

# **Java Performance Tuning and Optimization**

**Activity Guide**

D69518GC10

Edition 1.0

June 2011

D73451

**ORACLE®**

**Copyright © 2011, Oracle and/or its affiliates. All rights reserved.**

#### **Disclaimer**

This document contains proprietary information 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 where your use constitutes "fair use" under copyright 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.

#### **Restricted Rights Notice**

If this documentation is delivered to the United States Government or anyone using the documentation on behalf of the United States 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.

#### **Authors**

Clarence Tauro, Michael Williams

#### **Technical Contributors and Reviewers**

Charlie Hunt, Staffan Friberg

**This book was published using: Oracle Tutor**

# Table of Contents

---

<b>Practices for Lesson 1: Introduction</b> .....	<b>1-1</b>
Practices for Lesson 1: Overview.....	1-2
<b>Practices for Lesson 2: Java Virtual Machine and Performance Overview</b> .....	<b>2-1</b>
Practices for Lesson 2: Overview.....	2-2
Practice 2-1: Log In to Solaris.....	2-3
Practice 2-2: Open Terminal Windows in Solaris .....	2-4
Practice 2-3: Open a Text File in Solaris .....	2-5
Practice 2-4: Start NetBeans and Open a Project.....	2-6
<b>Practices for Lesson 3: Monitoring Operating System Performance</b> .....	<b>3-1</b>
Practices for Lesson 3: Overview.....	3-2
Practice 3-1: Using the prstat Utility .....	3-3
<b>Practices for Lesson 4: Monitoring the JVM</b> .....	<b>4-1</b>
Practices for Lesson 4: Overview.....	4-2
Practice 4-0: Setting up VisualVM and VisualGC.....	4-3
Practice 4-1: Examining Garbage Collection Basics .....	4-5
Practice 4-2: Examining the Permanent Generation .....	4-6
Practice 4-3: Using <code>-verbose:gc</code> .....	4-7
Practice 4-4: Using <code>-XX:+PrintGCDetails</code> .....	4-9
Practice 4-5: Obtaining Application Stopped Time.....	4-11
Practice 4-6: Using <code>jstat</code> to Monitor GC .....	4-13
Practice 4-7: Monitoring a Remote Application (Optional) .....	4-15
Practice 4-8: Using <code>jconsole</code> .....	4-17
Practice 4-9: Examining VisualVM Capabilities.....	4-19
Practice 4-10: Examining VisualGC Capabilities.....	4-21
Practice 4-11: Examining JIT Compilation Activity .....	4-26
<b>Practices for Lesson 5: Performance Profiling</b> .....	<b>5-1</b>
Practices for Lesson 5: Overview.....	5-2
Practice 5-1: Application Profiling Using NetBeans Profiler .....	5-3
Practice 5-2: Profiling root Methods .....	5-6
Practice 5-3: Exploring Thread State with NetBeans Profiler .....	5-8
Practice 5-4: Modifying the NetBeans Profiler Session .....	5-9
Practice 5-5: Attaching the Profiler to Another JVM .....	5-10
Practice 5-6: Profiling a Web Application with NetBeans Profiler .....	5-11
Practice 5-7: Profiling an Application by Using Oracle Studio.....	5-13
Practice 5-8: Profiling Heap Memory with <code>jmap</code> and <code>jhat</code> .....	5-17
Practice 5-9: Profiling with NetBeans and Oracle Studio.....	5-19
Practice 5-10: Performing Memory Leak Profiling.....	5-21
Practice 5-11: Using <code>jhat</code> to Detect Memory Leaks .....	5-25
Practice 5-12: Profiling Memory Leaks with VisualVM.....	5-27
Practice 5-13: Profiling with NetBeans Profiler's HeapWalker .....	5-29
Practice 5-14: Finding Lock Contention.....	5-32
<b>Practices for Lesson 6: Garbage Collection Schemes</b> .....	<b>6-1</b>
Practices for Lesson 6: Overview.....	6-2
Practice 6-1: Discovering Ergonomic Selections.....	6-3

<b>Practices for Lesson 7: Garbage Collection Tuning .....</b>	<b>7-1</b>
Practices for Lesson 7: Overview.....	7-2
Practice 7-1: Using JVM Heap Sizing.....	7-3
Practice 7-2: Using the PrintGCStats Script .....	7-5
Practice 7-3: Using GCHisto.....	7-7
<b>Practices for Lesson 8: Language-Level Concerns and Garbage Collection.....</b>	<b>8-1</b>
Practices for Lesson 8: Overview.....	8-2
<b>Practices for Lesson 9: Performance Tuning at the Language Level.....</b>	<b>9-1</b>
Practices for Lesson 9: Overview.....	9-3
Practice 9-1: Testing Performance of String/StringBuffer/StringBuilder.....	9-4
Practice 9-2: Performance Testing of Exceptions .....	9-6
Practice 9-3: Performance Benchmarking of Collection Classes .....	9-8
Practice 9-4: Benchmarking of Primitives vs. Object Types.....	9-10
Practice 9-5: Benchmarking File Classes .....	9-12