launched, thereby saving considerable amounts of startup time.

The emulator probably defaulted to appearing full size and in portrait orientation. It is useful to be aware that these default options can be changed. Within the AVD Manager, select the new Nexus 9 entry and click on the pencil icon in the *Actions* column of the device row. In the configuration screen locate the *Startup size and orientation* section and change the *Scale* menu to *2dp on device = 1px on screen* to reduce the size of the emulator on the screen. Exit and restart the emulator session to see this change take effect. The size of the emulator may also be changed dynamically simply by resizing the window. More details on the emulator are covered in the next chapter (*Using and Configuring the Android Studio 2 AVD Emulator*).

To save time in the next section of this chapter, leave the emulator running before proceeding.

5.4 Running the Application in the AVD

With an AVD emulator configured, the example AndroidSample application created in the earlier chapter now can be compiled and run. With the AndroidSample project loaded into Android Studio, simply click on the run button represented by a green triangle located in the Android Studio toolbar as shown in Figure 5-4 below, select the *Run -> Run…* menu option or use the Shift+F10 keyboard shortcut:

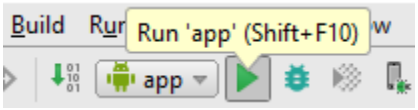

Figure 5-4

By default, Android Studio will respond to the run request by displaying the *Select Deployment Target* dialog. This provides the option to execute the application on an AVD instance that is already running, or to launch a new AVD session specifically for this application. Figure 5-5 lists the previously created Nexus 9 AVD as a running device as a result of the steps performed in the preceding section. With this device selected in the dialog, click on *OK* to install and run the application on the emulator.

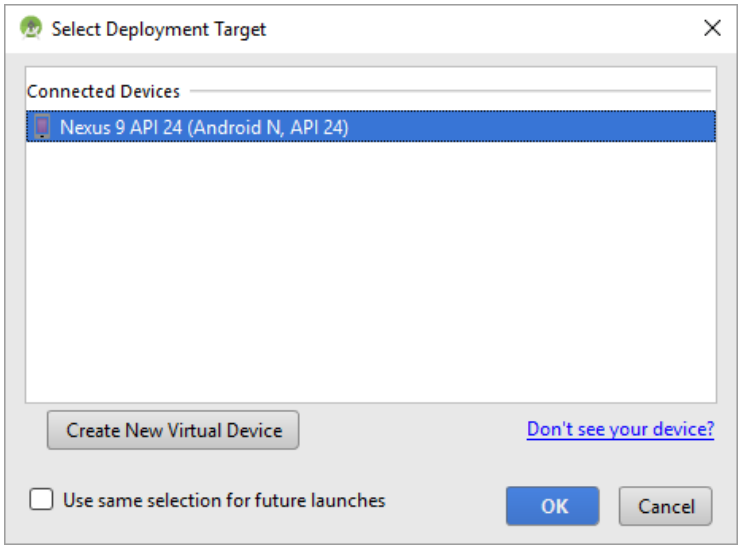

Figure 5-5

Once the application is installed and running, the user interface for the AndroidSampleActivity class will appear within the emulator:

