JDK Tools (Performance Related)

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jps

- List the JVMs that are currently running including embedded VMs
  - Associate a 'process number' with the running application
- jps

```
27798 Jps
25301 Main
```

- jps -l

```
28029 sun.tools.jps.Jps
25301 org.netbeans.Main
```

jinfo

- List configuration information from a running VM or a core file
  - Information includes VM properties and command line flags
- jinfo <pid from jps>

```
Java System Properties:
java.vendor = Sun Microsystems Inc.
netbeans.user = /home/shulk/.netbeans/6.0
sun.java.launcher = SUN_STANDARD
sun.management.compiler = HotSpot Client Compiler
...
VM Flags:
-Djdk.home=/opt/java/javase/jdk1.6 -Dnetbeans.dirs=/opt/java/tools/netbeans-6.0.1/nb6.0:/opt/java/tools/netbeans-6.0.1/ide8:/opt/java/tools...
```

jstat

- List the statistics for a given VM
  - Class loading, GC on all spaces, hotspot compilation
  - See Troubleshooting Guide
- Provide a sample interval and the number of samples to take

Process id **Interval** **No. of sample**

```
jstat -gcutil 25301 1000 10
 S0     S1     E      O      P      YGC     YGCT    FGC     FGCT    GCT
 73.79  0.00   81.32  42.10  99.56  1344    8.880   36      17.363  26.243
 73.79  0.00   81.32  42.10  99.56  1344    8.880   36      17.363  26.243
 73.79  0.00   81.32  42.10  99.56  1344    8.880   36      17.363  26.243
```

jstack

- Prints the stack traces of all the the threads attached to a virtual machine
  - Application thread, internal VM thread,
- Also performs deadlock detection with -l option
- Use -F to force stack if VM is hung
  - Solaris and Linux only

jstack – Sample Output

```
"Java Source Worker Thread" prio=10 tid=0x08267800 nid=0x63a5 waiting on condition
[0x4532c000..0x4532d040]
  java.lang.Thread.State: TIMED_WAITING (parking)
  at sun.misc.Unsafe.park(Native Method)
  - parking to wait for  <0x54b8d090> (a
java.util.concurrent.locks.AbstractQueuedSynchronizer$ConditionObject)
  at java.util.concurrent.locks.LockSupport.parkNanos(LockSupport.java:198)
  ...
  at java.util.concurrent.ThreadPoolExecuto$Worker.run(ThreadPoolExecutor.java:907)
  at java.lang.Thread.run(Thread.java:619)

  Locked ownable synchronizers:
  - <0x54b8cdd0> (a java.util.concurrent.locks.ReentrantLock$NonfairSync)
```

jmap

- Prints memory related statistics
  - Details the overall memory configuration
  - Details section on each of the space with capacity, free and used

jmap Sample Output (Solaris/Linux)

```
Mark Sweep Compact GC
Heap Configuration:
   MinHeapFreeRatio = 40
   MaxHeapFreeRatio = 70
   MaxHeapSize      = 169869312 (162.0MB)
   NewSize          = 1048576 (1.0MB)
   MaxNewSize       = 4294901760 (4095.9375MB)
   OldSize          = 4194304 (4.0MB)
   NewRatio         = 12
   SurvivorRatio    = 8
   PermSize         = 33554432 (32.0MB)
   MaxPermSize      = 209715200 (200.0MB)
...
Eden Space:
   capacity = 6881280 (6.5625MB)
   used     = 4437312 (4.23175048828125MB)
   free     = 2443968 (2.33074951171875MB)
   64.48381696428571% used
```

jmap (Solaris/Linux)

```
cmlee
[cmlee@linux:~]{1004} jmap
Usage:
    jmap [option] <pid>
        (to connect to running process)
    jmap [option] <executable <core>
        (to connect to a core file)
    jmap [option] [server_id@]<remote server IP or hostname>
        (to connect to remote debug server)

where <option> is one of:
    <none>               to print same info as Solaris pmap
    -heap                to print java heap summary
    -histo[:live]        to print histogram of java object heap; if the "live"
                         suboption is specified, only count live objects
    -permstat            to print permanent generation statistics
    -finalizerinfo       to print information on objects awaiting finalization
    -dump:<dump-options> to dump java heap in hprof binary format
                         dump-options:
                           live         dump only live objects; if not specified,
                                        all objects in the heap are dumped.
                           format=b     binary format
                           file=<file>  dump heap to <file>
                         Example: jmap -dump:live,format=b,file=heap.bin <pid>
    -F                   force. Use with -dump:<dump-options> <pid> or -histo
                         to force a heap dump or histogram when <pid> does not
                         respond. The "live" suboption is not supported
                         in this mode.
    -h | -help           to print this help message
    -J<flag>             to pass <flag> directly to the runtime system
[cmlee@linux:~]{1005}
```

jmap (Windows)

