



instantiations

JIT Compilation for VA Smalltalk


Cologne, Germany – August 28th
ESUG 2019


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VA Smalltalk VM

VA Smalltalk VM

- › Performance-critical parts powered by LLVM
- › CMake-based build system
- › FFI powered by libffi
- › True headless optional VM
- › VA Smalltalk is IoT ready!

VA Smalltalk VM Update

- › New interpreter for ARM
- › Improved interpreter for x86
- › Return struct by value for FFI
- › New JIT compiler for x86 (ARM-ready)

New JIT Compiler

New JIT Compiler

- › Template-based
- › Powered by LLVM
- › Very fast

Templates

- › Generated by LLVM at build-time
- › Minimum platform-specific parts
- › Maximum code reuse with interpreter
- › Templates as a standard object file

A Typical Template

TPpushLiteral:

```
movabsq $FXMethodLiteralOp0, %rax
```

```
movq %rax, -8(%r15)
```

```
addq $-8, %r15
```

Compiling

- › Copy templates
 - › Do optimisations
- › Perform relocations fixup

Optimisations

- › Super-instructions
- › Avoid stack usage where possible
- › Inline caches

Inline caches

- › Monomorphic inline cache
- › Polymorphic inline cache
- › Megamorphic inline cache

A Send Template

TPsendArgs0:

```
movq %rdx, 88(%rbp)
movabsq $FXReturnAddress, %rsi
movq %rsi, 96(%rbp)
movl $768, 224(%rbp)
movabsq $FXSendArgsReturnTo, %rax
xorl %edx, %edx
rex64 jmpq *%rax
[ inline cache data ]
```

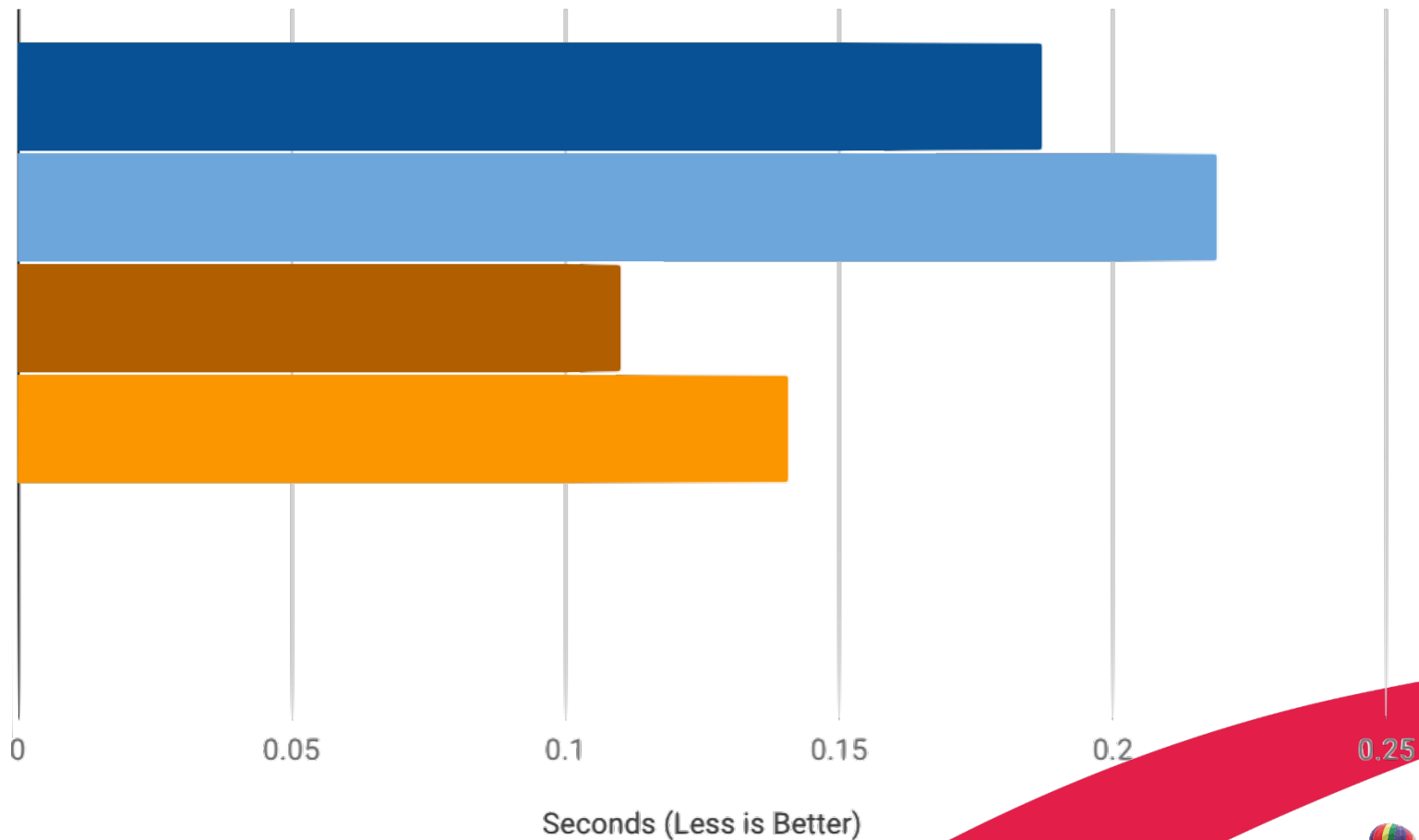
Decompilation

- › PC is native in a stack frame
- › No additional memory footprint
- › Frame is marked if it is running native code