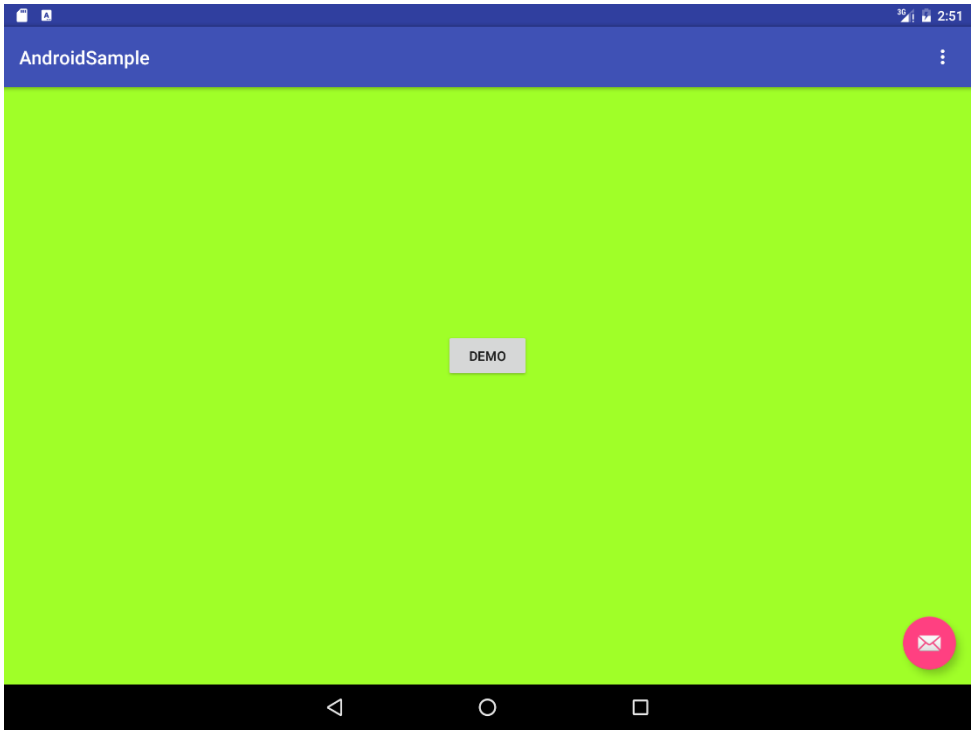

Figure 5-6

In the event that the activity does not automatically launch, check to see if the launch icon has appeared among the apps on the emulator. If it has, simply click on it to launch the application. Once the run process begins, the Run and Android Monitor tool windows will become available. The Run tool window will display diagnostic information as the application package is installed and launched. Figure 5-7 shows the Run tool window output from a successful application launch:

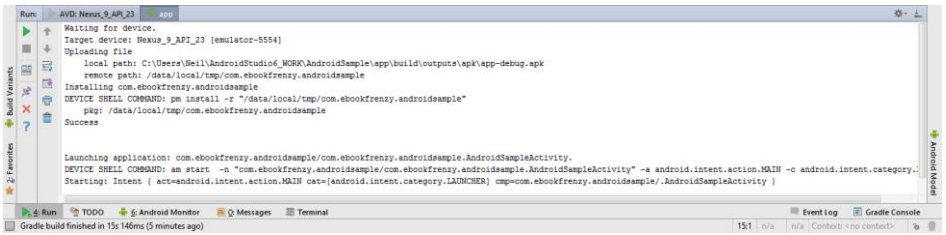

Figure 5-7

If problems are encountered during the launch process, the Run tool will provide information that will hopefully help to isolate the cause of the problem.

Assuming that the application loads into the emulator and runs as expected, we have safely verified that the Android development environment is correctly installed and configured.

5.5 Run/Debug Configurations

A particular project can be configured such that a specific device or emulator is used automatically each time it is run from within Android Studio. This avoids the necessity to make a selection from the device chooser each time the application is executed. To review and modify the Run/Debug configuration, click on the button to the left of the run button in the Android Studio toolbar and select the *Edit Configurations…* option from the resulting menu:

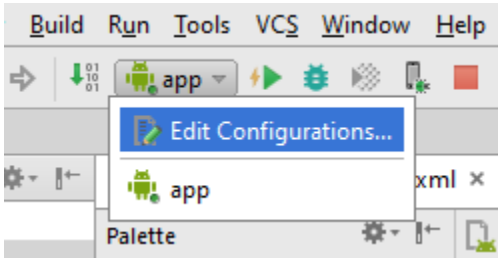

Figure 5-8

In the *Run/Debug Configurations* dialog, the application may be configured to always use a preferred emulator by selecting *Emulator* from the *Target* menu located in the *Deployment Target Options* section and selecting the emulator from the drop down menu. Figure 5-9, for example, shows the AndroidSample application configured to run by default on the previously created Nexus 9 emulator:

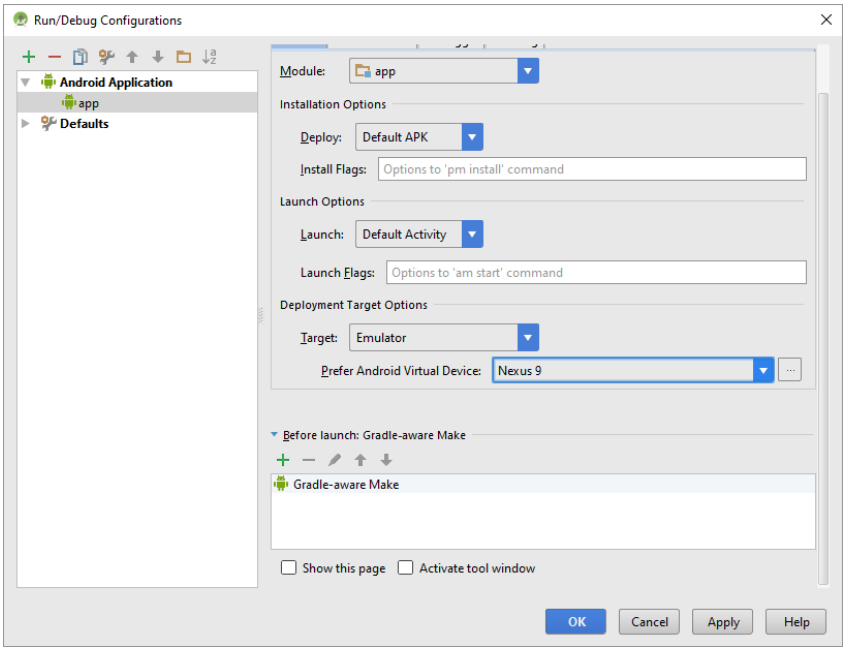

Figure 5-9

Be sure to switch the Target menu setting back to "Show Device Chooser Dialog" mode before moving on to the next chapter of the book.

