

Building graphic-rich and better performing  
native applications



Pro  
**Android C++**  
with the **NDK**

Onur Cinar



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# Pro Android C++ with the NDK

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*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

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**About the Author**

**About the Technical Reviewer**

**Preface**

■ **Chapter 1: Getting Started with C++ on Android**

■ **Chapter 2: Exploring the Android NDK**

■ **Chapter 3: Communicating with Native Code using JNI**

■ **Chapter 4: Auto-Generate JNI Code Using SWIG**

■ **Chapter 5: Logging, Debugging, and Troubleshooting**

■ **Chapter 6: Bionic API Primer**

■ **Chapter 7: Native Threads**

■ **Chapter 8: POSIX Socket API: Connection-Oriented Communication**

■ **Chapter 9: POSIX Socket API: Connectionless Communication**

■ **Chapter 10: POSIX Socket API: Local Communication**

■ **Chapter 11: C++ Support**

■ **Chapter 12: Native Graphics API**

■ **Chapter 13: Native Sound API**

■ **Chapter 14: Profiling and NEON Optimization**

**Index**

# Contents

---

[About the Author](#)

[About the Technical Reviewer](#)

[Preface](#)

## ■ [Chapter 1: Getting Started with C++ on Android](#)

[Microsoft Windows](#)

[Downloading and Installing the Java Development Kit on Windows](#)

[Downloading and Installing the Apache ANT on Windows](#)

[Downloading and Installing the Android SDK on Windows](#)

[Downloading and Installing the Cygwin on Windows](#)

[Downloading and Installing the Android NDK on Windows](#)

[Downloading and Installing the Eclipse on Windows](#)

[Apple Mac OS X](#)

[Installing Xcode on Mac](#)

[Validating the Java Development Kit on Mac](#)

[Validating the Apache ANT on Mac](#)

[Validating the GNU Make](#)

[Downloading and Installing the Android SDK on Mac](#)

[Downloading and Installing the Android NDK on Mac](#)

[Downloading and Installing the Eclipse on Mac](#)

[Ubuntu Linux](#)

[Checking the GNU C Library Version](#)

[Enabling the 32-Bit Support on 64-Bit Systems](#)

[Downloading and Installing the Java Development Kit on Linux](#)

[Downloading and Installing the Apache ANT on Linux](#)

[Downloading and Installing the GNU Make on Linux](#)

[Downloading and Installing the Android SDK on Linux](#)

[Downloading and Installing the Android NDK on Linux](#)

[Downloading and Installing the Eclipse on Linux](#)

[Downloading and Installing the ADT](#)

[Installing the Android Platform Packages](#)

[Configuring the Emulator](#)

[Summary](#)

## ■ Chapter 2: Exploring the Android NDK

---

Components Provided with the Android NDK

Structure of the Android NDK

Starting with an Example

- Specifying the Android NDK Location

- Importing the Sample Project

- Adding Native Support to Project

- Running the Project

- Building from the Command Line

- Examining the Structure of an Android NDK Project

Build System

- Android.mk

- Application.mk

Using the NDK-Build Script

Troubleshooting Build System Problems

Summary

## ■ Chapter 3: Communicating with Native Code using JNI

What is JNI?

