Building graphic-rich and better performing native applications

Pro Android C++ with the NDK

Onur Cinar

Apress®

Pro Android C++ with the NDK

Onur Cinar

Apress®

Pro Android C++ with the NDK

ISBN-13 (pbk): 978-1-4302-4827-9

ISBN-13 (electronic): 978-1-4302-4828-6

President and Publisher: Paul Manning

Lead Editor: Steve Anglin

Technical Reviewer: Grant Allen

Editorial Board: Steve Anglin, Mark Beckner, Ewan Buckingham, Gary Cornell, Louise Corrigan, Morgan Ertel, Jonathan Gennick, Jonathan Hassell, Robert Hutchinson, Michelle Lowman, James Markham, Matthew Moodie, Jeff Olson, Jeffrey Pepper, Douglas Pundick, Ben Renow-Clarke, Dominic Shakeshaft, Gwenan Spearing, Matt Wade, Tom Welsh

Coordinating Editor: Brigid Duffy

Copy Editor: Mary Behr

Compositor: SPi Global

Indexer: SPi Global
Artist: SPi Global
Cover Designer: Anna Ishchenko

Distributed to the book trade worldwide by Springer Science+Business Media New York, 233 Spring Street, 6th Floor, New York, NY 10013. Phone 1-800-SPRINGER, fax (201) 348-4505, e-mail orders-ny@springer-sbm.com, or visit www.springeronline.com. Apress Media, LLC is a California LLC and the sole member (owner) is Springer Science + Business Media Finance Inc (SSBM Finance Inc). SSBM Finance Inc is a Delaware corporation.

For information on translations, please e-mail rights@apress.com, or visit www.apress.com.

Apress and friends of ED books may be purchased in bulk for academic, corporate, or promotional use. eBook versions and licenses are also available for most titles. For more information, reference our Special Bulk Sales–eBook Licensing web page at www.apress.com/bulk-sales.

Any source code or other supplementary materials referenced by the author in this text is available to readers at www.apress.com. For detailed information about how to locate your book's source code, go to www.apress.com/source-code/.

Dedicated to my son Deren, my wife Sema, and my parents, Zekiye and Dogan, for their love, continuous support, and always encouraging me to pursue my dreams.

I could not have done this without all of you.

—Onur Cinar

Contents at a Glance

Contents

About the Author

Onur Cinar has over 17 years of experience in design, development, and management of large scale complex software projects, primarily in mobile and telecommunication space. His expertise spans VoIP, video communication, mobile applications, grid computing, and networking technologies on diverse platforms. He has been actively working with Android platform since its beginning. He is the author of the book Android Apps with Eclipse from Apress. He has a Bachelor of Science degree in Computer Science from Drexel University in Philadelphia, PA, United States. He is currently working at Skype division of Microsoft as the Sr. Product Engineering Manager for the Skype client on Android platform.

About the Technical Reviewer

Grant Allen has worked in the IT field for over 20 years as a CTO, enterprise architect, and database architect. Grant's roles have covered private enterprise, academia, and the government sector around the world, specializing in globalscale systems design, development, and performance. He is a frequent speaker at industry and academic conferences, on topics ranging from data mining to compliance, and technologies such as databases (DB2, Oracle, SQL Server, and MySQL), content management, collaboration, disruptive innovation, and mobile ecosystems like Android.

His first Android application was a task list to remind him to finish all his other unfinished Android projects.

Grant works for Google, and in his spare time is completing a PhD on building innovative high-technology environments.

Grant is the author of Beginning DB2: From Novice to Professional (Apress, 2008), and lead author of Oracle SQL Recipes: A Problem-Solution Approach (Apress, 2010) and The Definitive Guide to SQLite, 2nd Edition (Apress, 2010).

Preface

Android is one of the major players in mobile phone market, and continuously growing its market share. It is the first complete, open, and free mobile platform that is enabling endless opportunities for mobile application developers.

Althrough the official programming language for the Android platform is Java, the application developers are not limited to using only the Java techonology.

Android allows application developers to implement parts of their application using native-code languages such as C and C++ through the Android Native Development Kit (NDK). In this book, you will learn how to use the Android NDK to implement performance-critical portions of your Android applications using native-code languages.

Android C++ with the NDK provides a detailed overview of native application development, available native APIs, the troubleshooting techniques, including the step by step instructions and screenshots to help Android developers to quickly get up to speed on developing native application.