5.6 Stopping a Running Application

To stop a running application, simply click on stop button located in the main toolbar as shown in Figure 5-10:

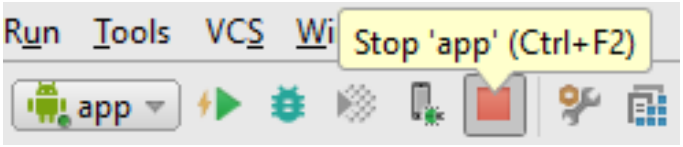

Figure 5-10

An app may also be terminated using the Android Monitor. Begin by displaying the *Android Monitor* tool window either using the window bar button, or via the quick access menu (invoked by moving the mouse pointer over the button in the left hand corner of the status bar as shown in Figure 5-11).

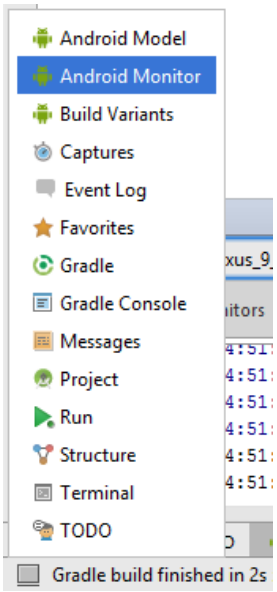

Figure 5-11

Once the Android tool window appears, select the *androidsample* app menu highlighted in Figure 5-12 below:

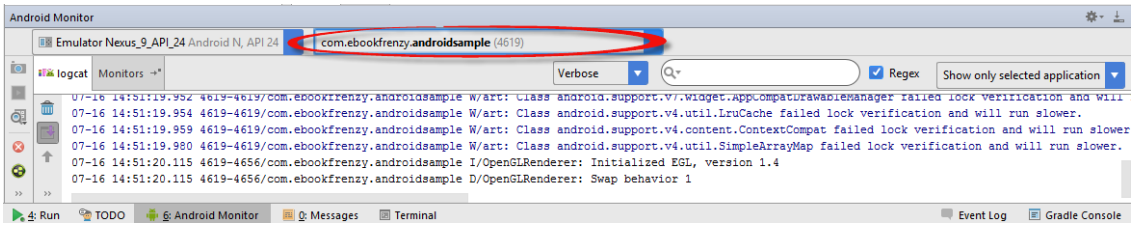

Figure 5-12

With the process selected, stop it by clicking on the red *Terminate Application* button in the vertical toolbar to the left of the process list indicated by the arrow in the above figure.

An alternative to using the Android tool window is to open the Android Device Monitor. This can be launched via the *Tools -> Android -> Android Device Monitor* menu option. Once launched, the process may be selected from the list (Figure 5-13) and terminated by clicking on the red *Stop* button located in the toolbar above the list.

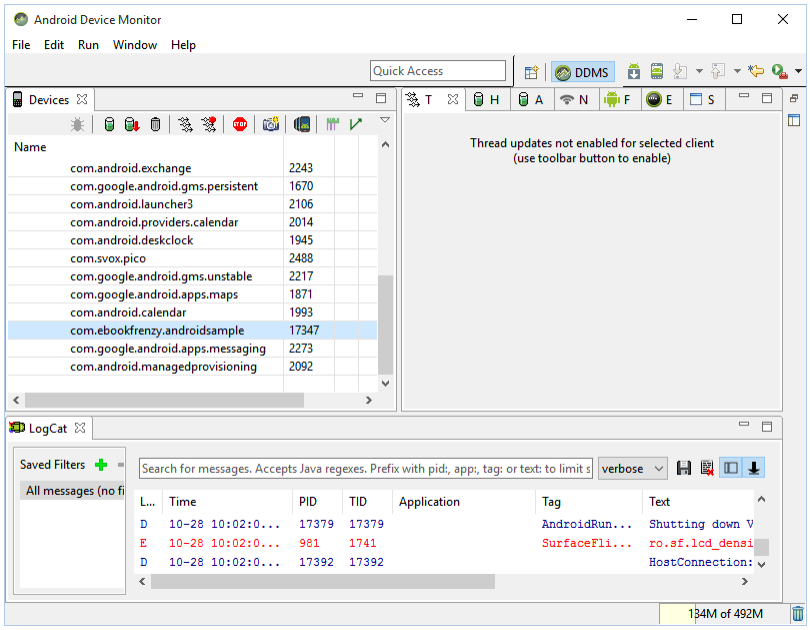

Figure 5-13

5.7 AVD Command-line Creation

As previously discussed, in addition to the graphical user interface it is also possible to create a new AVD directly from the command-line. This is achieved using the *android* tool in conjunction with some command-line options. Once initiated, the tool will prompt for additional information before creating the new AVD.