Benchmarks

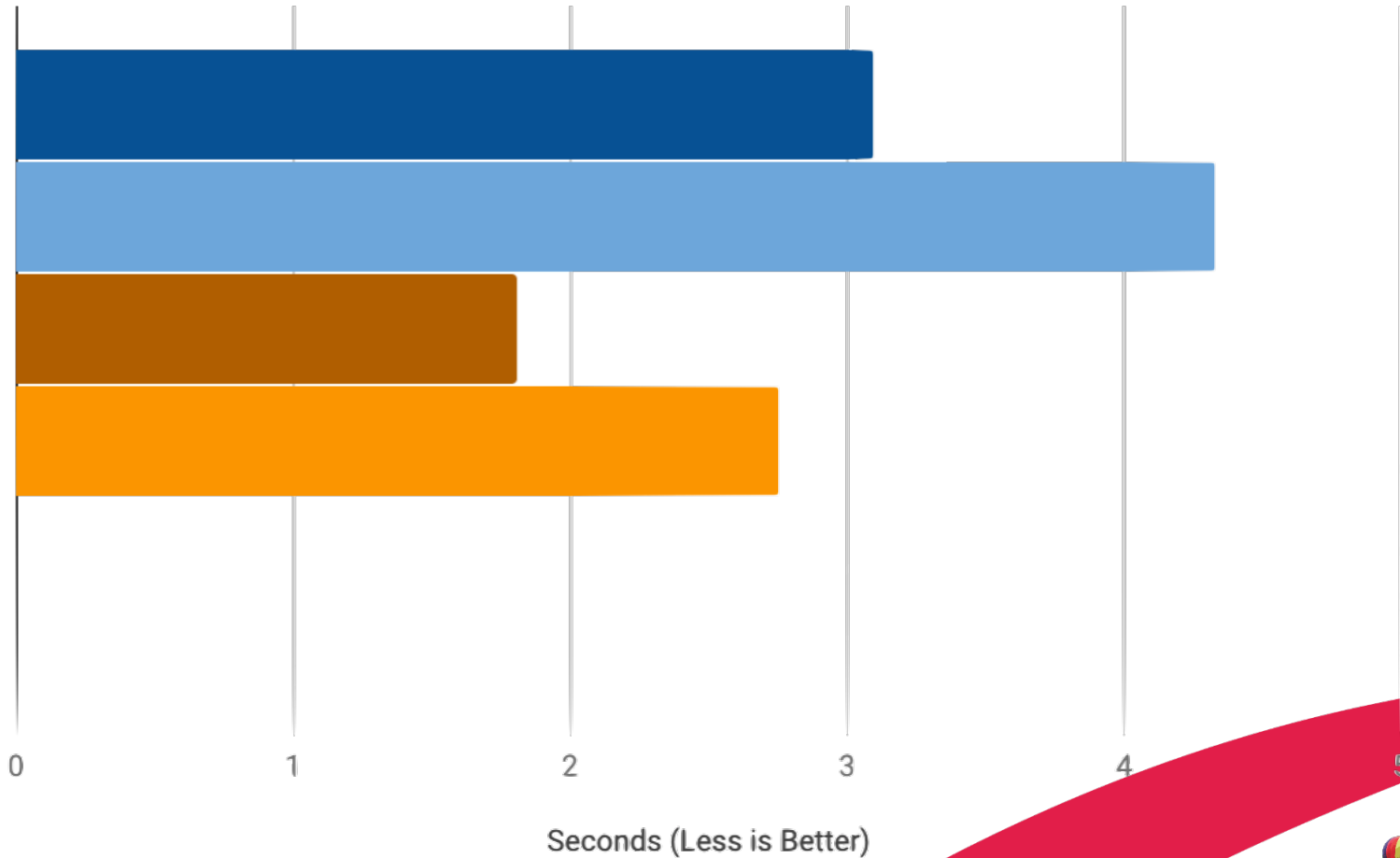
Integer Arithmetic

- 8.x_JIT
- 8.x_INTERP
- 9.x_JIT
- 9.x_INTERP

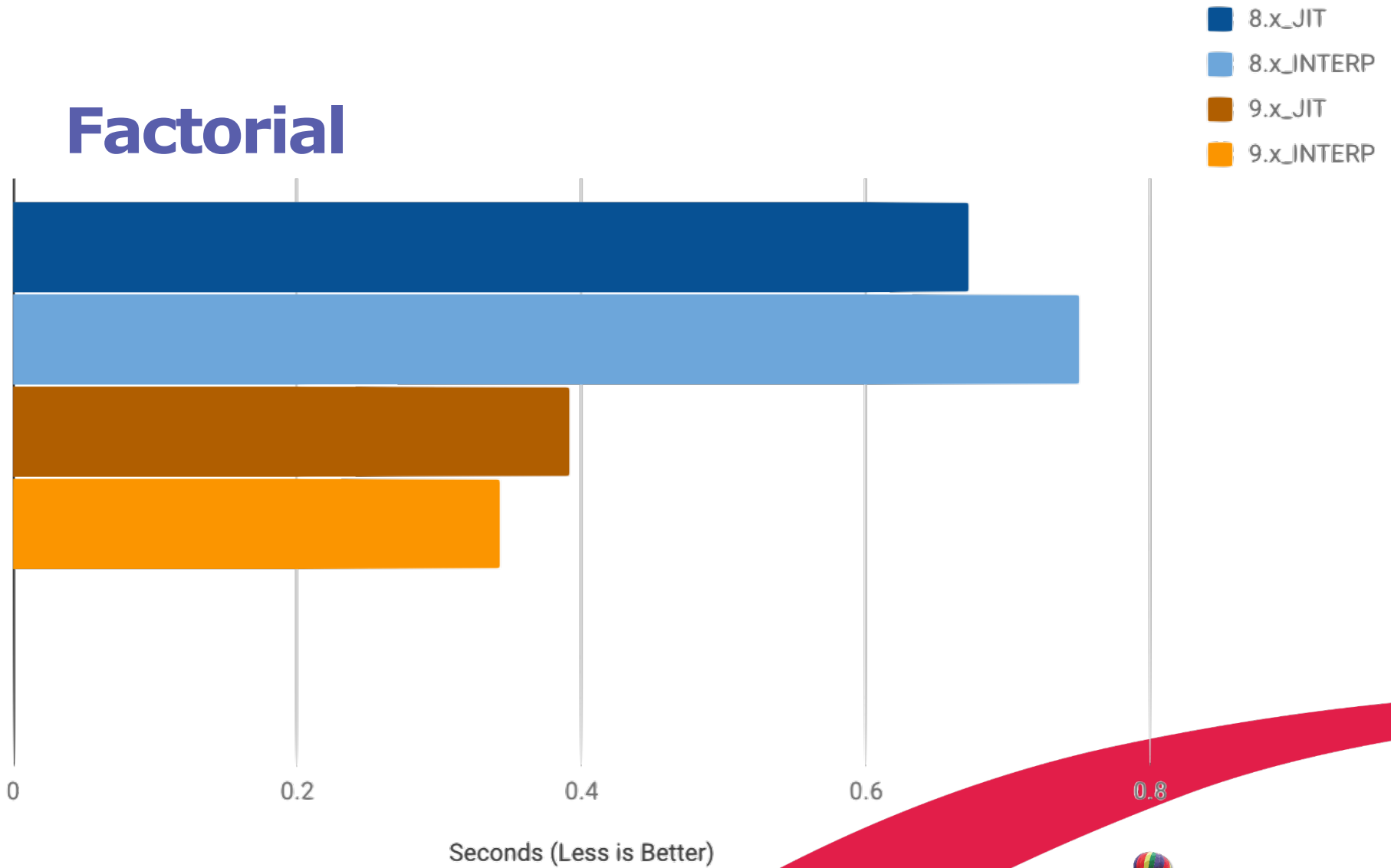