What You Will Learn

This book includes the following:

- Installing the Android native development environment on major operating systems.
- Using the Eclipse IDE to develop native code.
- Connecting native code to Java world using Java Native Interface (JNI).
- Auto-generating the JNI code using SWIG.
- Developing multithreaded native apps using the POSIX and Java threads.
- Developing networking native apps using POSIX sockets.
- Debug native code through logging, GDB, and Eclipse Debugger.
- Analyzing memory issues through Valgrind.
- Measuring application performance through GProf.
- Optimizing native code through SIMD/NEON.

Downloading the Code

The source code for this book is available to readers at www.apress.com.

Contacting the Author

Readers can contact the author through author's Android C++ with the NDK site at http://www.zdo.com/android-c++-with-the-ndk to ask questions.

Getting Started with C++ on Android

Needless to say, exploring and practicing are the best methods for learning. Having a fully functional development environment ready at the very beginning of this book will enable you to explore and experiment with the material while working through the chapters. The Android C++ development environment is mainly formed by the following components:

- Android Software Development Kit (SDK)
- Android Native Development Kit (NDK)
- Android Development Tools (ADT) Plug-In for Eclipse
- Java Development Kit (JDK)
- Apache ANT Build System
- GNU Make Build System
- Eclipse IDE

This chapter will provide step-by-step instructions for setting up the proper Android C++ development environment. Android development tools are provided for the major operating systems:

- Microsoft Windows
- Apple Mac OS X
- Linux

Since the requirements and the installation procedure vary depending on the operating system, the following sections will walk you through the steps for setting up the Android C++ development environment based on the operating system. You can skip over the ones that don’t apply to you.

Microsoft Windows

Android development tools require Windows XP (32-bit only), Vista, or Windows 7. In this section, you will be downloading and installing the following components :

- Java JDK 6
- Apache ANT Build System
- Android SDK
- Cygwin
- Android NDK
- Eclipse IDE

Downloading and Installing the Java Development Kit on Window

Android development tools require Java Development Kit (JDK) version 6 in order to run. Java Runtime Edition (JRE) itself is not sufficient. Java JDK 6 needs to be installed prior installing the Android development tools.

> **Note** Android development tools only support Java compiler compliance level 5 or 6. Although the later versions of JDK can be configured to comply with those levels, using JDK 6 is much simpler and less prone to errors.

Multiple JDK flavors are supported by Android development tools, such as IBM JDK, Open JDK, and Oracle JDK (formerly known as Sun JDK). In this book, it is assumed that Oracle JDK will be used since it supports a broader range of platforms.

In order to download Oracle JDK, navigate to `www.oracle.com/technetwork/java/javase/downloads/index.html` and follow these steps:

1. Click the JDK 6 download button, as shown in Figure 1-1. At the time of this writing the latest version of Oracle JDK 6 is Update 33.

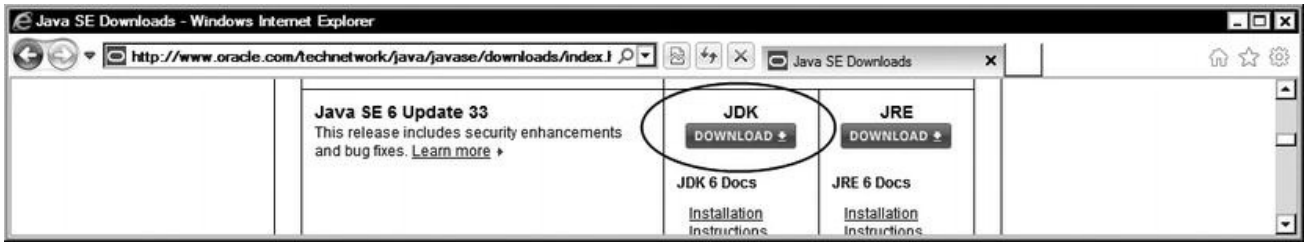

Figure 1-1 . *Oracle JDK 6 Download button*

2. Clicking the Oracle JDK 6 Download button takes you to a page listing the Oracle JDK 6 installation packages for supported platforms.
3. Check “Accept License Agreement” and download the installation package for Windows x86, as shown in Figure 1-2.

