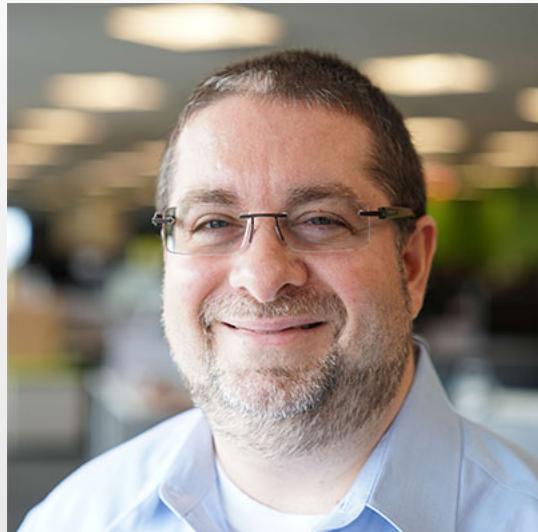


JVMS.Compare

Benchmark Performance of Different JDK/JVM combos

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About Us



- Java Champions
- JCP Executive Committee Reps. for BNY Mellon
- Ardent bloggers and tweeters
- Director at BNY Mellon
- 16+ years of experience in Financial Tech.
- Programming in Java since 1998
- JUG Leader @ NYJavaSIG
- Creator of Java-Katas Github repository
- Managing Director at BNY Mellon
- 18+ years of experience in Financial Tech.
- Programming in Java since 1997
- Member of JSR 335 Expert Group
- Creator of Eclipse Collection Java Library

Session Agenda

Compare benchmarks for operations using:

Eclipse Collections and JDK Java Collection Framework:

- on a primitive `IntList & List<Integer>`
- on a `List<Person>`

using several JDK/JVM combinations

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-
- ♣ No tweaks* to VM Options or Flags
 - ♣ Intent to test out-of-the-box throughputs

WHY?

- Show Java developers what the comparisons reveal.
- Show JVM developers what can be improved.

JMH Disclaimers

JMH is tuned for OpenJDK Hotspot as evidenced by the warnings it prints when running on OpenJ9:

WARNING: Not a HotSpot compiler command compatible VM ("Eclipse OpenJ9 VM-11.0.6-internal"), compilerHints are disabled.

In order to level the playing field, re-ran all with the System property: `java.vm.name` set to ‘**anonymous**’ for all JDks.

Benchmark Disclaimers

- Microbenchmarks are **hyper-focused** tests which test one very specific execution pattern
- They are **not always** a good predictor of program behavior.
- Most programs will not have the clean profiles of the microbenched code
- The hot path of the microbench may disappear in the context of a larger program.
- Microbenchmarks tend to only take one aspect - **throughput** - into account and ignore the other tradeoffs like startup and memory usage.

Hardware - The Beast

Model Name: Mac Pro

Model Identifier: MacPro6,1

Processor Name: 12-Core Intel Xeon E5

Processor Speed: 2.7 GHz

Number of Processors: 1

Total Number of Cores: 12

L2 Cache (per Core): 256 KB

L3 Cache: 30 MB

Memory: 64 GB



Hardware - The Little Monster

Model Name: **MacBook Pro**

Model Identifier: MacBookPro11,1

Processor Name: Intel Core i7

Processor Speed: 2.8 GHz

Number of Processors: 1

Total Number of Cores: 2

L2 Cache (per Core): 256 KB

L3 Cache: 4 MB

Memory: 16 GB



Compared JDK/JVMs

JDK/JVM combinations tested:

1. Oracle JDK 11 (v11.0.6)
2. GraalVM Enterprise Edition (v19.3.1)
3. GraalVM Community Edition (v19.3.1)
4. AdoptOpenJDK 11 w/Hotspot (v11.0.6 +10)
5. AdoptOpenJDK 11 w/OpenJ9 (v11.0.6 +10, 0.18.1)
6. OpenJDK 11 (v11.0.2)
7. OpenJDK 11 embedded Graal JVMCI (v11.0.2)
8. GraalVM Enterprise Edition C2 Compiler (v19.3.1)

JDK Flags - Part 1

In order to run the **embedded** Graal compiler in OpenJDK 11 (#7):

7. OpenJDK 11 embedded Graal JVMCI (v11.0.2)

- +XX:+UnlockExperimentalVMOptions
- +XX:+EnableJVMCI
- +XX:+UseJVMCICompiler

JDK Flags - Part 2

In order to run the C2 compiler in GraalVM EE v19.3.1 (#8):

8. GraalVM Enterprise Edition C2 Compiler (v19.3.1)

- +XX:+UnlockExperimentalVMOptions
- +XX:-UseJVMCICompiler

Notice the minus before the UseJVMCICompiler

JDK Flags - Part 3

No hints for heap sizes:

- Collection with size 1_000_000 (1 million items)
- Collection with size 1000 (1 thousand items)

Setting Xmx and Xms to 1024M (to remove heap growth variability)

- Collection with size 1_000_000 (1 million items)
- Collection with size 1000 (1 thousand items)

Benchmark Math

Some relevant numbers in terms of what is run:

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- * Mode.Throughput on collections, seeded with different sizes
- * 42 benchmarks run for 8 JDK/JVMs = 336 benchmarks
- * 336 benchmarks run in 2 forks = 672 executions

Benchmarks on IntList operations

Three operations were benchmarked on primitive collections:

- **Filter**: Filter in all even numbers (6 benchmarks)
- **Sum**: Sum of all integers in the collection (6 benchmarks)
- **Transform**: Multiply each integer by 2 (6 benchmarks)