Fraction Arithmetic

- 8.x_JIT
- 8.x_INTERP
- 9.x_JIT
- 9.x_INTERP

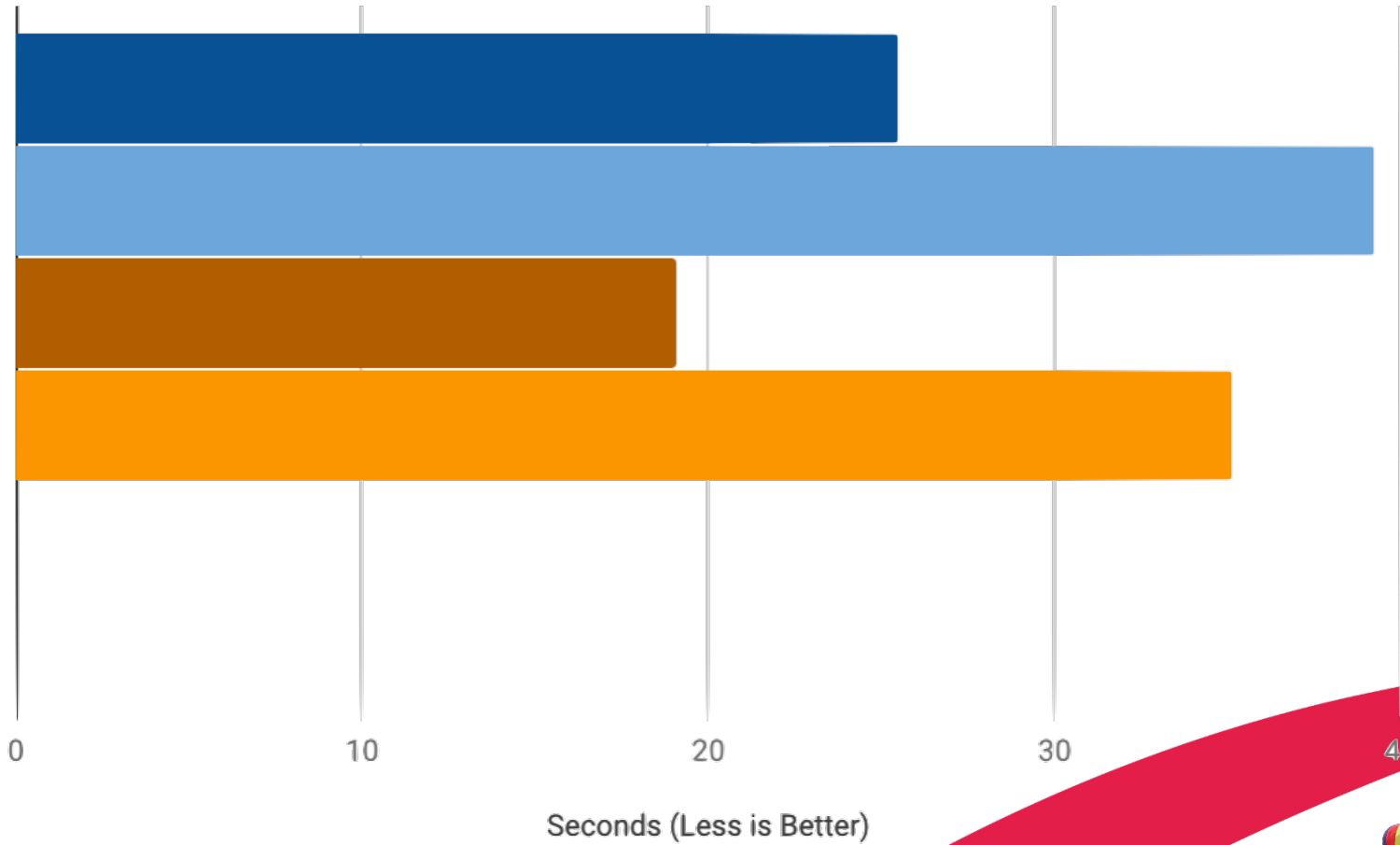


Factorial



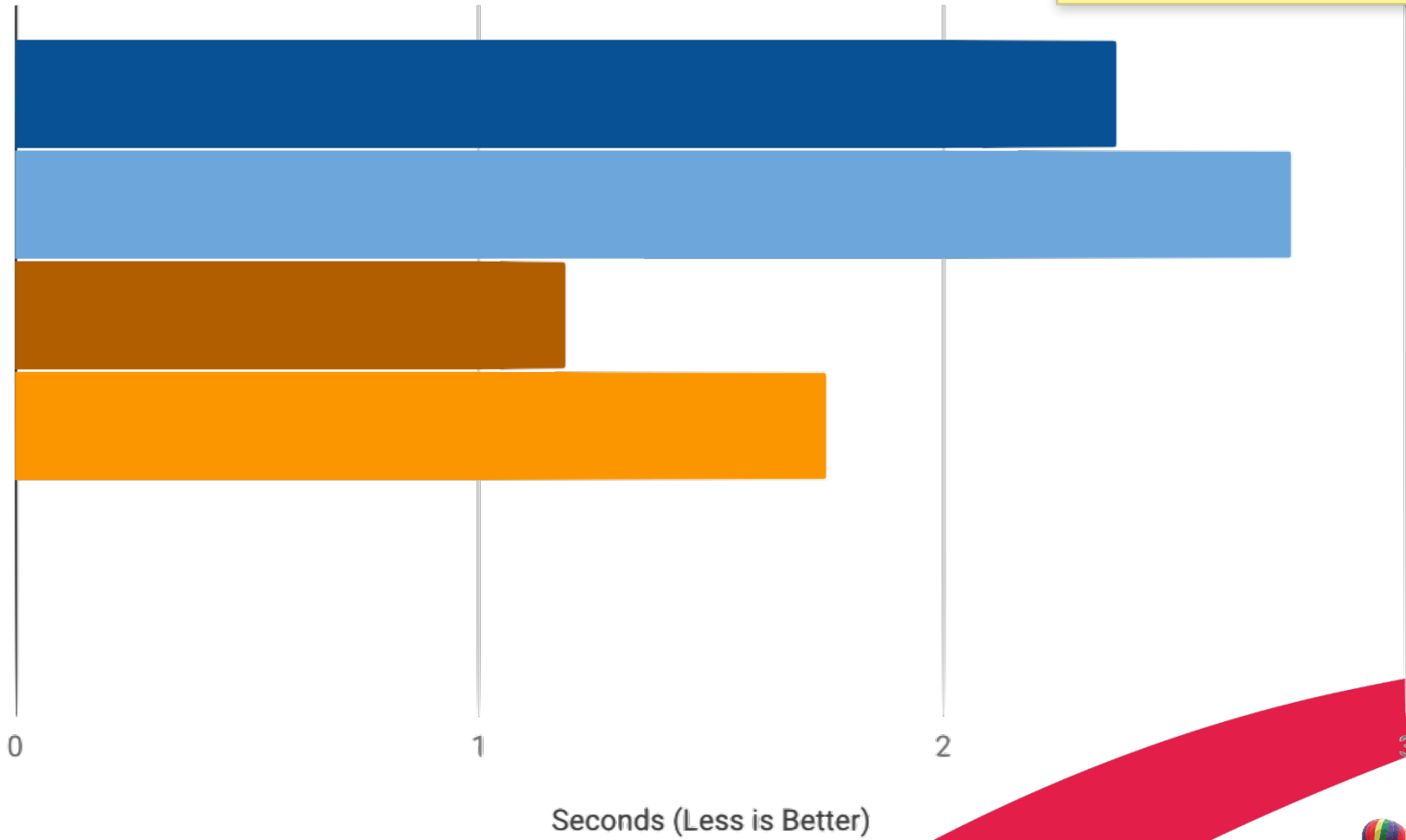