Assuming that the system has been configured such that the Android SDK *tools* directory is included in the PATH environment variable, a list of available targets for the new AVD may be obtained by issuing the following command in a terminal or command window:

```
android list targets
```

The resulting output from the above command will contain a list of Android SDK versions that are available on the system. For example:

```
Available Android targets:
----------
id: 1 or "Google Inc.:Google APIs:23"
     Name: Google APIs
     Type: Add-On
     Vendor: Google Inc.
     Revision: 1
```

```
     Description: Android + Google APIs
     Based on Android 6.0 (API level 23)
     Libraries:
      * com.google.android.media.effects (effects.jar)
          Collection of video effects
      * com.android.future.usb.accessory (usb.jar)
          API for USB Accessories
      * com.google.android.maps (maps.jar)
          API for Google Maps
     Skins: HVGA, QVGA, WQVGA400, WQVGA432, WSVGA, WVGA800 (default),
WVGA854, WXGA720, WXGA800, WXGA800-7in
 Tag/ABIs : google_apis/x86
----------
id: 2 or "android-N"
     Name: Android N (Preview)
     Type: Platform
     API level: N
     Revision: 3
     Skins: HVGA, QVGA, WQVGA400, WQVGA432, WSVGA, WVGA800 (default),
WVGA854, WXGA720, WXGA800, WXGA800-7in
 Tag/ABIs : android-tv/x86, default/x86, default/x86_64
```

The syntax for AVD creation is as follows:

```
android create avd -n <name> -t <targetID> [-<option> <value>]
```

For example, to create a new AVD named *Nexus9* using the target id for the Android N API level 24 device (in this case id 2) using the default x86_64 ABI, the following command may be used:

```
android create avd –n Nexus9 -t 2 --abi "default/x86_64"
```

The android tool will create the new AVD to the specifications required for a basic Android 7 device, also providing the option to create a custom configuration to match the specification of a specific device if required. Once a new AVD has been created from the command line, it may not show up in the Android Device Manager tool until the *Refresh* button is clicked.

In addition to the creation of new AVDs, a number of other tasks may be performed from the command line. For example, a list of currently available AVDs may be obtained using the *list avd* command line arguments:

```
android list avd

Available Android Virtual Devices:
    Name: Nexus9
```

```
    Path: C:\Users\Neil\.android\avd\deleteme.avd
  Target: Android N (API level 24)
 Tag/ABI: default/x86_64
    Skin: WVGA800
---------
    Name: Nexus_9_API_24
  Device: Nexus 9 (Google)
    Path: C:\Users\Neil\.android\avd\Nexus_9_API_24.avd
  Target: Android N (API level 24)
 Tag/ABI: default/x86_64
    Skin: nexus_9
  Sdcard: 100M
```

Similarly, to delete an existing AVD, simply use the *delete* option as follows:

```
android delete avd –n <avd name>
```

5.8 Android Virtual Device Configuration Files

By default, the files associated with an AVD are stored in the *.android/avd* sub-directory of the user's home directory, the structure of which is as follows (where *<avd name>* is replaced by the name assigned to the AVD):

```
<avd name>.avd/config.ini
<avd name>.avd/userdata.img
<avd name>.ini
```

The *config.ini* file contains the device configuration settings such as display dimensions and memory specified during the AVD creation process. These settings may be changed directly within the configuration file and will be adopted by the AVD when it is next invoked.

The *<avd name>.ini* file contains a reference to the target Android SDK and the path to the AVD files. Note that a change to the *image.sysdir* value in the *config.ini* file will also need to be reflected in the *target* value of this file.

5.9 Moving and Renaming an Android Virtual Device

The current name or the location of the AVD files may be altered from the command line using the *android* tool's *move avd* argument. For example, to rename an AVD named Nexus9 to Nexus9B, the following command may be executed:

```
android move avd -n Nexus9 -r Nexus9B
```

To physically relocate the files associated with the AVD, the following command syntax should be used:

```
android move avd -n <avd name> -p <path to new location>
```

For example, to move an AVD from its current file system location to /tmp/Nexus9Test:

```
android move avd -n Nexus9 -p /tmp/Nexus9Test
```

Note that the destination directory must not already exist prior to executing the command to move an AVD.

5.10 Summary

A typical application development process follows a cycle of coding, compiling and running in a test environment. Android applications may be tested on either a physical Android device or using an Android Virtual Device (AVD) emulator. AVDs are created and managed using the Android AVD Manager tool which may be used either as a command line tool or using a graphical user interface. When creating an AVD to simulate a specific Android device model it is important that the virtual device be configured with a hardware specification that matches that of the physical device.

