azul

Welcome to the Jungle

A safari through the JVM landscape

Gerrit Grunwald, Senior Developer Advocate

ABOUT ME.









OPEN JDK

A FREE AND OPEN SOURCE IMPLEMENTATION OF THE JAVA PLATFORM STANDARD EDITION (JAVA SE)



OPEN JDK WEBSITE



https://openjdk.org/





OPEN JDK SOURCE CODE



https://github.com/openjdk/jdk



CONTRIBUTORS

- Alibaba
- Amazon
- Ampere
- ARM
- Azul
- BellSoft
- Datadog
- Google

- Huawei
- IBM
- Many Individuals
- Intel
- JetBrains
- Linaro
- Loongson
- Microdoc

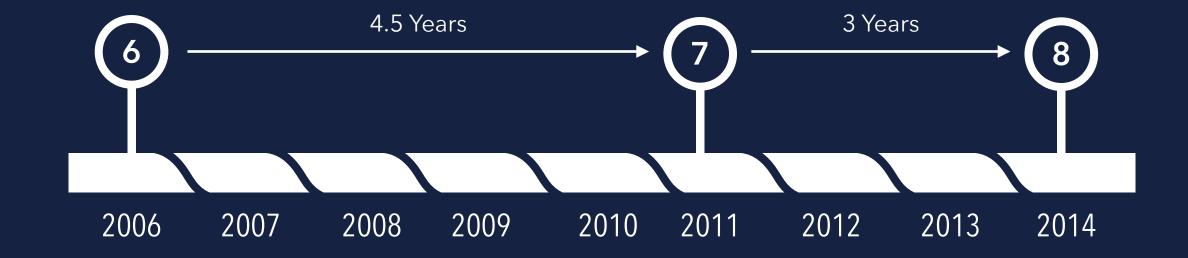
- Microsoft
- NTT Data
- Oracle
- Qualcomm
- Red Hat
- SAP
- Tencent
- Twitter

CONTRIBUTORS

IT'S NOTA ONE MAN SHOW!



OLD RELEASE CADENCE

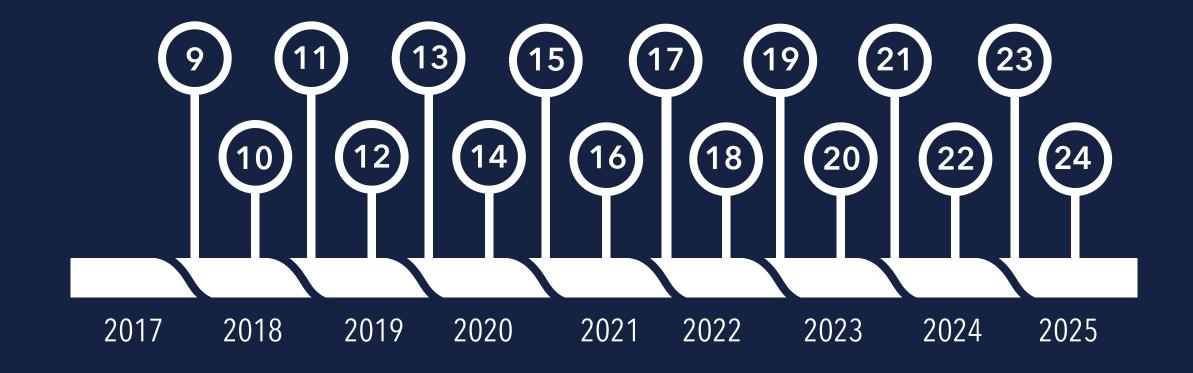


OLD RELEASE CADENCE

WAIT MULTIPLE YEARS BEFORE ONE CAN TEST A NEW JDK



NEW RELEASE CADENCE



NEW RELEASE CADENCE

NOW A NEW JDK CAN BE TESTED EVERY 6 MONTHS







Java Development Kit



Java Runtime Environment

JAVA DEVELOPMENT KIT / JAVA RUNTIME ENVIRONMENT

JRE

Java Virtual Machine

Class Libraries

JAVA DEVELOPMENT KIT / JAVA RUNTIME ENVIRONMENT



JAVA DEVELOPMENT KIT / JAVA RUNTIME ENVIRONMENT



JDK / JRE

JAVA DEVELOPMENT KIT / JAVA RUNTIME ENVIRONMENT

RECOMMENDATION (UP TO JDK8)