Command Prompt

```
C:\Documents and Settings\sang>jmap
Usage:
    jmap -histo <pid>
      (to connect to running process and print histogram of java object heap
    jmap -dump:<dump-options> <pid>
      (to connect to running process and dump java heap)

    dump-options:
      format=b     binary default
      file=<file>  dump heap to <file>

    Example:       jmap -dump:format=b,file=heap.bin <pid>

C:\Documents and Settings\sang>
```

HPROF Heapdump

- Uses the JVMTI to get information from a Java VM
- Data capture includes
  - CPU usages, heap dump, thread states
- Start at commandline
  - java -Xrunhprof:<options> MyJavaApp
  - Includes format=b for jhat analysis
- Useful options
  - heap=all – displays all heap info
  - cpu=sample – sample active thread
- Dump on application exit or CTRL-\

jhat

- Allows you to interactively work with a memory snapshot captured by jmap
  - Use jmap -dump:format=b,file=heap_dump_file
- Use jhat to “parse” (read) heap file
  - Hosted on a web server
  - Access through a standard browser
- Shows the following (standard query)
  - All classes
  - Object on the heap
  - Instances
  - Objects reachable from root set

jhat Object Query Language

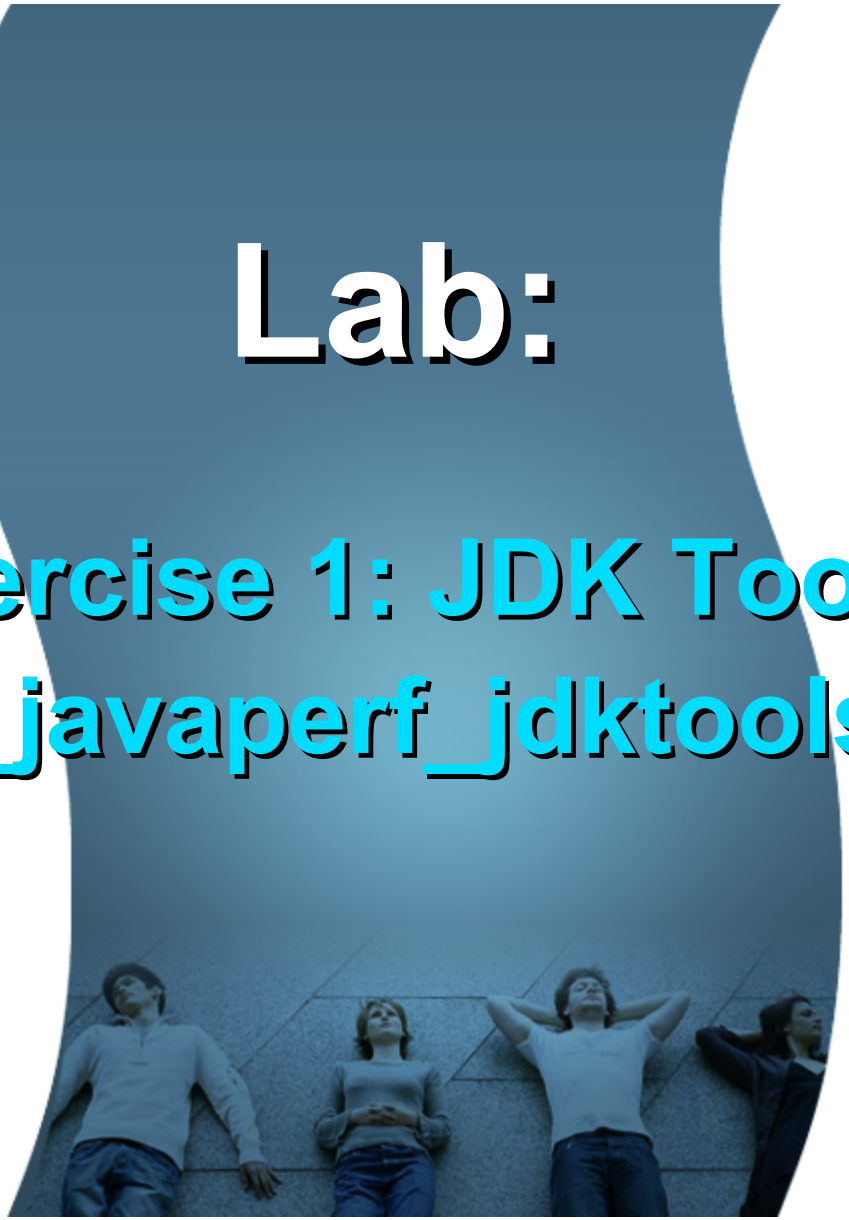
- Develop custom query with object query language
  - SQL like, uses JavaScript for expression in from and where clause
  - A set of built-in functions like heap, referrers, reachables, sizeof, etc.
- Use to answer questions like
  - Find all String instances that whose data size are >= 512 in size