Prime Summing

- 8.x_JIT
- 8.x_INTERP
- 9.x_JIT
- 9.x_INTERP



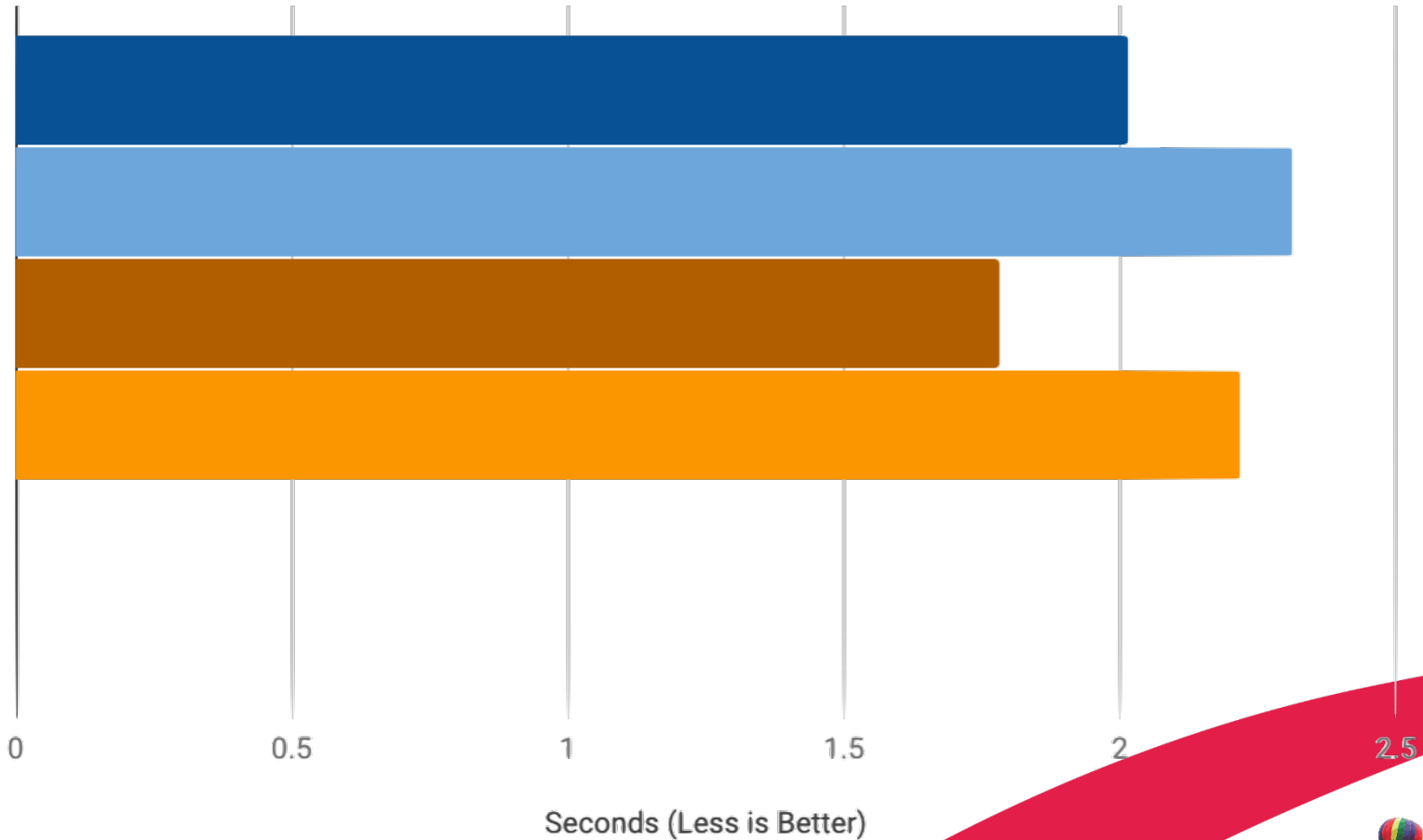
arbitrary-precision arithmetic

Pi Digits