Development

JDK

Production

JRE

JDK / JRE

JAVA DEVELOPMENT KIT / JAVA RUNTIME ENVIRONMENT

RECOMMENDATION (FROM JDK9)

Development

JDK

Production

JLINK JRE

Tool to create a custom Java runtime images

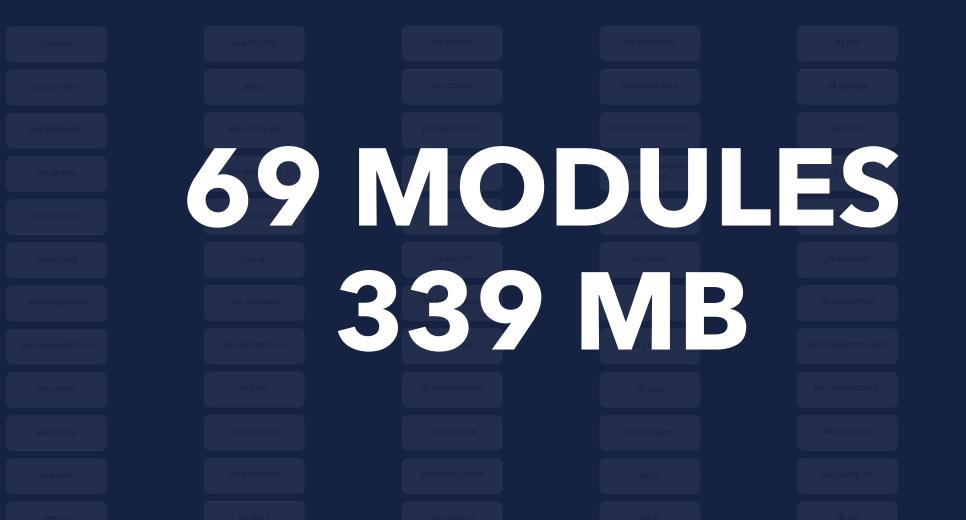




Custom Java Runtime Environment

JAVA PLATFORM MODULE SYSTEM





JDK / JRE

JAVA PLATFORM MODULE SYSTEM





JAVA PLATFORM MODULE SYSTEM









11 MODULES 48 MB

JAVA DEVELOPMENT KIT / JAVA RUNTIME ENVIRONMENT



69 modules

339 MB



21.0.1





21.0.1

11 modules

48 MB





BUILDS OF OPEN JDK

BUILDS OF OPEN JDK

- Adopt OpenJDK[†]
- Bi Sheng
- Corretto
- Dragonwell
- JetBrains
- Kona
- Liberica

- Microsoft
- OJDK Build[†]
- Open Logic
- Oracle JDK
- Oracle OpenJDK
- Red Hat
- SAP Machine

- Semeru
- Semeru cert.
- Temurin
- Trava
- Zulu
- Platform Prime

BUILDS OF OPEN JDK



BUILDS OF GRAALVM

BUILDS OF GRAALVM

- Gluon GraalVM
- GraalVM Community (former GraalVM CE)
- GraalVM (former GraalVM Enterprise)
- Liberica Native Image Kit
- Mandrel

WHICH ONE TO CHOOSE?