Starting with an Example

- Declaration of Native Methods

- Loading the Shared Libraries

- Implementing the Native Methods

Data Types

- Primitive Types

- Reference Types

Operations on Reference Types

- String Operations

- Array Operations

- NIO Operations

- Accessing Fields

- Calling Methods

- Field and Method Descriptors

Exception Handling



Catching Exceptions

Throwing Exceptions

---

## Local and Global References

Local References

Global References

Weak Global References

## Threading

Synchronization

Native Threads

## Summary

# ■ Chapter 4: Auto-Generate JNI Code Using SWIG

## What is SWIG?

### Installation

Installing on Windows

Installing on Mac OS X

Installing on Ubuntu Linux

## Experimenting with SWIG Through an Example

Interface File

Invoking SWIG from Command Line

Integrating SWIG into Android Build Process

Updating the Activity

Executing the Application

Exploring Generated Code

## Wrapping C Code

Global Variables

Constants

Read-Only Variables

Enumerations

Structures

Pointers

## Wrapping C++ Code

Pointers, References, and Values

Default Arguments

Overloaded Functions

## Exception Handling

## Memory Management

## Calling Java from Native Code

- Asynchronous Communication

- Enabling Directors

- Enabling RTTI

- Overriding the Callback Method

- Updating the HelloJni Activity

## Summary

# ■ Chapter 5: Logging, Debugging, and Troubleshooting

## Logging

- Framework

- Native Logging APIs

- Controlled Logging

- Console Logging

## Debugging

- Prerequisites

- Debug Session Setup

- Setting up the Example for Debugging

- Starting the Debugger

## Troubleshooting

- Stack Trace Analysis

- Extended Checking of JNI

- Memory Issues

- Strace

## Summary

# ■ Chapter 6: Bionic API Primer

## Reviewing Standard Libraries

## Yet Another C Library?

- Binary Compatibility

- What is Provided?

- What is Missing?