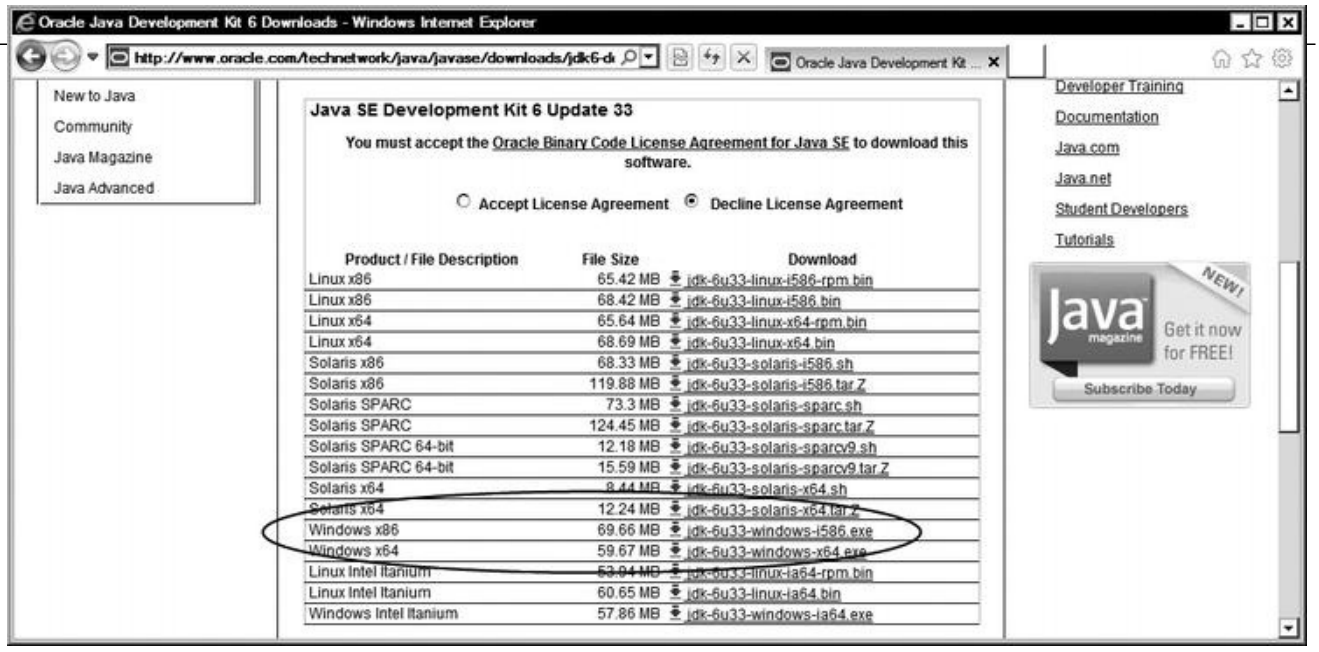

Figure 1-2 . *Download Oracle JDK 6 for Windows x86*

Now you can install. The Oracle JDK 6 installation package for Windows comes with a graphical installation wizard. The installation wizard will guide you through the process of installing JDK. The installation wizard will first install the JDK, and then the JRE. During the installation process, the wizard will ask for the destination directories, as well as the components to be installed. You can continue with the default values here. Make a note of the installation directory for the JDK part, shown in Figure 1-3.

