

Java Programming Language, Java SE 6

Student Guide

SL-275-SE6 G.2

D61748GC11

Edition 1.1

June 2010

D67981

ORACLE®

Copyright © 2009, 2010, Oracle and/or its affiliates. All rights reserved.

Disclaimer

This document contains proprietary information, is provided under a license agreement containing restrictions on use and disclosure, and is protected by copyright and other intellectual property laws. You may copy and print this document solely for your own use in an Oracle training course. The document may not be modified or altered in any way. Except as expressly permitted in your license agreement or allowed by law, you may not use, share, download, upload, copy, print, display, perform, reproduce, publish, license, post, transmit, or distribute this document in whole or in part without the express authorization of Oracle.

The information contained in this document is subject to change without notice. If you find any problems in the document, please report them in writing to: Oracle University, 500 Oracle Parkway, Redwood Shores, California 94065 USA. This document is not warranted to be error-free.

Sun Microsystems, Inc. Disclaimer

This training manual may include references to materials, offerings, or products that were previously offered by Sun Microsystems, Inc. Certain materials, offerings, services, or products may no longer be offered or provided. Oracle and its affiliates cannot be held responsible for any such references should they appear in the text provided.

Restricted Rights Notice

If this documentation is delivered to the U.S. Government or anyone using the documentation on behalf of the U.S. Government, the following notice is applicable:

U.S. GOVERNMENT RIGHTS

The U.S. Government's rights to use, modify, reproduce, release, perform, display, or disclose these training materials are restricted by the terms of the applicable Oracle license agreement and/or the applicable U.S. Government contract.

Trademark Notice

Oracle and Java are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

AMD, Opteron, the AMD logo, and the AMD Opteron logo are trademarks or registered trademarks of Advanced Micro Devices. Intel and Intel Xeon are trademarks or registered trademarks of Intel Corporation. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. UNIX is a registered trademark licensed through X/Open Company, Ltd.

This page intentionally left blank.

This page intentionally left blank.

Table of Contents

About This Course	Preface-xv
Course Goals.....	Preface-xv
Course Overview	Preface-xvii
Course Map.....	Preface-xviii
Module-by-Module Overview	Preface-xix
Course Objectives.....	Preface-xxi
Topics Not Covered.....	Preface-xxii
How Prepared Are You?.....	Preface-xxiii
Introductions	Preface-xxiv
How to Use Course Materials	Preface-xxv
Typographical Conventions and Symbols	Preface-xxvi
Icons	Preface-xxvi
Typographical Conventions	Preface-xxvii
Additional Conventions.....	Preface-xxviii
Getting Started.....	1-1
Objectives	1-1
Relevance.....	1-2
Additional Resources	1-3
What Is the Java™ Technology?	1-4
Primary Goals of the Java Technology	1-5
The Java Virtual Machine	1-6
Garbage Collection	1-7
The Java Runtime Environment.....	1-8
JVM™ Tasks.....	1-10
The Class Loader.....	1-10
The Bytecode Verifier	1-11
A Simple Java Application.....	1-12
The TestGreeting Application	1-13
The Greeting Class.....	1-15
Compiling and Running the TestGreeting Program.....	1-16
Troubleshooting the Compilation	1-17

Object-Oriented Programming	2-1
Objectives	2-1
Relevance.....	2-2
Software Engineering	2-3
The Analysis and Design Phase.....	2-5
Analysis and Design Example	2-6
Abstraction.....	2-7
Classes as Blueprints for Objects	2-7
Declaring Java Technology Classes.....	2-8
Declaring Attributes	2-9
Declaring Methods.....	2-10
Example	2-11
Accessing Object Members.....	2-12
Information Hiding.....	2-13
Encapsulation	2-15
Declaring Constructors	2-16
The Default Constructor	2-17
Source File Layout	2-18
Software Packages	2-19
The package Statement.....	2-20
The import Statement.....	2-21
Directory Layout and Packages	2-23
Development	2-24
Compiling Using the -d Option	2-24
Deployment	2-25
Terminology Recap.....	2-26
Using the Java Technology API Documentation.....	2-27
Identifiers, Keywords, and Types.....	3-1
Objectives	3-1
Relevance.....	3-2
Comments	3-3
Semicolons, Blocks, and White Space	3-4
Identifiers	3-6
Java Programming Language Keywords	3-7
Basic Java Programming Language Types.....	3-8
Primitive Types	3-8
Logical – boolean.....	3-8
Textual – char	3-9
Textual – String.....	3-9
Integral – byte, short, int, and long.....	3-10
Floating Point – float and double.....	3-11
Variables, Declarations, and Assignments.....	3-12
Java Reference Types.....	3-13