THINGS THAT CAN HELP MAKING A DECISION

Term of Support

- Term of Support
- Updates

- Term of Support
- Updates
- Compliance

- Term of Support
- Updates
- Compliance
- Cost

- Term of Support
- Updates
- Compliance
- Cost
- Performance

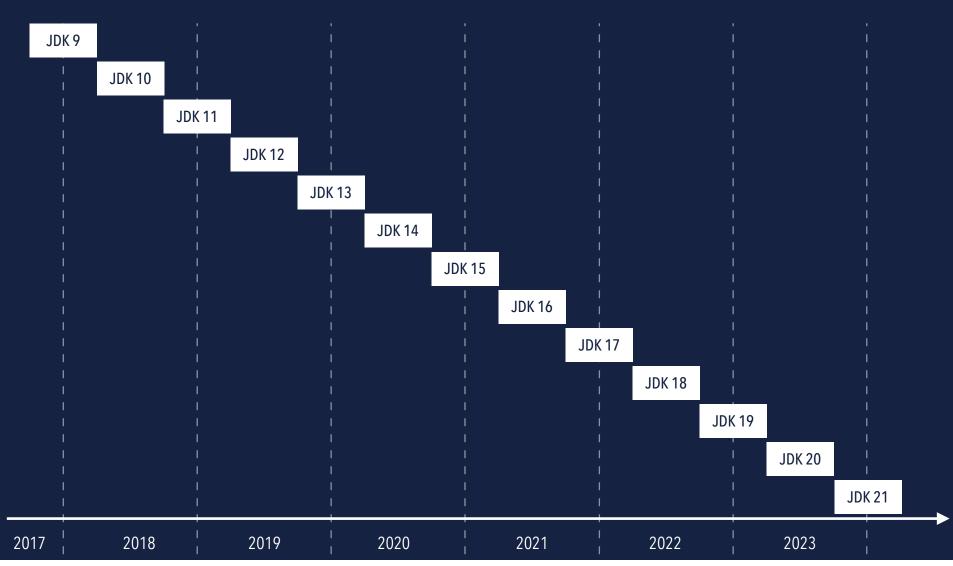




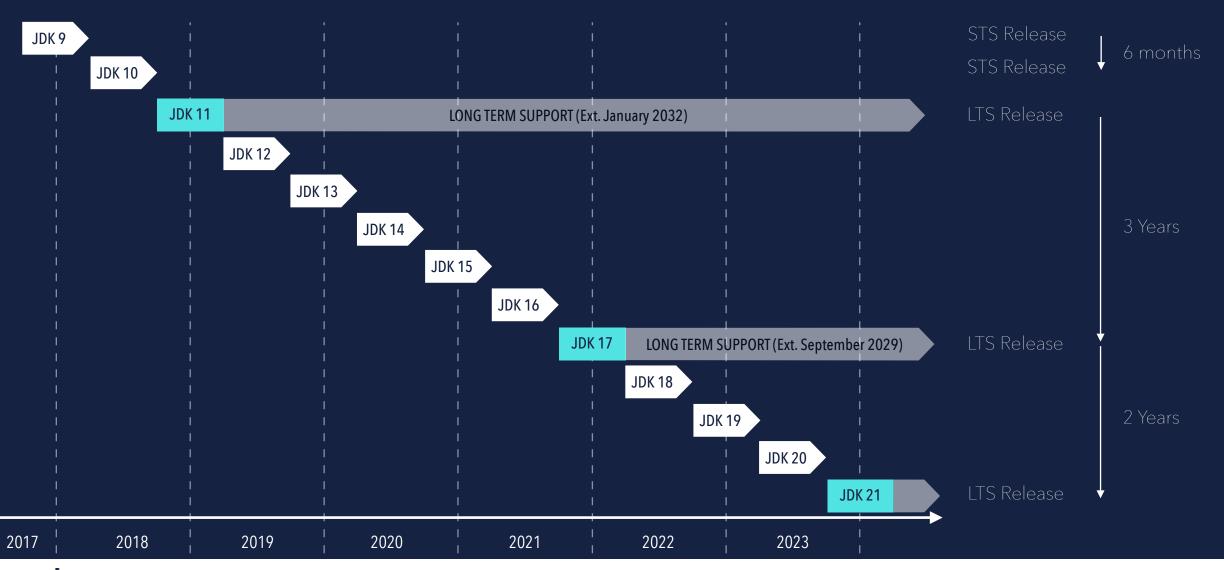


Long Term Support

STS AND LTS



STS AND LTS



STS AND LTS

STS RELEASES ONLY GET UPDATES FOR 6 MONTHS!!!

STS AND LTS

LTS RELEASES
GET UPDATES
FOR YEARS !!!

STS AND LTS

NOT EVERY DISTRIBUTION PROVIDES STS AND LTS RELEASES !!!

STS AND LTS

RECOMMENDATION

Development

STS / LTS

Production

LTS







Patch Set Update

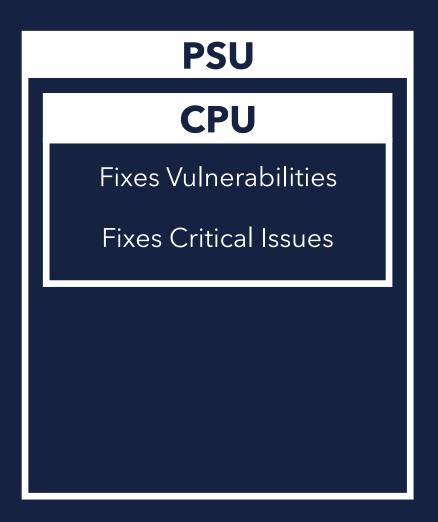
CRITICAL PATCH UPDATE / PATCH SET UPDATE