Chapter 6

6. Using and Configuring the Android Studio AVD Emulator

The Android Virtual Device (AVD) emulator environment bundled with Android Studio 1.x was an uncharacteristically weak point in an otherwise reputable application development environment. Regarded by many developers as slow, inflexible and unreliable, the emulator was long overdue for an overhaul. Fortunately, Android Studio 2 introduced an enhanced emulator environment providing significant improvements in terms of configuration flexibility and overall performance. According to the Android Studio team at Google, launching an app on the new emulator is now faster than running on a physical Android device. Not only does the emulator contain many new configuration options, these changes can be made in real-time while the application is running.

Before the next chapter explores testing on physical Android devices, this chapter will take some time to provide an overview of the Android Studio AVD emulator and highlight many of the configuration features that are available to customize the environment.

6.1 The Emulator Environment

When launched, the emulator displays an initial splash screen during the loading process as illustrated in Figure 6-1:

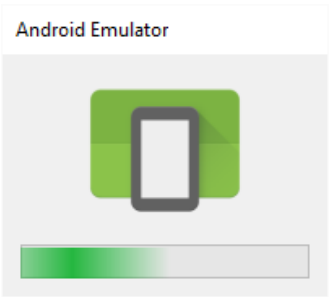

Figure 6-1

Once loaded, the main emulator window appears containing a representation of the chosen device type (in the case of Figure 6-2 this is a Nexus 5 device):

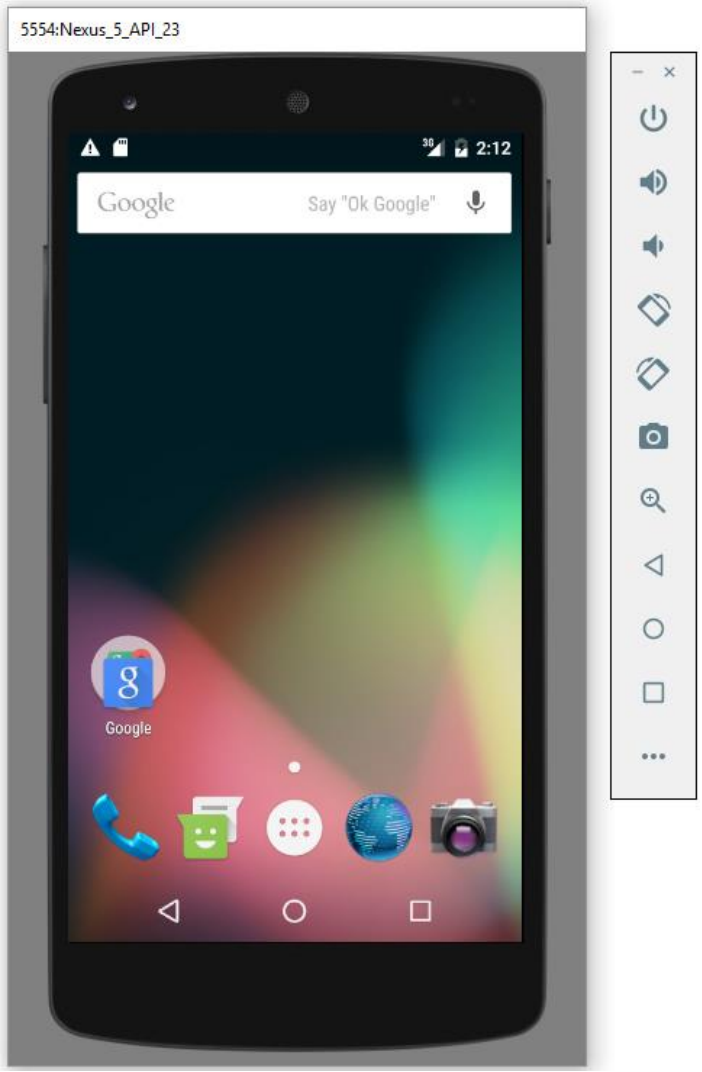

Figure 6-2

Positioned along the right hand edge of the window is the toolbar providing quick access to the emulator controls and configuration options.

6.2 The Emulator Toolbar Options

The emulator toolbar (Figure 6-3) provides access to a range of options relating to the appearance and behavior of the emulator environment.