    select s from java.lang.String s where sizeof(s.value) >= 512
  - Find all URL instances that is referenced by 2 or more objects

    select u from java.net.URL u where count(referrers(u)) > 2

Lab:

Exercise 1: JDK Tools
1516_javaperf_jdktools.zip



Visual Tool - jconsole

- Bundle with JDK
  - Graphical console that enables you monitor and manage Java applications
  - API to create your own plugin to jconsole
- Provides information on
  - Memory usage and GC activities
  - Threads, thread stack trace, locks
  - Objects pending finalization
  - Runtime information such as uptime, CPU time
  - JVM information such as classpath, properties, command line arguments, etc.

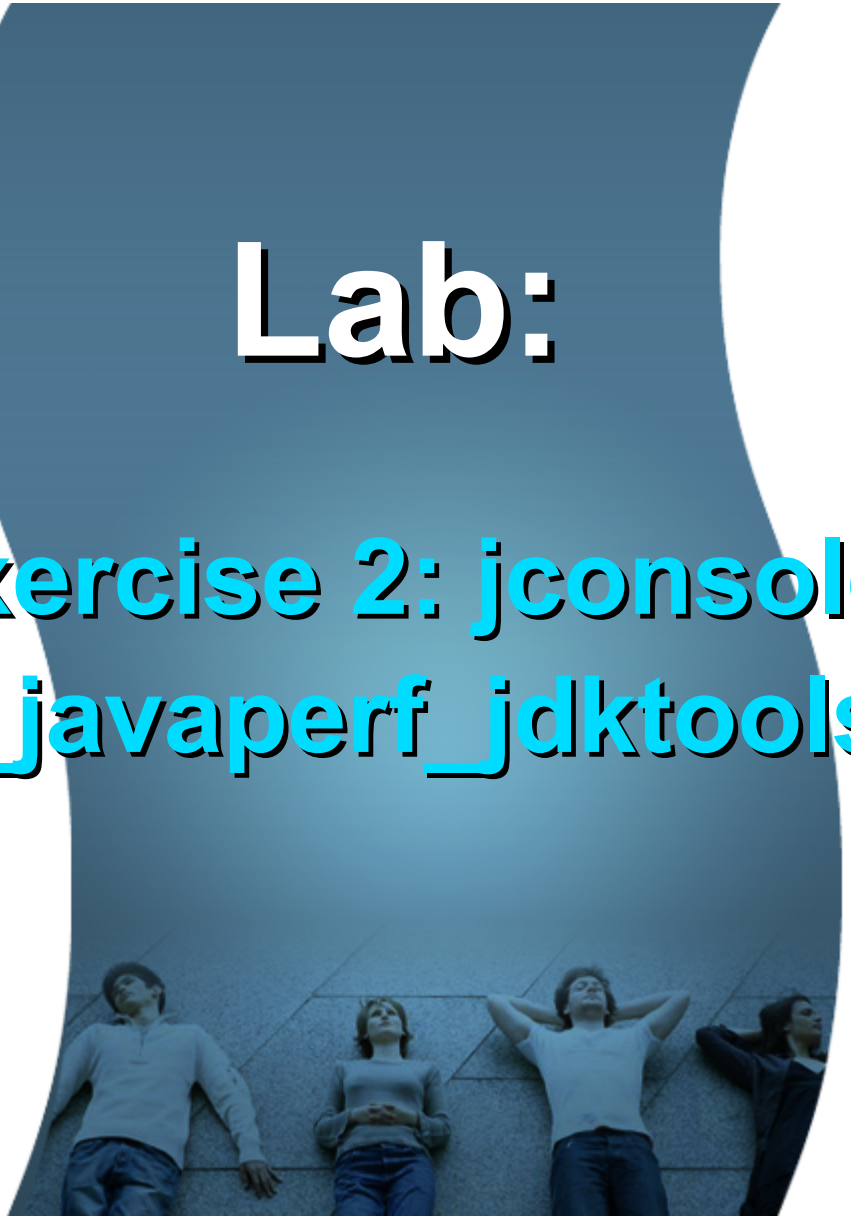
Visual Tool – VisualVM

- Open source project
  - Based on NetBeans platform, uses the update center
  - Current plugin includes VisualGC, jconsole, thread dump analyzer, profiler
  - Runs only on JDK 6 and later
  - http://visualvm.dev.java.net