CPU

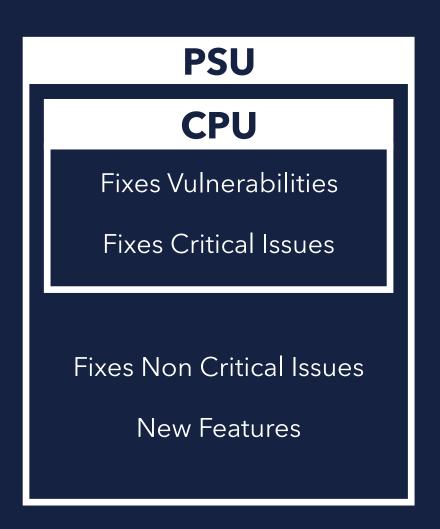
Fixes Vulnerabilities

Fixes Critical Issues

CRITICAL PATCH UPDATE / PATCH SET UPDATE



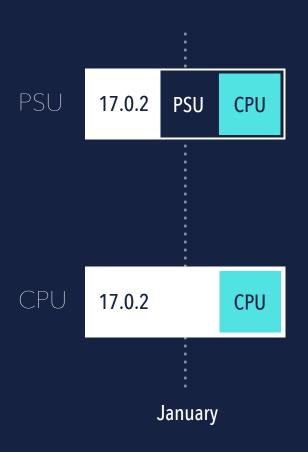
CRITICAL PATCH UPDATE / PATCH SET UPDATE