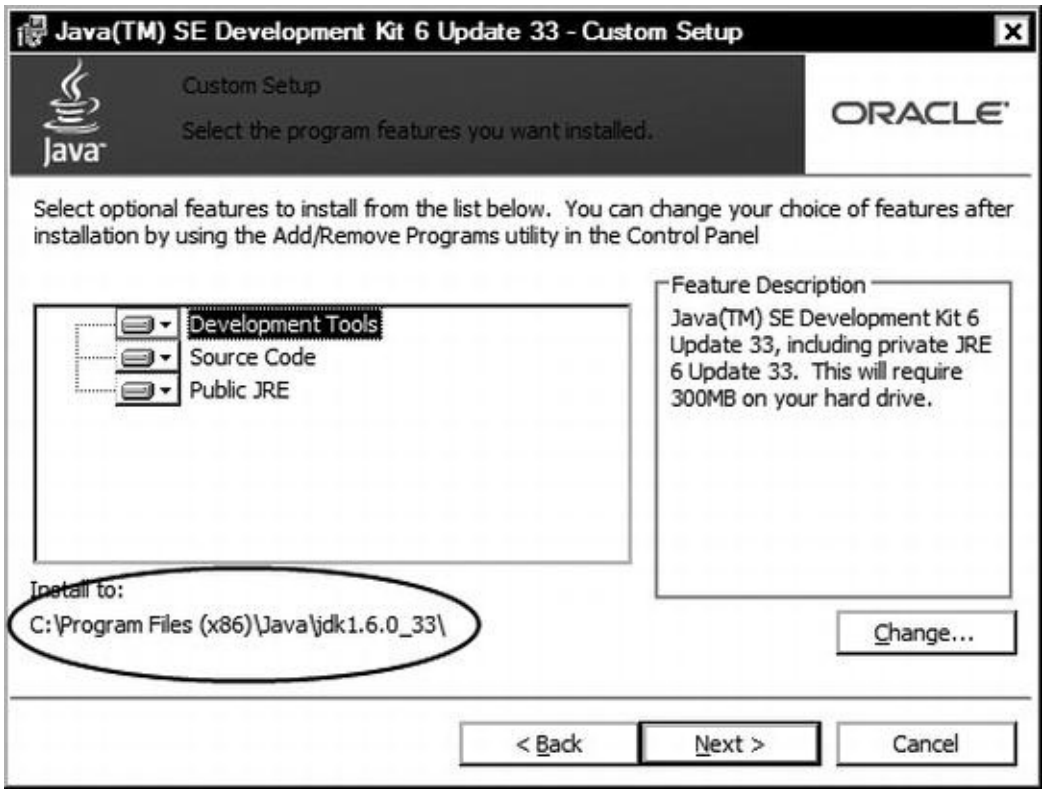

Figure 1-3 . *Oracle JDK 6 installation directory*

The JDK will be ready to use upon completion of the installation process. The installation wizard does not automatically add the Java binary directory into the system executable search

path, also known as the PATH variable. This needs to be done manually as the last step of the JDK installation.

1. Choose Control Panel from the Start button menu.
2. Click the System icon to launch the System Properties dialog.
3. Switch to the Advanced tab and click the Environment Variables button, as shown in Figure 1-4.