## Memory Management

---

Memory Allocation

Dynamic Memory Management for C

Dynamic Memory Management for C++

## Standard File I/O

Standard Streams

Using the Stream I/O

Opening Streams

Writing to Streams

Reading from Streams

Seeking Position

Checking Errors

Closing Streams

## Interacting with Processes

Executing a Shell Command

Communicating with the Child Process

## System Configuration

Getting a System Property Value by Name

Getting a System Property by Name

## Users and Groups

Getting the Application User and Group IDs

Getting the Application User Name

## Inter-Process Communication

## Summary

## ■ Chapter 7: Native Threads

### Creating the Threads Example Project

Creating the Android Project

Adding the Native Support

Declaring the String Resources

Creating a Simple User Interface

Implementing the Main Activity

Generating the C/C++ Header File

Implementing the Native Functions

Updating the Android.mk Build Script

## Java Threads

---

Updating the Example Application to use Java Threads

Executing the Java Threads Example

Pros and Cons of using Java Threads for Native Code

## POSIX Threads

Using POSIX Threads in Native Code

Creating Threads using pthread\_create

Updating the Example Application to use POSIX Threads

Executing the POSIX Threads Example

## Return Result from POSIX Threads

Updating the Native Code to Use pthread\_join

## Synchronizing POSIX Threads

Synchronizing POSIX Threads using Mutexes

Synchronizing POSIX Threads Using Semaphores

## Priority and Scheduling Strategy for POSIX Threads

POSIX Thread Scheduling Strategy

POSIX Thread Priority

## Summary

# ■ Chapter 8: POSIX Socket API: Connection-Oriented Communication

## Echo Socket Example Application

Echo Android Application Project

Abstract Echo Activity

Echo Application String Resources

Native Echo Module

## Connection-Oriented Communication through TCP Sockets

Echo Server Activity Layout

Echo Server Activity

Implementing the Native TCP Server

Echo Client Activity Layout

Echo Client Activity

Implementing the Native TCP Client

Updating the Android Manifest

Running the TCP Sockets Example

## Summary

## ■ **Chapter 9: POSIX Socket API: Connectionless Communication**

---

Adding Native UDP Server Method to Echo Server Activity

Implementing the Native UDP Server

New UDP Socket: socket

Receive Datagram from Socket: recvfrom

Send Datagram to Socket: sendto

Native UDP Server Method

Adding Native UDP Client Method to Echo Client Activity

Implementing the Native UDP Client

Native UDP Client Method

Running the UDP Sockets Example

Interconnecting the Emulators for UDP

Starting the Echo UDP Client

Summary

## ■ **Chapter 10: POSIX Socket API: Local Communication**

Echo Local Activity Layout

Echo Local Activity

Implementing the Native Local Socket Server

New Local Socket: socket

Bind Local Socket to Name: bind

Accept on Local Socket: accept

Native Local Socket Server

Adding Local Echo Activity to Manifest