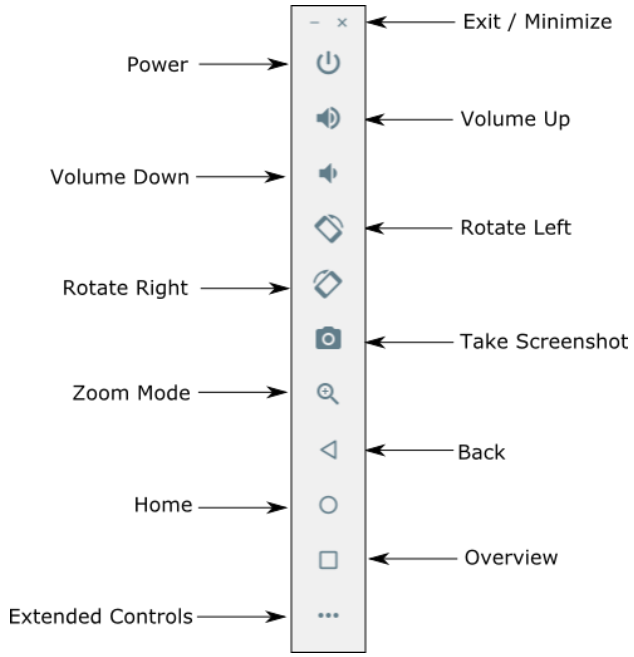

Figure 6-3

Each button in the toolbar has associated with it a keyboard accelerator which can be identified either by hovering the mouse pointer over the button and waiting for the tooltip to appear, or via the help option of the extended controls panel.

Though many of the options contained within the toolbar are self-explanatory, each option will be covered for the sake of completeness:

- **Exit / Minimize** – The uppermost 'x' button in the toolbar exits the emulator session when selected while the '-' option minimizes the entire window.
- **Power** – The Power button simulates the hardware power button on a physical Android device. Clicking and releasing this button will lock the device and turn off the screen. Clicking and holding this button will initiate the device "Power off" request sequence.
- **Volume Up / Down** – Two buttons that control the audio volume of playback within the simulator environment.
- **Rotate Left/Right** – Rotates the emulated device between portrait and landscape orientations.
- **Screenshot** – Takes a screenshot of the content currently displayed on the device screen. The captured image is stored at the location specified in the Settings screen of the extended controls panel as outlined later in this chapter.
- **Zoom Mode** – This button toggles in and out of zoom mode, details of which will be covered later in this chapter.

- **Back** – Simulates selection of the standard Android "Back" button. As with the Home and Overview buttons outlined below, the same results can be achieved by selecting the actual buttons on the emulator screen.
- **Home** – Simulates selection of the standard Android "Home" button.
- **Overview** – Simulates selection of the standard Android "Overview" button which displays the currently running apps on the device.
- **Extended Controls** – Displays the extended controls panel, allowing for the configuration of options such as simulated location and telephony activity, battery strength, cellular network type and fingerprint identification.

6.3 Working in Zoom Mode

The zoom button located in the emulator toolbar switches in and out of zoom mode. When zoom mode is active the toolbar button is depressed and the mouse pointer appears as a magnifying glass when hovering over the device screen. Clicking the left mouse button will cause the display to zoom in relative to the selected point on the screen, with repeated clicking increasing the zoom level. Conversely, clicking the right mouse button decreases the zoom level. Toggling the zoom button off reverts the display to the default size.

Clicking and dragging while in zoom mode will define a rectangular area into which the view will zoom when the mouse button is released.

While in zoom mode the visible area of the screen may be panned using the horizontal and vertical scrollbars located within the emulator window.

6.4 Resizing the Emulator Window

The size of the emulator window (and the corresponding representation of the device) can be changed at any time by clicking and dragging on any of the corners or sides of the window.

6.5 Extended Control Options

The extended controls toolbar button displays the panel illustrated in Figure 6-4. By default, the location settings will be displayed. Selecting a different category from the left hand panel will display the corresponding group of controls:

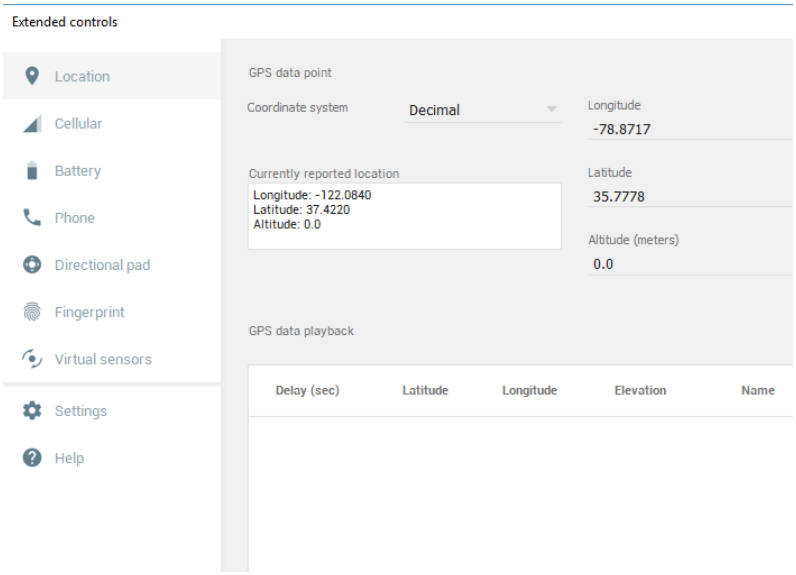

Figure 6-4

6.5.1 Location

The location controls allow simulated location information to be sent to the emulator in the form of decimal or sexigesimal coordinates. Location information can take the form of a single location, or a sequence of points representing movement of the device, the latter being provided via a file in either GPS Exchange (GPX) or Keyhole Markup Language (KML) format.