Constructing and Initializing Objects	3-14
Memory Allocation and Layout.....	3-15
Explicit Attribute Initialization	3-15
Executing the Constructor	3-16
Assigning a Variable.....	3-16
This Is Not the Whole Story	3-16
Assigning References.....	3-17
Pass-by-Value	3-18
The <code>this</code> Reference.....	3-20
Java Programming Language Coding Conventions.....	3-21
Expressions and Flow Control.....	4-1
Objectives	4-1
Relevance.....	4-2
Variables.....	4-3
Variables and Scope.....	4-3
Variable Initialization.....	4-5
Initialization Before Use Principle	4-6
Operators.....	4-7
Operator Precedence	4-7
Logical Operators.....	4-8
Bitwise Logical Operators.....	4-9
Right-Shift Operators <code>>></code> and <code>>>></code>	4-10
Left-Shift Operator <code><<</code>	4-10
Shift Operator Examples	4-11
String Concatenation With <code>+</code>	4-12
Casting.....	4-12
Promotion and Casting of Expressions.....	4-13
Branching Statements.....	4-14
Simple <code>if</code> , <code>else</code> Statements.....	4-14
Complex <code>if</code> , <code>else</code> Statements.....	4-14
The <code>switch</code> Statement.....	4-16
Looping Statements	4-18
The <code>for</code> Loops	4-18
The <code>while</code> Loop.....	4-18
The <code>do/while</code> Loop.....	4-19
Special Loop Flow Control	4-19
Arrays	5-1
Objectives	5-1
Relevance.....	5-2
Declaring Arrays	5-3
Creating Arrays.....	5-4
Creating Reference Arrays.....	5-5
Initializing Arrays.....	5-6
Multidimensional Arrays.....	5-7
Array Bounds	5-8
Using the Enhanced <code>for</code> Loop	5-8
Array Resizing.....	5-9
Copying Arrays.....	5-10

Class Design	6-1
Objectives	6-1
Relevance.....	6-2
Subclassing.....	6-3
Single Inheritance.....	6-4
Access Control	6-6
Overriding Methods	6-7
Overridden Methods Cannot Be Less Accessible.....	6-8
Invoking Overridden Methods	6-9
Polymorphism	6-10
Virtual Method Invocation	6-10
Heterogeneous Collections.....	6-11
Polymorphic Arguments	6-12
The instanceof Operator.....	6-13
Casting Objects.....	6-14
Overloading Methods	6-15
Methods Using Variable Arguments	6-16
Overloading Constructors	6-17
Constructors Are Not Inherited.....	6-18
Invoking Parent Class Constructors.....	6-18
Constructing and Initializing Objects: A Slight Reprise.....	6-20
Constructor and Initialization Examples.....	6-20
The Object Class	6-22
The equals Method.....	6-22
The toString Method	6-24
Wrapper Classes.....	6-26
Autoboxing of Primitive Types.....	6-27
Advanced Class Features	7-1
Objectives	7-1
Relevance.....	7-2
The static Keyword.....	7-3
Class Attributes	7-3
Class Methods	7-4
Static Initializers	7-6
The final Keyword	7-7
Final Classes.....	7-7
Final Methods.....	7-7
Final Variables.....	7-7
Enumerated Types.....	7-9
Old-Style Enumerated Type Idiom	7-10
The New Enumerated Type	7-13
Advanced Enumerated Types.....	7-16
Static Imports.....	7-18
Abstract Classes.....	7-19
The Problem.....	7-20
The Solution	7-21