Running the Local Sockets Example

Asynchronous I/O

Summary

## ■ **Chapter 11: C++ Support**

Supported C++ Runtimes

GAbi++ C++ Runtime

STLport C++ Runtime

GNU STL C++ Runtime

# Specifying the C++ Runtime

---

Static vs. Shared Runtimes

C++ Exception Support

C++ RTTI Support

C++ Standard Library Primer

- Containers

- Iterators

- Algorithms

Thread Safety of C++ Runtime

C++ Runtime Debug Mode

- GNU STL Debug Mode

- STLport Debug Mode

Summary

## ■ Chapter 12: Native Graphics API

Availability of Native Graphics API

Creating an AVI Video Player

- Make AVILib a NDK Import Module

- Create the AVI Player Android Application

- Create the AVI Player Main Activity

- Creating the Abstract Player Activity

Rendering using JNI Graphics API

- Enabling the JNI Graphics API

- Using the JNI Graphics API

- Updating AVI Player with Bitmap Renderer

- Running the AVI Player with Bitmap Renderer

Rendering Using OpenGL ES

- Using the OpenGL ES API

- Enabling OpenGL ES 1.x API

- Enabling OpenGL ES 2.0 API

- Updating AVI Player with OpenGL ES Renderer

Rendering Using Native Window API

- Enabling the Native Window API

- Using the Native Window API

## Summary

### ■ Chapter 13: Native Sound API

#### Using the OpenSL ES API

Compatibility with the OpenSL ES Standard

Audio Permissions

#### Creating the WAVE Audio Player

Make WAVELib a NDK Import Module

Create the WAVE Player Android Application

Creating the WAVE Player Main Activity

Implementing WAVE Audio Playback

#### Running the WAVE Audio Player

## Summary

### ■ Chapter 14: Profiling and NEON Optimization

#### GNU Profiler for Measuring Performance

Installing the Android NDK Profiler

Enabling the Android NDK Profiler

Analyzing gmon.out using GNU Profiler

#### Optimization using ARM NEON Intrinsics

Overview of ARM NEON Technology

Adding a Brightness Filter to AVI Player

Enabling the Android NDK Profiler for AVI Player

Profiling the AVI Player

Optimizing the Brightness Filter using NEON Intrinsics

#### Automatic Vectorization

Enabling Automatic Vectorization

Troubleshooting Automatic Vectorization

## Summary

## Index

# About the Author

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**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

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**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 global-scale 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

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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.

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

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](http://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 Windows

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](http://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](#).

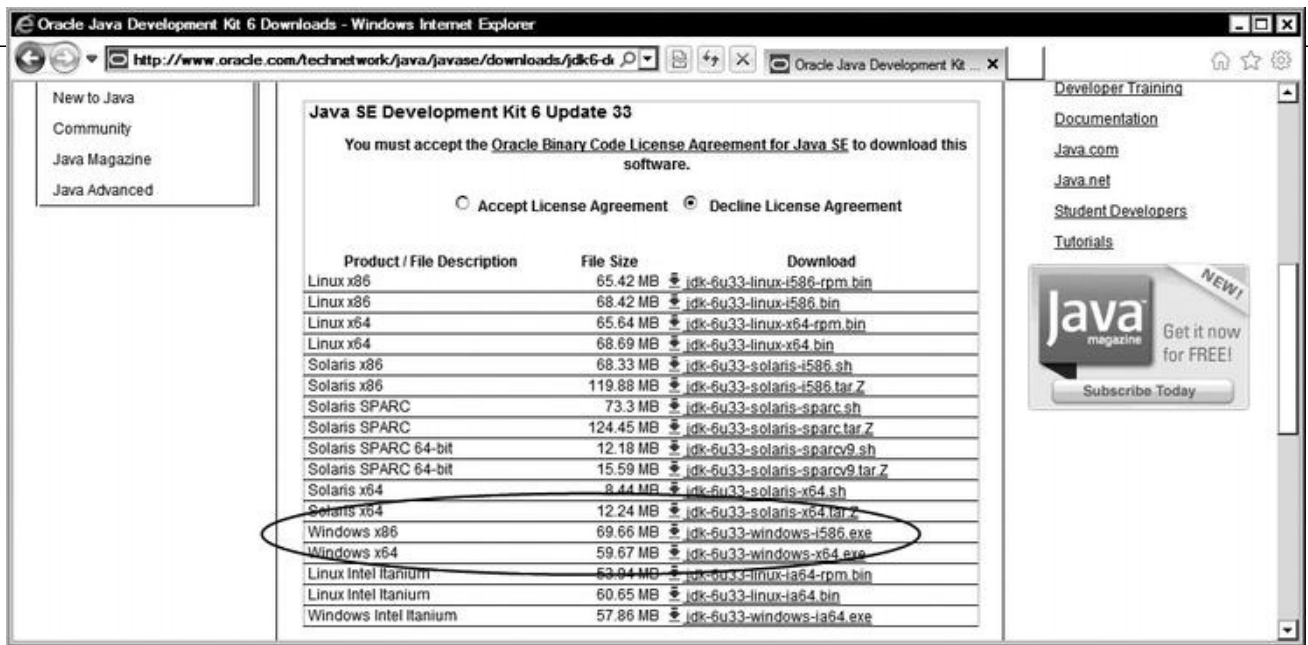


Figure 1-2 . Download Oracle JDK 6 for Windows x86

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.