A single location is transmitted to the emulator when the *Send* button is clicked. The transmission of GPS data points begins once the "play" button located beneath the data table is selected. The speed at which the GPS data points are fed to the emulator can be controlled using the speed menu adjacent to the play button.

6.5.2 Cellular

The type of cellular connection being simulated can be changed within the cellular settings screen. Options are available to simulate different network types (CSM, EDGE, HSDPA etc) in addition to a range of voice and data scenarios such as roaming and denied access.

6.5.3 Battery

A variety of simulated battery state and charging conditions can be simulated on this panel of the extended controls screen, including battery charge level, battery health and whether the AC charger is currently connected.

6.5.4 Phone

The phone extended controls provide two very simple but useful simulations within the emulator. The first option allows for the simulation of an incoming call from a designated phone number. This can be of particular use when testing the way in which an app handles high level interrupts of this nature.

The second option allows the receipt of text messages to be simulated within the emulator session. As in the real world, these messages appear within the Message app and trigger the standard notifications within the emulator.

6.5.5 Directional Pad

A directional pad (D-Pad) is an additional set of controls either built into an Android device or connected externally (such as a game controller) that provides directional controls (left, right, up, down). The directional pad settings allow D-Pad interaction to be simulated within the emulator.

6.5.6 Fingerprint

Many Android devices are now supplied with built-in fingerprint detection hardware. With the introduction of the Android Studio 2 emulator it is now possible to test fingerprint authentication without the need to test apps on a physical device containing a fingerprint sensor. Details on how to configure fingerprint testing within the emulator will be covered in detail later in this chapter.

6.5.7 Virtual Sensors

The virtual sensors option allows the accelerometer and magnetometer to be simulated to emulate the effects of the physical motion of a device such as rotation, movement and tilting through yaw, pitch and roll settings.

6.5.8 Settings

The settings panel provides a small group of configuration options. Use this panel to choose a darker theme for the toolbar and extended controls panel, specify a file system location into which screenshots are to be saved, and to configure the emulator window to appear on top of other windows on the desktop.

6.5.9 Help

The Help screen contains three sub-panels containing a list of keyboard shortcuts, links to access the emulator online documentation, file bugs and send feedback, and emulator version information.

6.6 Drag and Drop Support

An Android application is packaged into an APK file when it is built. When Android Studio built and ran the AndroidSample app created earlier in this book, for example, the application was compiled and packaged into an APK file. That APK file was then transferred to the emulator and launched.

The Android Studio 2 emulator also supports installation of apps by dragging and dropping the corresponding APK file onto the emulator window. To experience this in action, start the emulator, open Settings and select the Apps option. Within the list of installed apps, locate and select the AndroidSample app and, in the app detail screen, uninstall the app from the emulator.

Open the file system navigation tool for your operating system (e.g. Windows Explorer for Windows or Finder for Mac OS X) and navigate to the folder containing the AndroidSample project. Within this folder locate the *app/build/outputs/apk* subfolder. This folder should contain two APK files named *app-debug.apk* and *app-debug-unaligned.apk.* Drag the *app-debug.apk* file and drop it onto the emulator window. The dialog shown in (Figure 6-5) will subsequently appear as the APK file is installed.

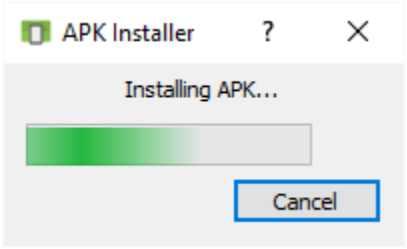

Figure 6-5

Once the APK file installation has completed, locate the app on the device and click on it to launch it.

In addition to APK files, any other type of file such as image, video or data files can be installed onto the emulator using this drag and drop feature. Such files are added to the SD card storage area of the emulator where they may subsequently be accessed from within app code.

6.7 Configuring Fingerprint Emulation

The emulator allows up to 10 simulated fingerprints to be configured and used to test fingerprint authentication within Android apps. To configure simulated fingerprints begin by launching the emulator, opening the Settings app and selecting the *Security* option.

Within the Security settings screen, select the *Fingerprint* option. On the resulting information screen click on the *Continue* button to proceed to the Fingerprint setup screen. Before fingerprint security can be enabled a backup screen unlocking method (such as a PIN number) must be configured. Click

on the *Fingerprint + PIN* button, enter and confirm a suitable PIN number and complete the PIN entry process.