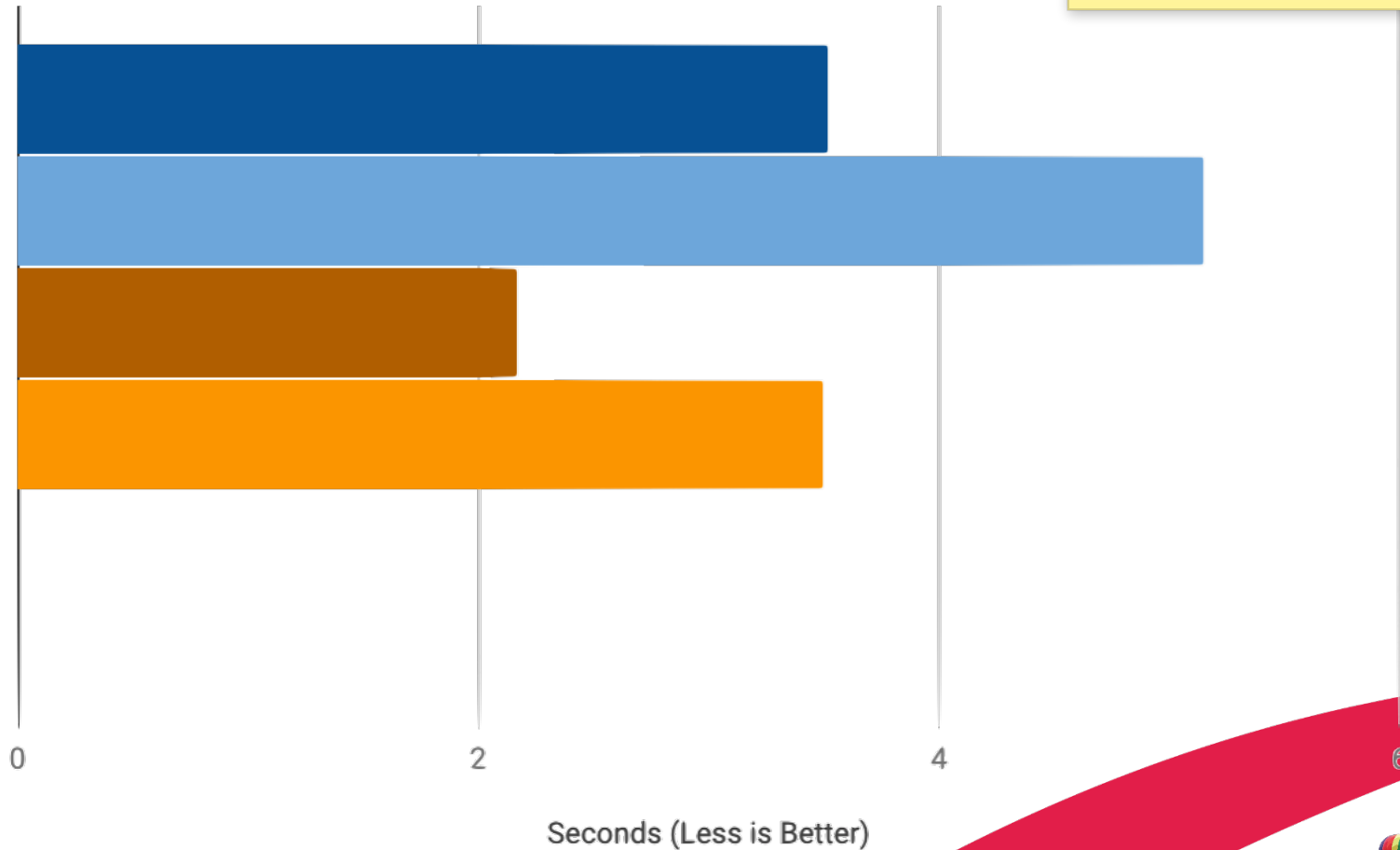
Mandelbrot

- 8.x_JIT
- 8.x_INTERP
- 9.x_JIT
- 9.x_INTERP

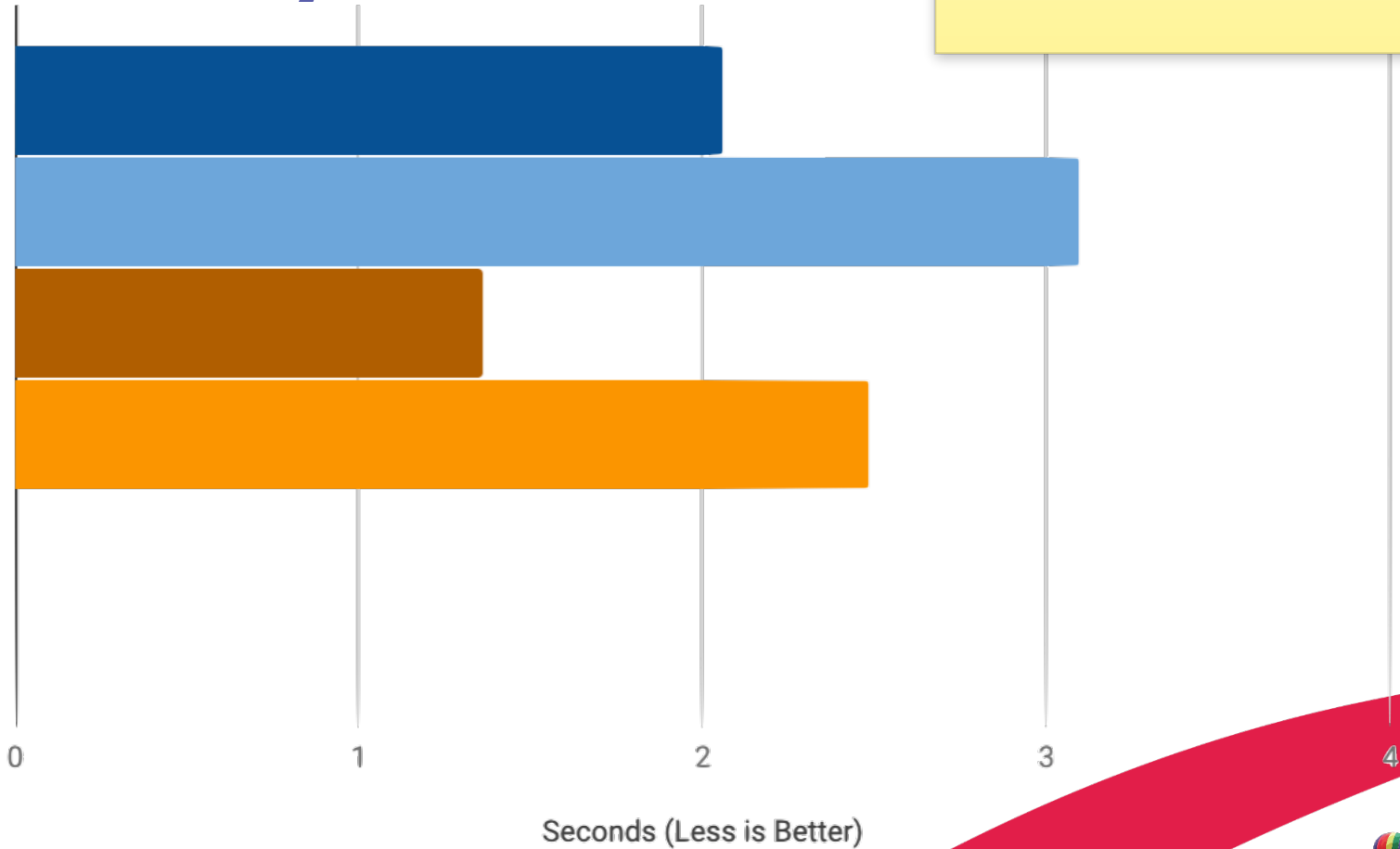


the spectral norm of an infinite matrix A , with entries $a_{11}=1$, $a_{12}=1/2$, $a_{21}=1/3$, $a_{13}=1/4$, $a_{22}=1/5$, $a_{31}=1/6$, etc
Fraction arithm & arrays