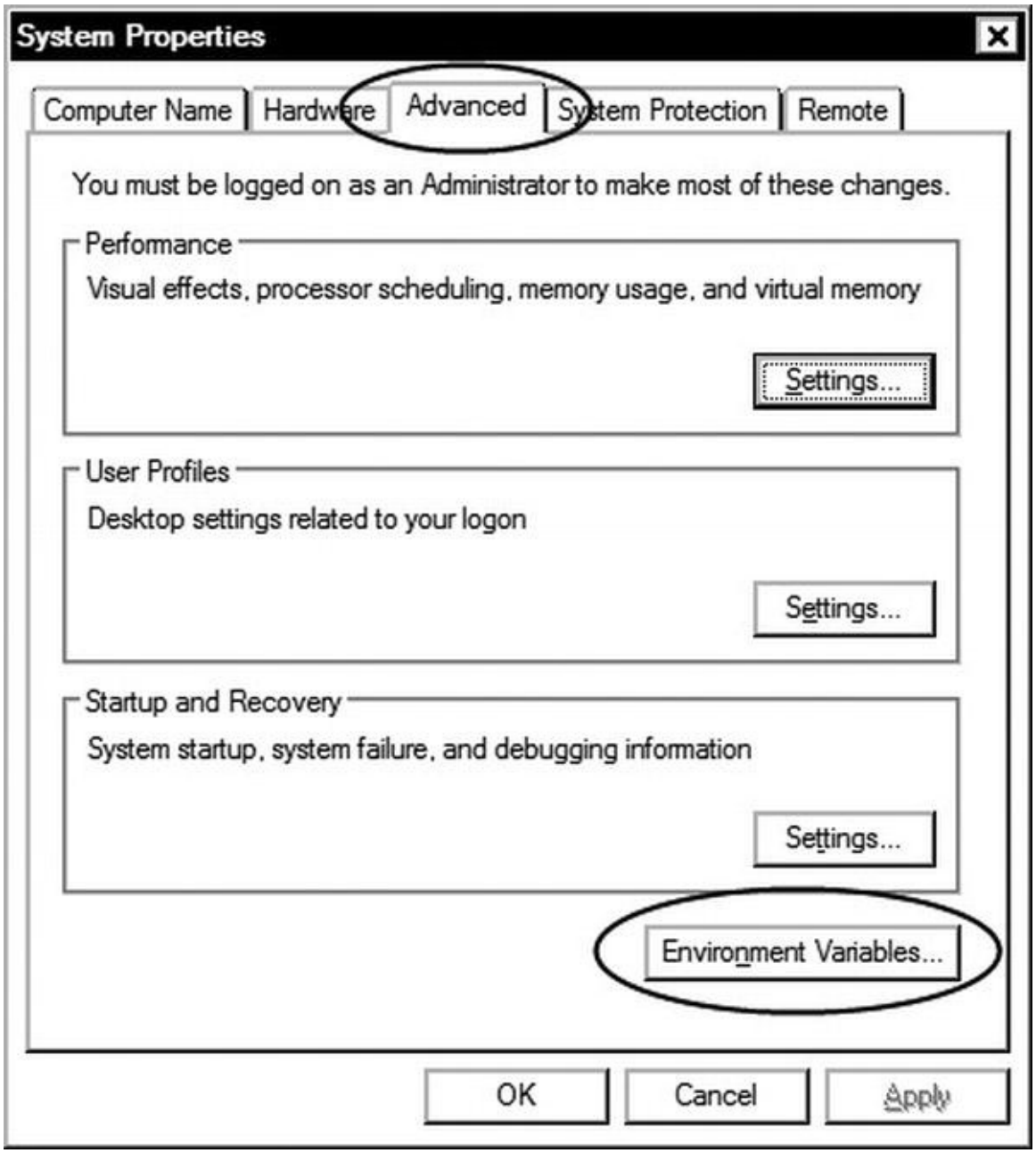

Figure 1-4 . *System Properties dialog*

4. Clicking the Environment Variables button will launch the Environment Variables dialog. The dialog is separated into two parts: the top one is for the user and the bottom is for the system.
5. Click the New button in the system variables section to define a new environment variable, as shown in Figure 1-5.