Interfaces	7-23
The Flyer Example	7-24
Multiple Interface Example	7-28
Uses of Interfaces	7-29
Exceptions and Assertions	8-1
Objectives	8-1
Relevance.....	8-2
Exceptions and Assertions.....	8-3
Exceptions	8-4
Exception Example	8-5
The try-catch Statement	8-6
Call Stack Mechanism	8-8
The finally Clause	8-9
Exception Categories	8-10
Common Exceptions.....	8-12
The Handle or Declare Rule	8-13
Method Overriding and Exceptions.....	8-15
Creating Your Own Exceptions	8-16
Throwing a User-Defined Exception	8-17
Handling a User-Defined Exception	8-18
Assertions.....	8-19
Recommended Uses of Assertions	8-19
Controlling Runtime Evaluation of Assertions	8-22
Collections and Generics Framework	9-1
Objectives	9-1
Additional Resources	9-2
The Collections API	9-3
Collection Implementations	9-5
A Set Example	9-5
A List Example	9-6
The Map Interface.....	9-8
A Map example.....	9-9
Legacy Collection Classes.....	9-10
Ordering Collections	9-11
The Comparable Interface	9-11
The Comparator Interface	9-13
Generics	9-17
Generic Set Example.....	9-18
Generic Map Example	9-19
Generics: Examining Type Parameters.....	9-20
Wild Card Type Parameters	9-22
Generics: Refactoring Existing Non-Generic Code	9-25
Iterators.....	9-27
The Enhanced for Loop	9-29

I/O Fundamentals	10-1
Objectives	10-1
Additional Resources	10-2
Command-Line Arguments	10-3
System Properties.....	10-4
The Properties Class	10-5
I/O Stream Fundamentals.....	10-6
Data Within Streams.....	10-6
Byte Streams	10-7
The InputStream Methods.....	10-7
The OutputStream Methods.....	10-8
Character Streams	10-9
The Reader Methods.....	10-9
The Writer Methods.....	10-10
Node Streams.....	10-11
A Simple Example.....	10-11
Buffered Streams	10-13
I/O Stream Chaining.....	10-14
Processing Streams	10-15
Basic Byte Stream Classes	10-16
The FileInputStream and FileOutputStream Classes	10-17
The BufferedInputStream and BufferedOutputStream Classes	10-17
The PipedInputStream and PipedOutputStream Classes	10-17
The DataInputStream and DataOutputStream Classes	10-17
The ObjectInputStream and ObjectOutputStream Classes	10-18
Serialization	10-21
Serialization and Object Graphs	10-21
Writing and Reading an Object Stream	10-22
Basic Character Stream Classes.....	10-25
The InputStreamReader and OutputStreamWriter Methods.....	10-26
Byte and Character Conversions	10-26
Using Other Character Encoding	10-26
The FileReader and FileWriter Classes.....	10-27
The BufferedReader and BufferedWriter Classes	10-27
The StringReader and StringWriter Classes	10-27
The PipedReader and PipedWriter Classes.....	10-27

Console I/ O and File I/O	11-1
Objectives	11-1
Additional Resources	11-2
Console I/O	11-3
Writing to Standard Output	11-3
Reading From Standard Input	11-4
Simple Formatted Output.....	11-6
Simple Formatted Input.....	11-7
Files and File I/O	11-8
Creating a New File Object	11-8
The File Tests and Utilities	11-9
File Stream I/O.....	11-10
Building Java GUIs Using the Swing API.....	12-1
Objectives	12-1
Additional Resources	12-2
Pluggable Look-and-Feel	12-4
Swing Architecture	12-5
Swing Packages	12-7
Examining the Composition of a Java Technology GUI	12-9
Swing Containers.....	12-11
Top-level Containers	12-11
Swing Components.....	12-12
The Swing Component Hierarchy.....	12-13
Properties of Swing Components.....	12-14
Common Component Properties.....	12-14
Component-Specific Properties	12-15
Layout Managers	12-16
The BorderLayout Layout Manager	12-16
The FlowLayout Layout Manager	12-18
The BoxLayout Layout Manager.....	12-19
The CardLayout Layout Manager	12-20
The GridLayout Layout Manager	12-21
The GridBagLayout Layout Manager.....	12-22
The GroupLayout Layout Manager	12-23
GUI Construction.....	12-24
Programmatic Construction	12-24
Handling GUI-Generated Events	13-1
Objectives	13-1
Additional Resources	13-2
What Is an Event?	13-3
Java SE Event Model.....	13-4
Delegation Model.....	13-4
A Listener Example.....	13-5
GUI Behavior	13-7
Event Categories	13-7
Complex Example.....	13-9