Spectral Normalization



Binary Trees

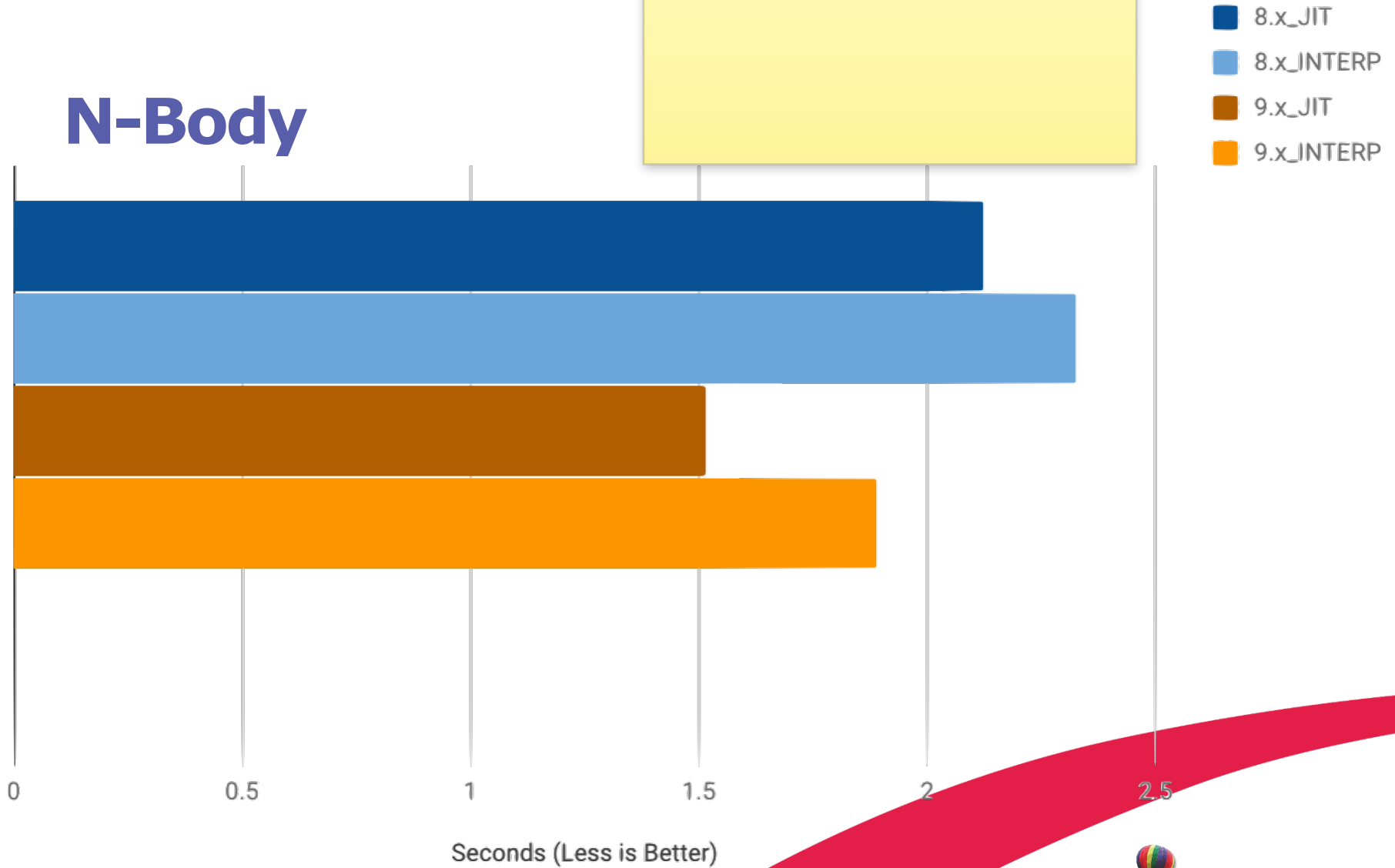


Allocate-walk-deallocate binary trees

x_JIT
x_INTERP
x_JIT
x_INTERP

N-Body

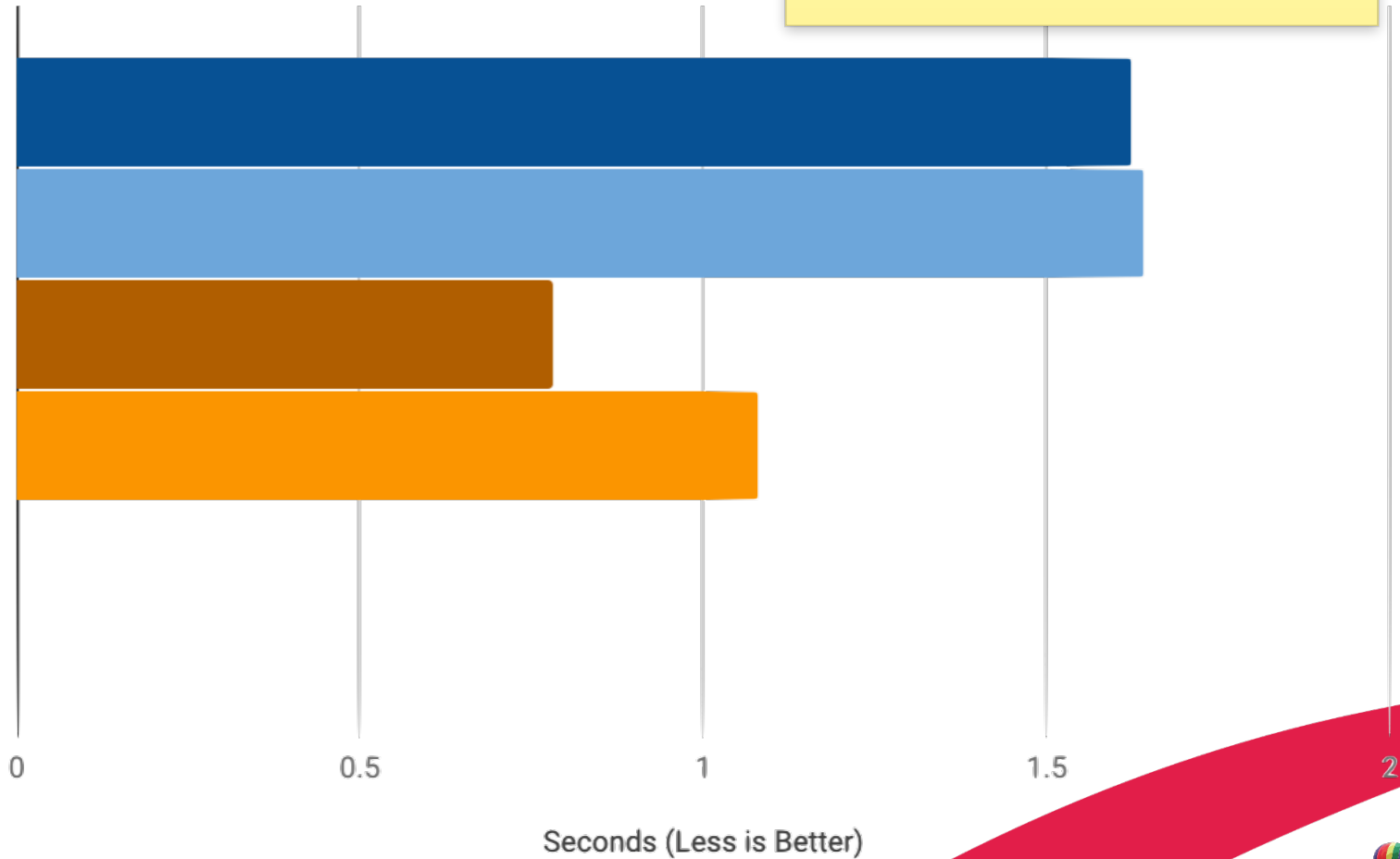
Models planet orbits, lots of floating-point operations