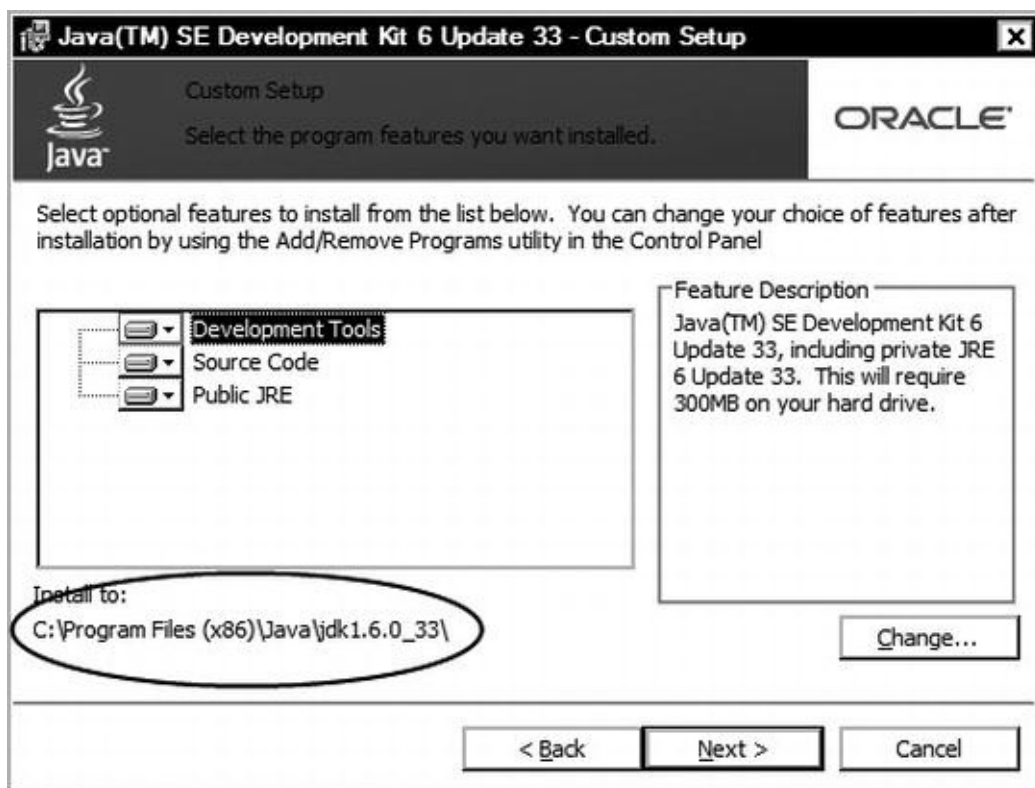
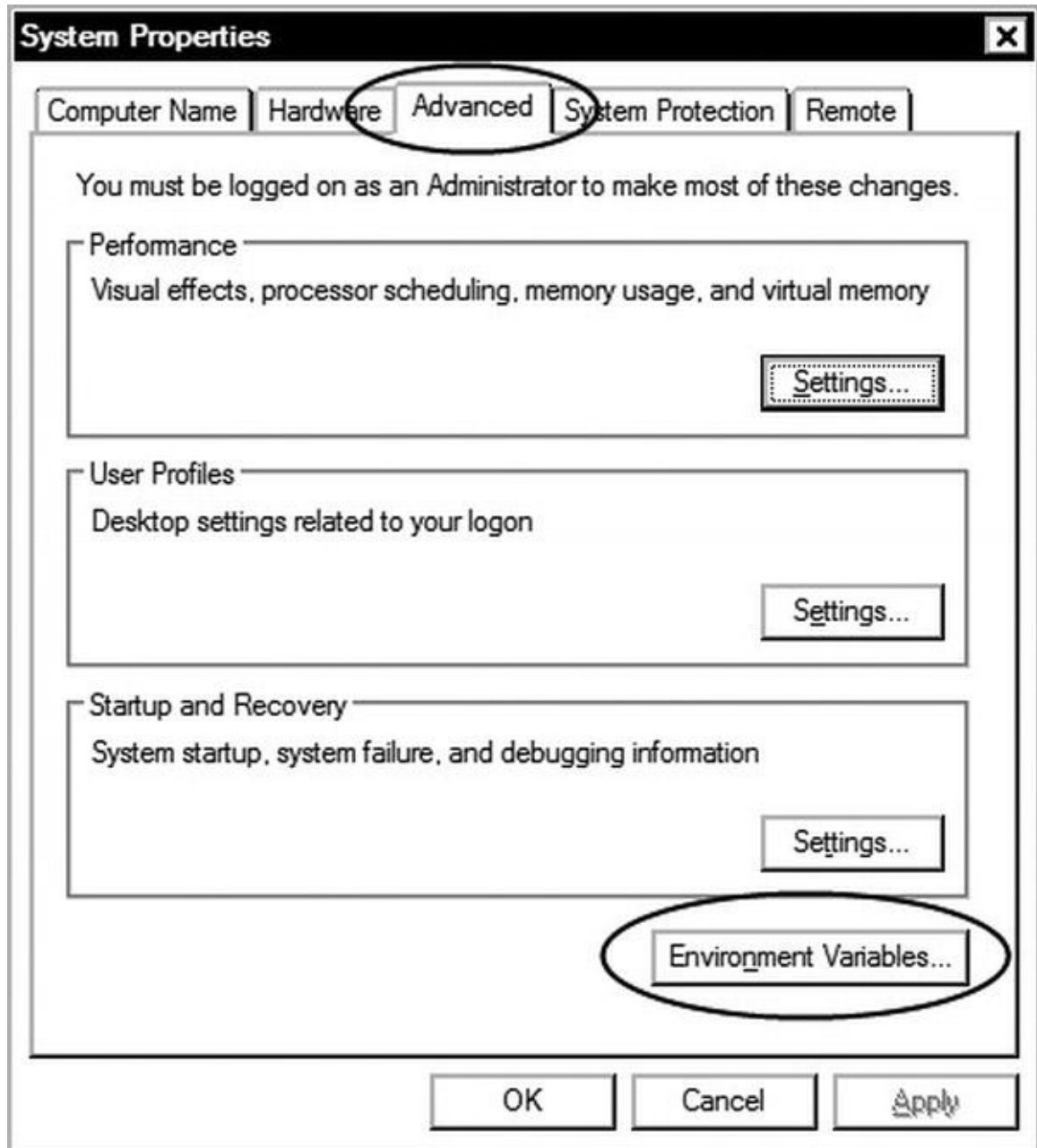