Proceed through the remaining screens until the Settings app requests a fingerprint on the sensor. At this point display the extended controls dialog, select the *Fingerprint* category in the left hand panel and make sure that *Finger 1* is selected in the main settings panel:

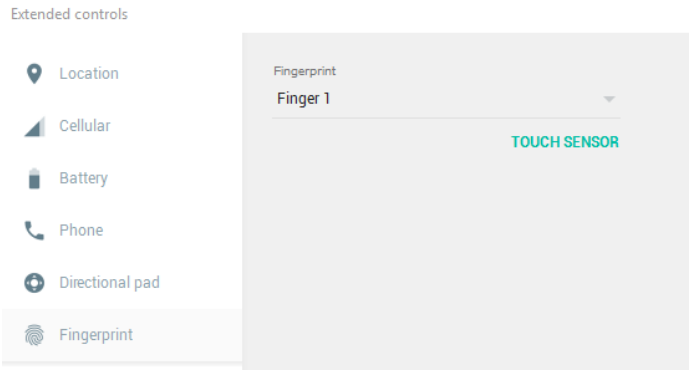

Figure 6-6

Click on the *Touch Sensor* button to simulate Finger 1 touching the fingerprint sensor. The emulator will report the successful addition of the fingerprint:

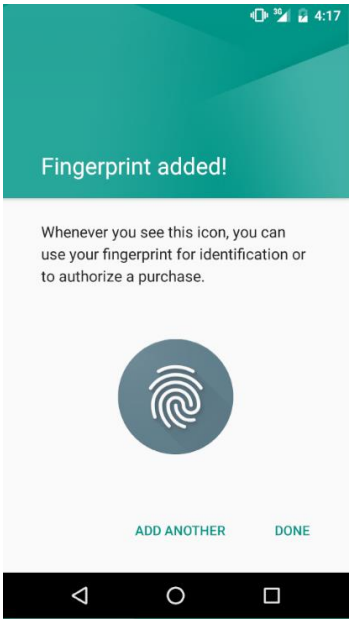

Figure 6-7

To add additional fingerprints click on the *Add Another* button and select another finger from the extended controls panel menu before clicking on the *Touch Sensor* button once again. The topic of building fingerprint authentication into an Android app is covered in detail in the chapter entitled *An Android Fingerprint Authentication Tutorial*.

6.8 Multi-Core Support

To increase the performance of the emulator Google has added the capability for the Android system image running within the emulator to make use of multiple cores within the processor of the computer system on which it is running. To specify the number of cores used by an emulator, shut the emulator down, load the AVD Manager (*Tools -> Android -> AVD Manager*) and edit the emulator configuration by clicking on the corresponding pencil icon in the list of emulators. In the Virtual Device Configuration screen click on the *Show Advanced Settings* button and locate the *Multi-Core CPU* menu (Figure 6-8) in the *Emulated Performance* section of the panel. From this menu select the number of cores to be used by the emulator (the total number of cores available will depend on the architecture of the CPU in the system).

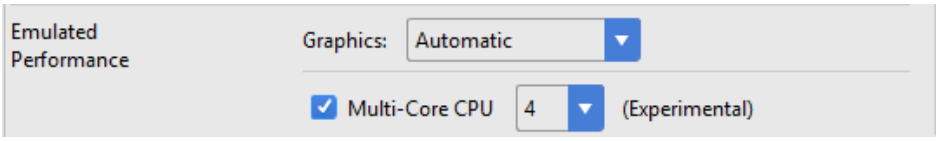

Figure 6-8

Once the setting has been configured, click on the Finish button to commit the change before re-launching the emulator.

6.9 Summary

Android Studio 2 contains a new and improved Android Virtual Device emulator environment designed to make it easier to test applications without the need to run on a physical Android device. This chapter has provided a brief tour of the emulator and highlighted key features that are available to configure and customize the environment to simulate different testing conditions.

Chapter 7

7. Testing Android Studio Apps on a Physical Android Device

Whilst much can be achieved by testing applications using an Android Virtual Device (AVD), there is no substitute for performing real world application testing on a physical Android device and there are a number of Android features that are only available on physical Android devices.

Communication with both AVD instances and connected Android devices is handled by the *Android Debug Bridge (ADB).* In this chapter we will work through the steps to configure the adb environment to enable application testing on a physical Android device with Mac OS X, Windows and Linux based systems.

7.1 An Overview of the Android Debug Bridge (ADB)

The primary purpose of the ADB is to facilitate interaction between a development system, in this case Android Studio, and both AVD emulators and physical Android devices for the purposes of running and debugging applications.

The ADB consists of a client, a server process running in the background on the development system and a daemon background process running in either AVDs or real Android devices such as phones and tablets.

The ADB client can take a variety of forms. For example, a client is provided in the form of a command-line tool named *adb* located in the Android SDK *platform-tools* sub-directory. Similarly, Android Studio also has a built-in client.

A variety of tasks may be performed using the *adb* command-line tool. For example, a listing of currently active virtual or physical devices may be obtained using the *devices* command-line argument. The following command output indicates the presence of an AVD on the system but no physical devices:

```
$ adb devices
List of devices attached
emulator-5554   device
```