Fasta

DNA chains. Integer & arrays

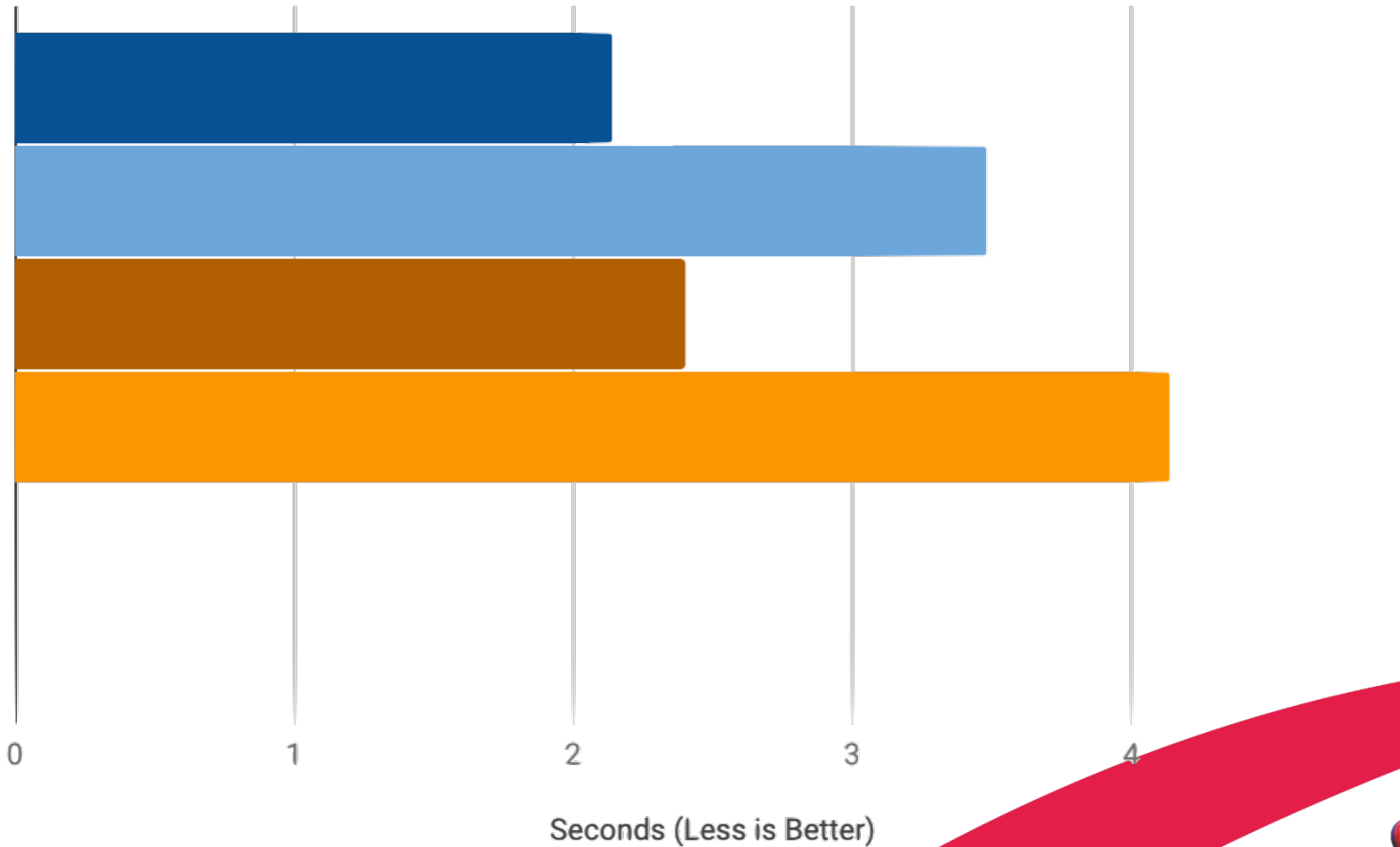
- 8.x_JIT
- 8.x_INTERP
- 9.x_JIT
- 9.x_INTERP



Creatures of different colors. Process switching

Chameneos-redux

- 8.x_JIT
- 8.x_INTERP
- 9.x_JIT
- 9.x_INTERP



Customers Feedback

We did some testing with x86 and got good results:

In a typical use case we have execution times e.g.

VA8.0.2x86 17.5 sec

VA9.0.1x86 21.5 sec

VA9.2x86_JIT 12.8 sec

— An Instantiations VA Smalltalk Customer

Conclusion

VA Smalltalk 9.2

- › Available now under Early Customer Access Program (ECAP) at instantiations.com/ecap
- › v.9.2 Release later this year

Contacts

General Information

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Thank you for your attention

Questions?