Benchmarks on Object operations

Four operations were benchmarked on non-primitive collections:

- **Filter**: Filter all Persons with height between 60 and 72 inches (7 benchmarks)
- **FilterAndGroup**: Filter all Persons less than 72 inches tall, then group by age (7 benchmarks)
- **IntSummaryStatistics**: Summary statistics by age (integer) of all Person instances (5 benchmarks)
- **CombinedSummaryStatistics**: Summary statistics on height (double), weight (double) and age (integer) (5 benchmarks)

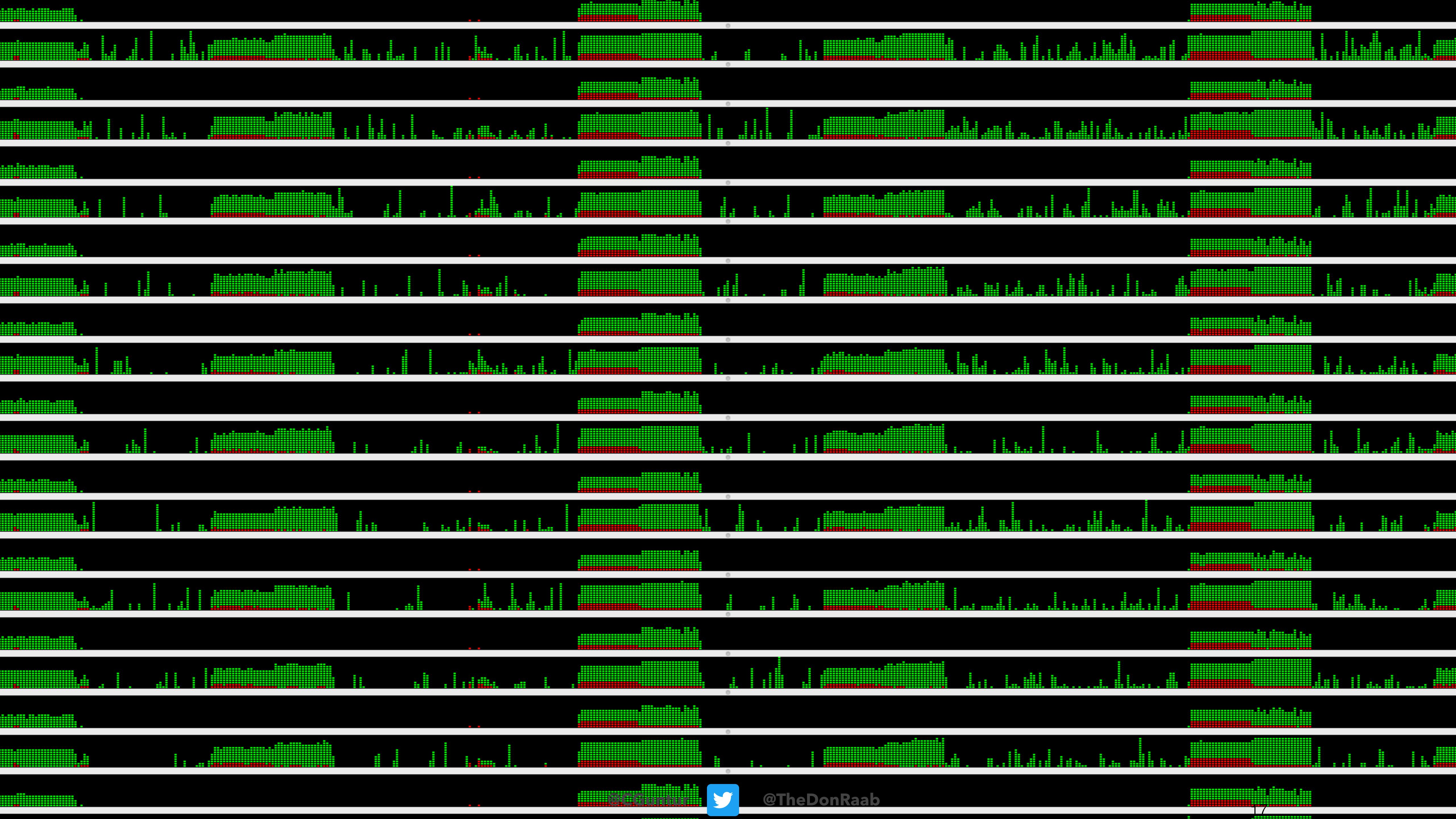
Links

Source Code:

<https://github.com/c-guntur/jvms-compare>

Results:

<https://github.com/c-guntur/jvms-compare-results>



Executions

1H_Named_JVM

Collection Size = 100, JVM name NOT anonymized.

1K_Anonymous_JVM

Collection Size = 1000, JVM name is anonymized.

1K_Anonymous_JVM_Heap_Controlled

Collection Size = 1000, JVM name is anonymized, Heap min and max = 1024m

1M_Named_JVM

Collection Size = 1M, JVM name NOT anonymized.

1M_Anonymous_JVM

Collection Size = 1M, JVM name is anonymized.

1M_Anonymous_JVM_Heap_Controlled

Collection Size = 1M, JVM name is anonymized, Heap min and max = 1024m

HANDS ON !



Other Flags to improve benchmarks

Applies to AdoptOpenJDK

- `-Xjit:acceptHugeMethods,scratchSpaceLimit=1048576`
- `-Xshareclasses:none`

JMH provides custom compiler options to OpenJDK, HotSpot, Graal and select Zing JVMs using the `-XX:CompileCommandFile=flag`