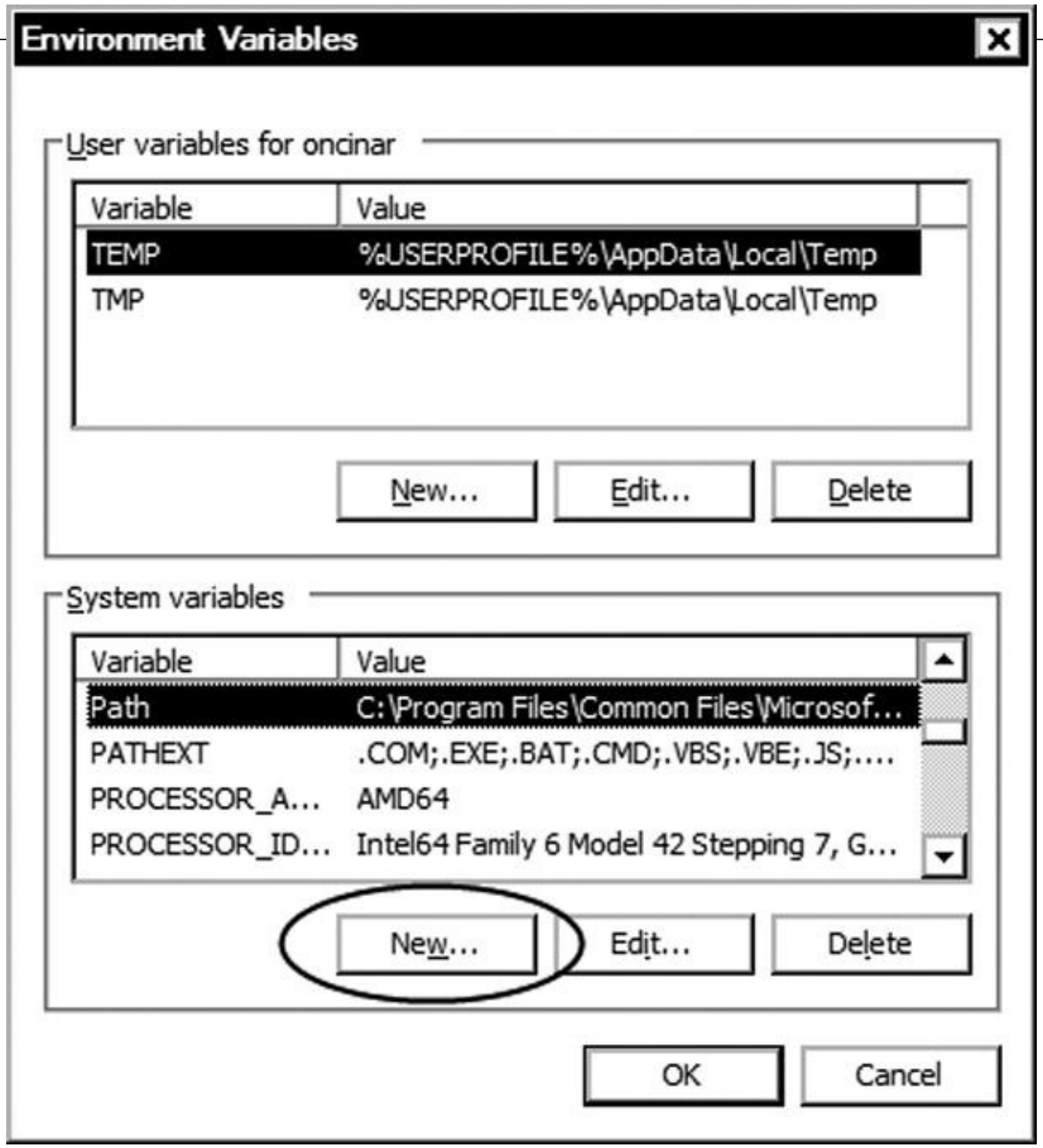

Figure 1-5 . *Environment Variables dialog*

6. Set the variable name to `JAVA_HOME` and the variable value to the Oracle JDK installation directory that you noted during the Oracle JDK installation, as shown in Figure 1-6.
7. Click OK button to save the environment variable.

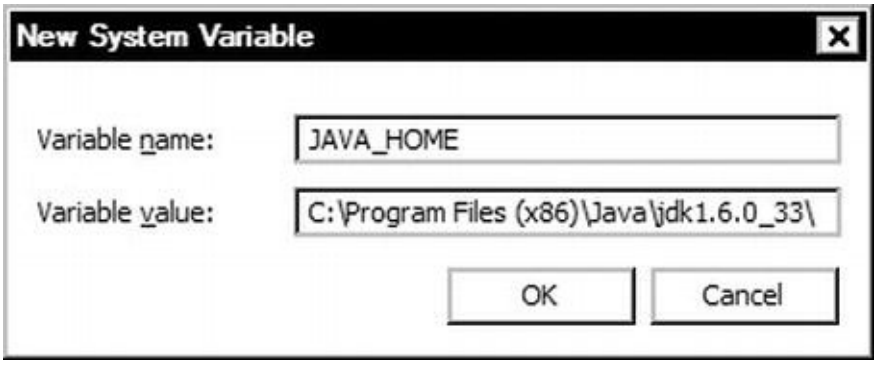

Figure 1-6 . *New JAVA_HOME environment variable*

8. From the list of system variables, double-click the `PATH` variable and append `;%JAVA_HOME%\bin` to the variable value, as shown in Figure 1-7.

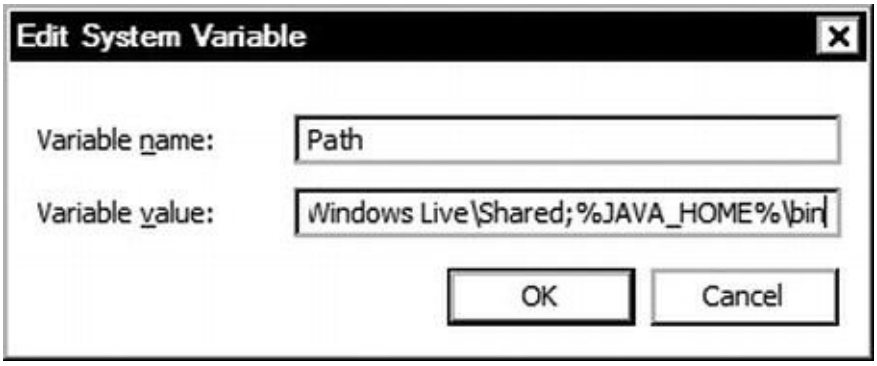

Figure 1-7. *Appending Oracle JDK binary path to system PATH variable*

The Oracle JDK is now part of the system executable search path and it is easily reachable. In order to validate the installation, open a command prompt window by choosing **Start ➤ Accessories ➤ Command Prompt**. Using the command prompt, execute `javac -version`. If the installation was successful, you will see the Oracle JDK version number, as shown in Figure 1-8.

Figure 1-8. *Validating Oracle JDK installation*

Downloading and Installing the Apache ANT on Windows

Apache ANT is a command-line build tool that whose mission is to drive any type of process that can be described in terms of targets and tasks. Android development tools require Apache ANT version 1.8 or later for the build process to function. At the time of this writing, the latest version of Apache ANT is 1.8.4.

In order to download Apache ANT, navigate to `http://ant.apache.org/bindownload.cgi` and download the installation package in ZIP format, as shown in Figure 1-9. Then follow these steps: