03: jvisualvm to debug deadlocks in Java applications

Posted on June 23, 2015 by Arulkumaran Kumaraswamipillai

This extends JConsole for debugging deadlocks in Java applications, using jvisualvm that gets shipped with your JDK.

Step 1: Java code that creates a **dead lock** situation by

a) thread-0 holding on to lock1 and waiting for the lock2,

b) and thread-1 holding on to lock2 and waiting for the lock1.

```
package com.debug.multithread;

public class DeadLockTest extends Thread {

    public static Object lock1 = new Object();
    public static Object lock2 = new Object();

    public void method1() {
        synchronized (lock1) {
            delay(500);  //some operation
            System.out.println("method1: " + Thr
            synchronized (lock2) {
                System.out.println("method1 is e
            }
        }
    }

    public void method2() {
        synchronized (lock2) {
            delay(500);   //some operation
            System.out.println("method1: " + Thr
            synchronized (lock1) {
                System.out.println("method2 is e
            }
        }
    }

    @Override
    public void run() {
        method1();
        method2();
    }

    /**
     * main metghod runs on a main thread
     * @param args
     */
    public static void main(String[] args) {
        DeadLockTest thread1 = new DeadLockTest(
        DeadLockTest thread2 = new DeadLockTest(

        thread1.start();
        thread2.start();
    }

    /**
     * The delay is to simulate some real operat
     * @param timeInMillis
     */
    private void delay(long timeInMillis) {
        try {
            Thread.sleep(timeInMillis);
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
    }

}
```

Step 2: From a DOS command prompt use "**jps**" to list the java process ids. This command is in %JAVA_HOME%/bin

```
C:\>jps

9460 DeadLockTest
1952 Jps
8148
```

Step 3: Process id "9460" is the "DeadLockTest". So, let's open **jvisualvm** that is shipped with Java in %JAVA_HOME%/bin.

16 Technical Key Areas

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- ⊞ Coding (26)
- ⊞ Concurrency (6)
- ⊞ Design Concepts (7)
- ⊞ Design Patterns (11)
- ⊞ Exception Handling (
- ⊞ Java Debugging (21)
- ⊞ Judging Experience I
- ⊞ Low Latency (7)
- ⊞ Memory Managemen
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- ⊞ QoS (8)
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- ⊞ Tools Tutorials (19)
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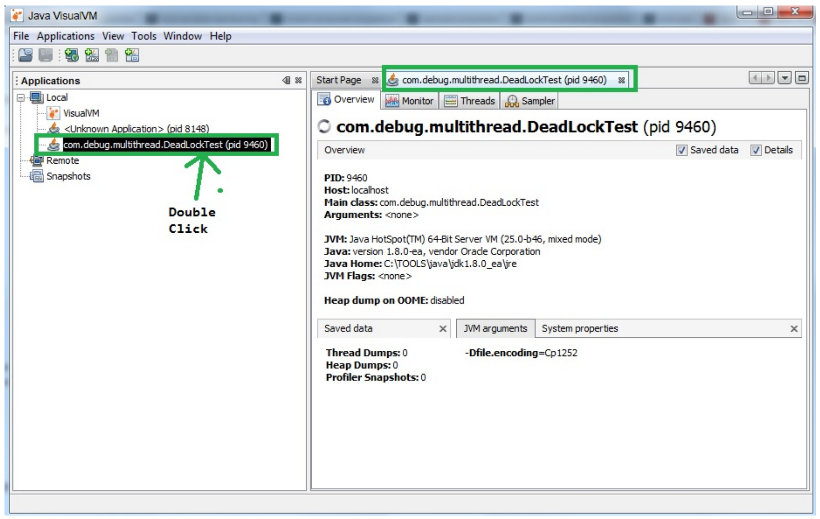
```
C:\>jvisualvm 9460
```

Step 4: jvisualvm shows where the problem is:

Double click on **DeadLockTest**.



com.debug.multithread.DeadLockTest (pid 9460)

PID: 9460
Host: localhost
Main class: com.debug.multithread.DeadLockTest
Arguments: <none>

JVM: Java HotSpot(TM) 64-Bit Server VM (25.0-b46, mixed mode)
Java: version 1.8.0-ea, vendor Oracle Corporation
Java Home: C:\TOOLS\java\jdk1.8.0_ea\jre
JVM Flags: <none>

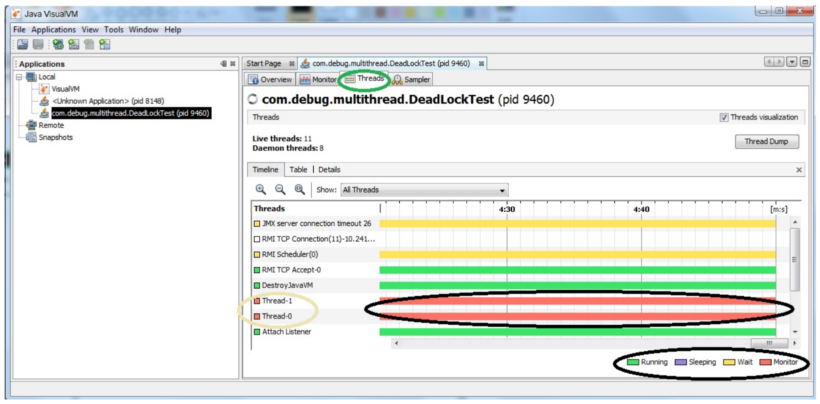
Heap dump on OOME: disabled

Thread Dumps: 0
Heap Dumps: 0
Profiler Snapshots: 0

-Dfile.encoding=Cp1252

jvisualvm

Thread states are color coded, and we are interested in the "Blocked" states, which are red in color.



com.debug.multithread.DeadLockTest (pid 9460)

Live threads: 11
Daemon threads: 8

Threads
- 🟨 JMX server connection timeout 26
- ☐ RMI TCP Connection(11)-10.241...
- 🟨 RMI Scheduler(0)
- 🟩 RMI TCP Accept-0
- 🟩 DestroyJavaVM
- 🟥 Thread-1
- 🟥 Thread-0
- 🟩 Attach Listener

jvisualvm color codes the thread states

How long is the monitor being held for?

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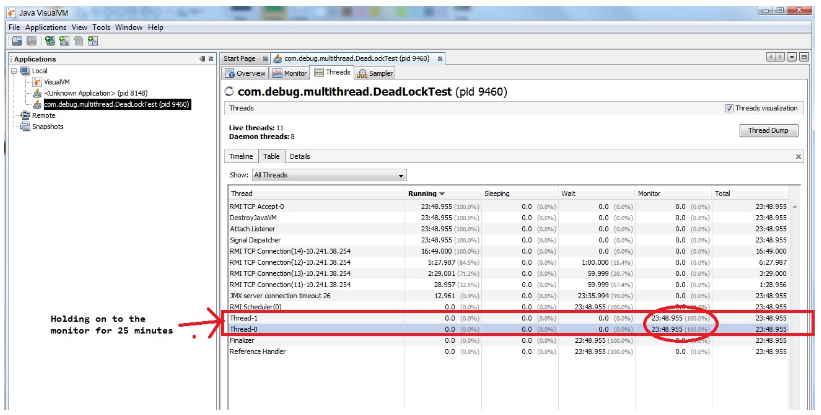

Java VisualVM
File Applications View Tools Window Help
Applications
Local
VisualVM
<Unknown Application> (pid 8148)
com.debug.multithread.DeadLockTest (pid 9460)
Remote
Snapshots
Start Page
Overview
Monitor
Threads
Sampler
Threads visualization
Thread Dump
Timeline
Table
Details
Holding on to the monitor for 25 minutes

com.debug.multithread.DeadLockTest (pid 9460)

Threads

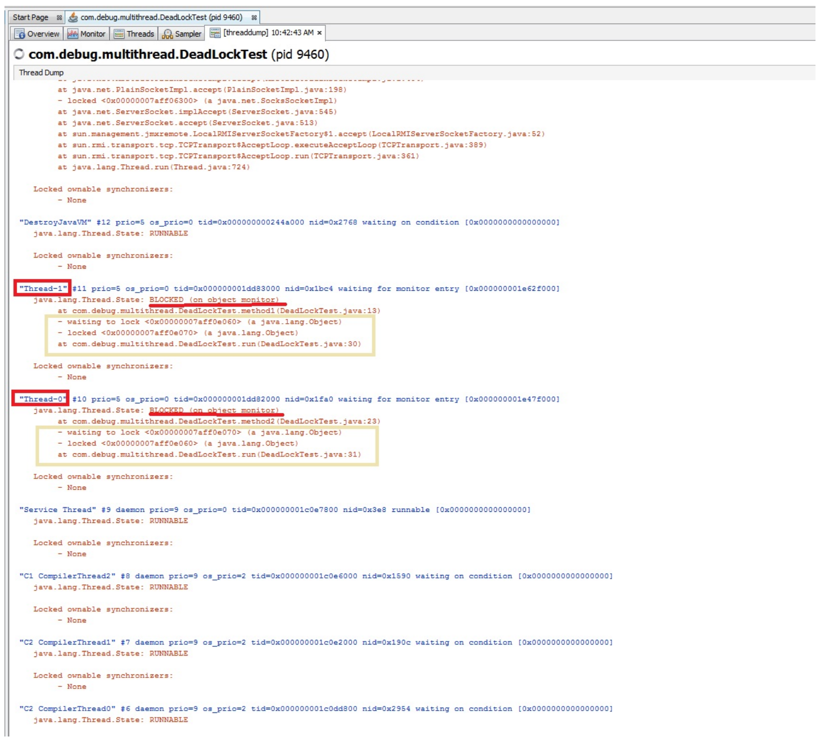
Live threads: 11
Daemon threads: 8

Show: All Threads

Thread	Running	Sleeping	Wait	Monitor	Total
RMI TCP Accept-0	23:48.955 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	23:48.955
DestroyJavaVM	23:48.955 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	23:48.955
Attach Listener	23:48.955 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	23:48.955
Signal Dispatcher	23:48.955 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	23:48.955
RMI TCP Connection(14)-10.241.38.254	16:49.000 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	16:49.000
RMI TCP Connection(12)-10.241.38.254	5:27.987 (84.5%)	0.0 (0.0%)	1:00.000 (15.4%)	0.0 (0.0%)	6:27.987
RMI TCP Connection(13)-10.241.38.254	2:29.001 (71.2%)	0.0 (0.0%)	59.999 (28.7%)	0.0 (0.0%)	3:29.000
RMI TCP Connection(11)-10.241.38.254	28.957 (32.5%)	0.0 (0.0%)	59.999 (67.4%)	0.0 (0.0%)	1:28.956
JMX server connection timeout 26	12.961 (0.9%)	0.0 (0.0%)	23:35.994 (99.0%)	0.0 (0.0%)	23:48.955
RMI Scheduler(0)	0.0 (0.0%)	0.0 (0.0%)	23:48.955 (100.0%)	0.0 (0.0%)	23:48.955
Thread-1	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	23:48.955 (100.0%)	23:48.955
Thread-0	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	23:48.955 (100.0%)	23:48.955
Finalizer	0.0 (0.0%)	0.0 (0.0%)	23:48.955 (100.0%)	0.0 (0.0%)	23:48.955
Reference Handler	0.0 (0.0%)	0.0 (0.0%)	23:48.955 (100.0%)	0.0 (0.0%)	23:48.955

jvisualvm the monitor (i.e. lock) has been held for a long time

Click the button “**Thread Dump**” to get more details



com.debug.multithread.DeadLockTest (pid 9460)

Thread Dump

```
        at java.net.PlainSocketImpl.accept(PlainSocketImpl.java:198)
        - locked <0x00000007aff06300> (a java.net.SocksSocketImpl)
        at java.net.ServerSocket.implAccept(ServerSocket.java:545)
        at java.net.ServerSocket.accept(ServerSocket.java:513)
        at sun.management.jmxremote.LocalRMIServerSocketFactory$1.accept(LocalRMIServerSocketFactory.java:52)
        at sun.rmi.transport.tcp.TCPTransport$AcceptLoop.executeAcceptLoop(TCPTransport.java:389)
        at sun.rmi.transport.tcp.TCPTransport$AcceptLoop.run(TCPTransport.java:361)
        at java.lang.Thread.run(Thread.java:724)

   Locked ownable synchronizers:
        - None

"DestroyJavaVM" #12 prio=5 os_prio=0 tid=0x000000000244a000 nid=0x2768 waiting on condition [0x0000000000000000]
   java.lang.Thread.State: RUNNABLE

   Locked ownable synchronizers:
        - None

"Thread-1" #11 prio=5 os_prio=0 tid=0x000000001dd83000 nid=0x1bc4 waiting for monitor entry [0x000000001e62f000]
   java.lang.Thread.State: BLOCKED (on object monitor)
        at com.debug.multithread.DeadLockTest.method1(DeadLockTest.java:13)
        - waiting to lock <0x00000007aff0e060> (a java.lang.Object)
        - locked <0x00000007aff0e070> (a java.lang.Object)
        at com.debug.multithread.DeadLockTest.run(DeadLockTest.java:30)

   Locked ownable synchronizers:
        - None

"Thread-0" #10 prio=5 os_prio=0 tid=0x000000001dd82000 nid=0x1fa0 waiting for monitor entry [0x000000001e47f000]
   java.lang.Thread.State: BLOCKED (on object monitor)
        at com.debug.multithread.DeadLockTest.method2(DeadLockTest.java:23)
        - waiting to lock <0x00000007aff0e070> (a java.lang.Object)
        - locked <0x00000007aff0e060> (a java.lang.Object)
        at com.debug.multithread.DeadLockTest.run(DeadLockTest.java:31)

   Locked ownable synchronizers:
        - None

"Service Thread" #9 daemon prio=9 os_prio=0 tid=0x000000001c0e7800 nid=0x3e8 runnable [0x0000000000000000]
   java.lang.Thread.State: RUNNABLE

   Locked ownable synchronizers:
        - None

"C1 CompilerThread2" #8 daemon prio=9 os_prio=2 tid=0x000000001c0e6000 nid=0x1590 waiting on condition [0x0000000000000000]
   java.lang.Thread.State: RUNNABLE

   Locked ownable synchronizers:
        - None

"C2 CompilerThread1" #7 daemon prio=9 os_prio=2 tid=0x000000001c0e2000 nid=0x190c waiting on condition [0x0000000000000000]
   java.lang.Thread.State: RUNNABLE

   Locked ownable synchronizers:
        - None

"C2 CompilerThread0" #6 daemon prio=9 os_prio=2 tid=0x000000001c0dd800 nid=0x2954 waiting on condition [0x0000000000000000]
   java.lang.Thread.State: RUNNABLE
```

Thread dump from jvisualvm

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