Multiple Listeners	13-12
Developing Event Listeners.....	13-13
Event Adapters.....	13-13
Event Handling Using Inner Classes	13-14
Event Handling Using Anonymous Classes.....	13-15
Concurrency in Swing.....	13-17
GUI-Based Applications	14-1
Objectives	14-1
Relevance.....	14-2
How to Create a Menu	14-3
Creating a JMenuBar.....	14-4
Creating a JMenu	14-5
Creating a JMenuItem	14-5
Creating a JCheckboxMenuItem.....	14-6
Controlling Visual Aspects.....	14-8
Colors.....	14-8
Threads	15-1
Objectives	15-1
Relevance.....	15-2
Threads	15-3
Creating the Thread.....	15-4
Starting the Thread	15-5
Thread Scheduling.....	15-6
Terminating a Thread.....	15-8
Basic Control of Threads.....	15-10
Testing Threads.....	15-10
Accessing Thread Priority	15-10
Putting Threads on Hold	15-10
Other Ways to Create Threads.....	15-13
Selecting a Way to Create Threads.....	15-14
Using the synchronized Keyword	15-15
The Problem.....	15-15
The Object Lock Flag.....	15-17
Releasing the Lock Flag.....	15-19
Using synchronized – Putting It Together	15-20
Thread States	15-21
Deadlock.....	15-21
Thread Interaction – wait and notify.....	15-22
Scenario	15-22
The Problem.....	15-22
The Solution.....	15-22
Thread Interaction.....	15-23
The wait and notify Methods	15-23
Thread States	15-24
Monitor Model for Synchronization	15-25

Putting It Together.....	15-26
The Producer Thread	15-27
The Consumer Thread	15-28
The SyncStack Class.....	15-29
The SyncTest Example.....	15-32
Networking.....	16-1
Objectives	16-1
Relevance.....	16-2
Networking.....	16-3
Sockets	16-3
Setting Up the Connection.....	16-3
Addressing the Connection	16-5
Port Numbers	16-5
Java Networking Model.....	16-6
Minimal TCP/IP Server	16-7
Minimal TCP/IP Client.....	16-8
Elements of Advanced Java Programming.....	A-1
Objectives	A-1
Introduction to Two-Tier and Three-Tier Architectures	A-2
Three-Tier Architecture.....	A-3
Three-Tier Client-Server Definition	A-3
A Database Front End	A-4
Introduction to the JDBC™ API.....	A-6
JDBC, An Overview.....	A-6
JDBC Drivers.....	A-7
The JDBC-ODBC Bridge	A-7
Distributed Computing.....	A-8
RMI.....	A-9
RMI Architecture.....	A-9
Creating an RMI Application	A-10
CORBA	A-11
The Java IDL	A-11
RMI Compared With CORBA.....	A-12
The JavaBeans™ Component Model	A-14
Bean Architecture.....	A-14
Bean Introspection	A-16
A Sample Bean Interaction	A-17
The Beans Development Kit (BDK)	A-17
JAR Files	A-18
Using the javadoc Tool.....	A-19
Documentation Tags.....	A-19
Example	A-20
Quick Reference for UML.....	B-1
Objectives	B-1
Additional Resources	B-2
UML Fundamentals.....	B-3

General Elements	B-6
Packages	B-6
Stereotypes	B-8
Annotation	B-8
Constraints	B-9
Tagged Values	B-9
Use Case Diagrams	B-10
Class Diagrams	B-11
Class Nodes	B-11
Inheritance	B-14
Interface Implementation	B-15
Association, Roles, and Multiplicity	B-16
Aggregation and Composition	B-18
Association Classes	B-19
Other Association Elements	B-21
Object Diagrams	B-22
Collaboration Diagrams	B-24
Sequence Diagrams	B-26
Statechart Diagrams	B-28
Transitions	B-29
Activity Diagrams	B-30
Component Diagrams	B-34
Deployment Diagrams	B-36
Swing Components	C-1
Objectives	C-1
Swing Component Examples	C-2
Top Level Containers	C-3
General-purpose Containers	C-4
Special-Purpose Containers	C-6
Buttons	C-8
Text Components	C-10
Uneditable Information Display Components	C-12
Menus	C-13
Formatted Display Components	C-14
Other Basic Controls	C-16