Lab:

Exercise 2: jconsole

1516_javaperf_jdktools.zip



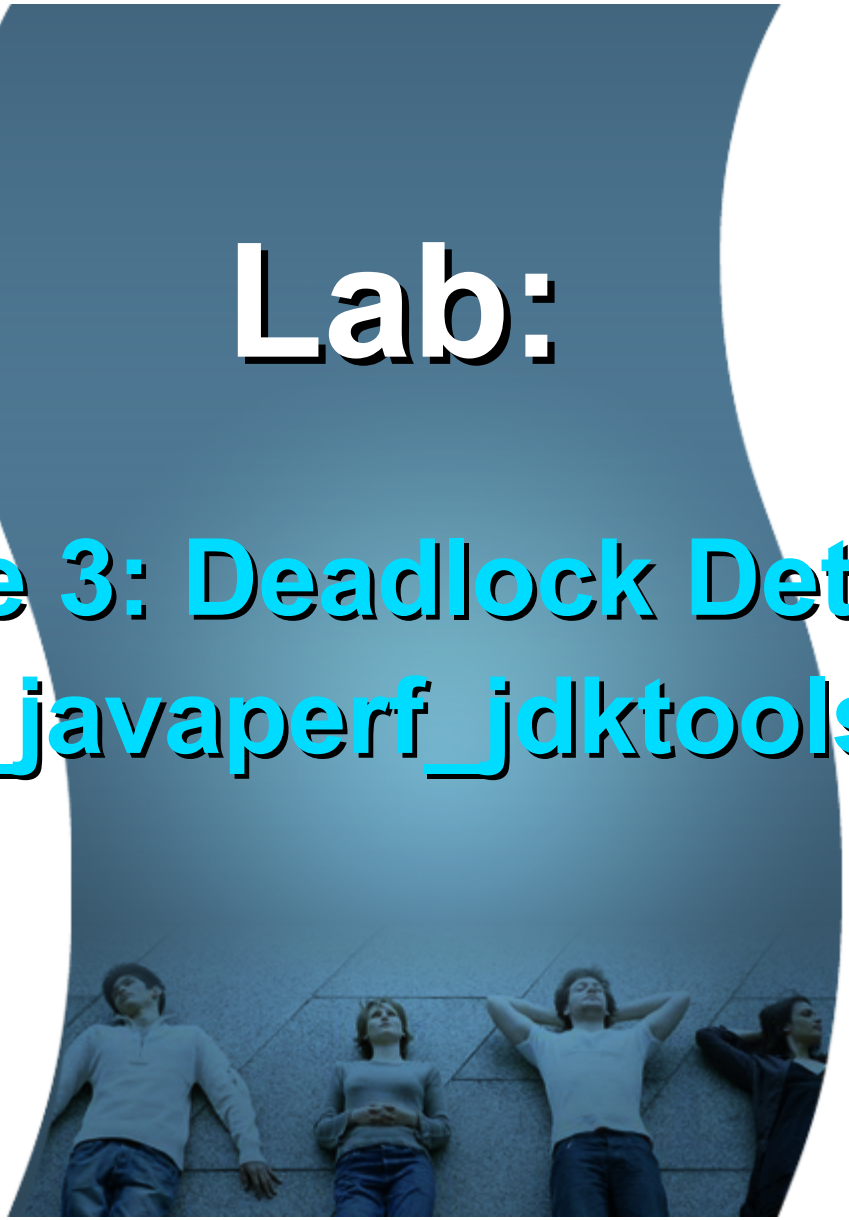
Deadlock Detection via jconsole

Deadlock Detection

- If your application is suspected to be deadlocked, use JConsole for deadlock detection
  - Where the deadlock occurred
  - Which threads are involved
  - Which thread owns and is blocked for which locks

Lab:

Exercise 3: Deadlock Detection
1516_javaperf_jdktools.zip



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