Figure 1-3 . Oracle JDK 6 installation directory

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](#).

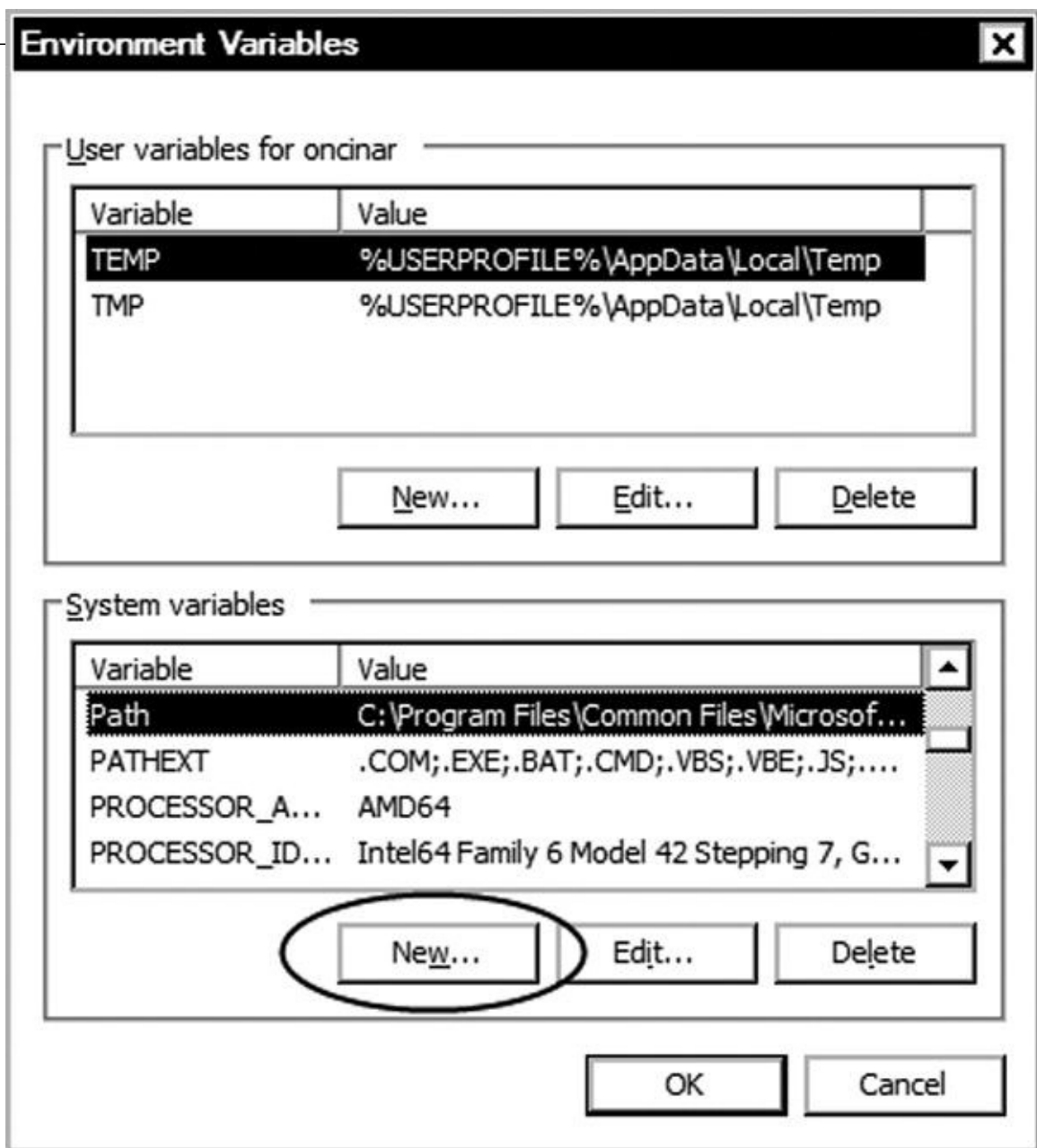


Figure 1-5 . Environment Variables dialog

- 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.
- Click OK button to save the environment variable.

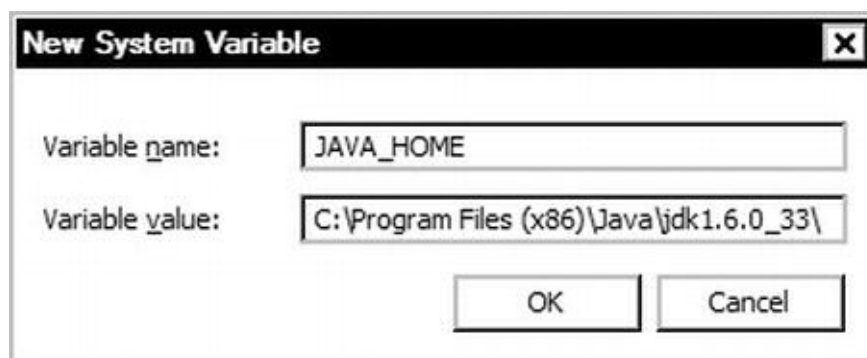
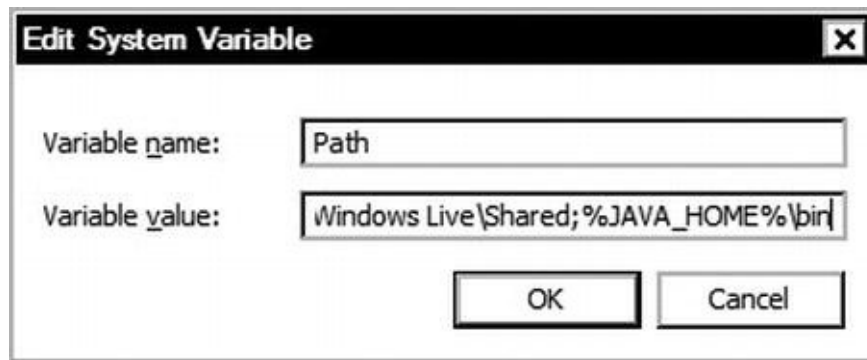


Figure 1-6 . New `JAVA_HOME` environment variable



- 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:



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