FOSDEM 2007
Java HotSpot™
Virtual Machine

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What Does the Virtual Machine Do?

- Bytecode execution
  - Interpreter (also does profiling)
  - 2 runtime compilers: `-client` and `-server`
  - On-stack replacement (OSR)
- Storage allocation and garbage collector
  - Fast inline allocation; concurrent, parallel collectors
- Runtimes
  - Start up, shut down, class loading, threads, synchronization, safepoints, interactions with operating system, etc.
Interactions with the Platform

• Few API's
  - jni.h
  - JVM/TI

• “Intrinsification” of hot, or easy, or critical methods
  - java.lang.Math.sin
  - java.lang.String.indexOf
  - sun.misc.Unsafe.compareAndSwapInt

• Mostly implementation
  - Can be on a different release cycle than the JRE
Some Things to Know (1)

Mark word in every object

<table>
<thead>
<tr>
<th>Bitfields</th>
<th>Tag</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hashcode</td>
<td>0</td>
<td>01 Unlocked</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lock record address</td>
<td>00</td>
<td>Light-weight locked</td>
</tr>
<tr>
<td>Monitor address</td>
<td>10</td>
<td>Heavy-weight locked</td>
</tr>
<tr>
<td>Forwarding address, etc.</td>
<td>11</td>
<td>Marked for GC</td>
</tr>
<tr>
<td>Thread ID</td>
<td>1</td>
<td>01 Biased / biasable</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Some Things to Know (2)

Klass in every object

instance(OopDesc)

Mark
Klass
Fields

instanceKlass

Mark
Klass
VTable
Fields

instanceKlassKlass

Mark
Klass
VTable
Fields

klassKlass

Mark
Klass
VTable
Fields

array(OopDesc)

Mark
Klass
Length
Data
Process

• Plan features, or get bug reports
• Discuss with group, etc.
• Write code
• Test for correctness, performance impact
• Code review by 2 other engineers
• Nightly testing in group workspace
• Integration testing in VM workspace
• “Big Apps” tests, cross-platform performance tests
• Backport (if necessary)
Actual Code!

- Coming up on 10 years of coding
- 188K lines of code
- 136 contributors + sponsored changes
  > You could be next!
- The virtual machine is already out under GPLv2
- Competition drives innovation
  > So do real applications and customers
- What's fun about it?
  > Complex multithreaded program that has to work perfectly!
Outside Projects

• University of Linz, Austria
  > “Escape Analysis in the Context of Dynamic Compilation and Deoptimization”, Thomas Kotzmann, Ph.D.
  > “Linear Scan Register Allocation for the Java HotSpot? Client Compiler”, Christian Wimmer, M.S., 2004
  > Others papers with Hanspeter Mössenböck

• Doug Lea, SUNY Oswego
  > Changes for JSR-133: memory model and threads
Further Reading


Blogs

• http://blogs.sun.com/jonthecollector
• http://blogs.sun.com/dagastine
• http://blogs.sun.com/tony