CAN INTRODUCE NEW ISSUES

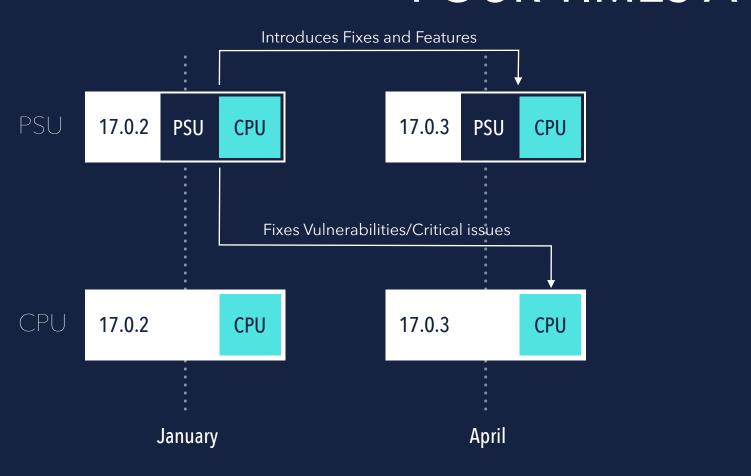


CRITICAL PATCH UPDATE / PATCH SET UPDATE

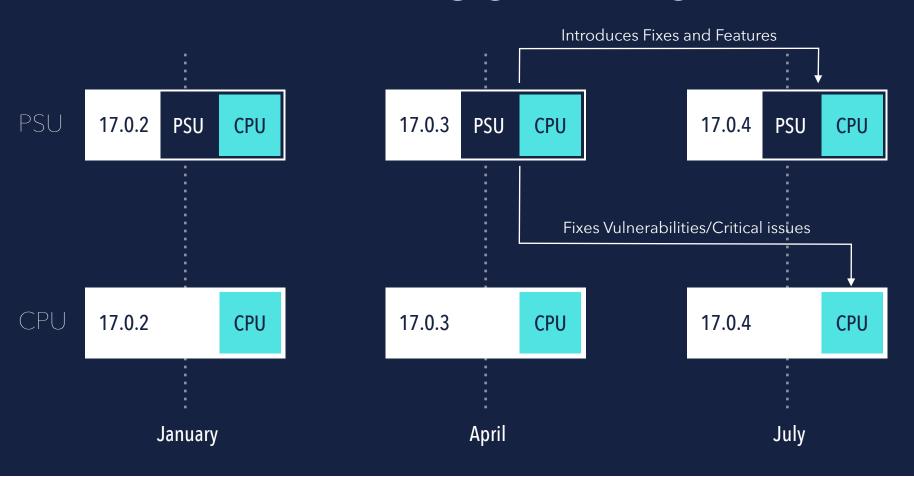




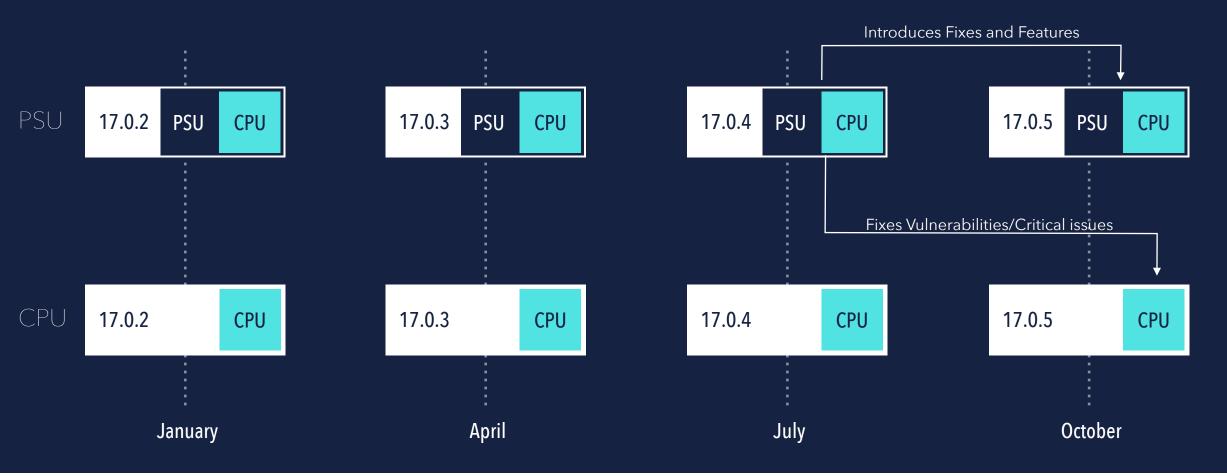
CRITICAL PATCH UPDATE / PATCH SET UPDATE



CRITICAL PATCH UPDATE / PATCH SET UPDATE



CRITICAL PATCH UPDATE / PATCH SET UPDATE



CRITICAL PATCH UPDATE / PATCH SET UPDATE

CPU UPDATES ARE 3 MONTHS BEHIND PSU UPDATES BUT WAY MORE SECURE !!!

CRITICAL PATCH UPDATE / PATCH SET UPDATE

PATCH SET UPDATES ARE AVAILABLE FROM

Most of the available distributions

CRITICAL PATCH UPDATE / PATCH SET UPDATE

CRITICAL PATCH UPDATES ARE AVAILABLE FROM

- Azul
- BellSoft
- Oracle

CRITICAL PATCH UPDATE / PATCH SET UPDATE

RECOMMENDATION

Development

CPU / PSU

Production

CPU

WHY CPUS MATTER

- PSU 8u252 introduced a change that prevented Hadoop Cluster and Solr from running
- CPU 8u251 only contained security fixes from PSU 8u242 and did not introduce this change





(Licensed by Oracle)

TECHNOLOGY COMPATIBILITY KIT

WHAT IT IS

Originally developed by Sun Microsystems

TECHNOLOGY COMPATIBILITY KIT

WHAT IT IS

- Originally developed by Sun Microsystems
- Intellectual Property, licensed by Oracle

TECHNOLOGY COMPATIBILITY KIT

WHAT IT IS

- Originally developed by Sun Microsystems
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- Contains 120 000+ individual tests for Java 11

TECHNOLOGY COMPATIBILITY KIT

- Originally developed by Sun Microsystems
- Intellectual Property, licensed by Oracle
- Contains 120 000+ individual tests for Java 11
- They are defined in the JCK



(Part of TCK)

JAVA COMPATIBILITY TEST SUITE

IT TESTS FEATURES THAT

Are likely to differ across implementations

JAVA COMPATIBILITY TEST SUITE

- Are likely to differ across implementations
- Rely on hardware or operating system specific behavior

JAVA COMPATIBILITY TEST SUITE

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- Rely on hardware or operating system specific behavior
- Are difficult to port

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- Either mask/abstract hardware behavior

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- Either mask/abstract hardware behavior
- Either mask/abstract operating system behavior

JAVA COMPATIBILITY TEST SUITE

HOW TO GET ACCESS TO THE JCK

Available at not charge

JAVA COMPATIBILITY TEST SUITE

HOW TO GET ACCESS TO THE JCK

- Available at not charge
- Must meet terms of the OCTLA (OpenJDK Community TCK License Agreement)

JAVA COMPATIBILITY TEST SUITE

HOW TO GET ACCESS TO THE JCK

- Available at no charge
- Must meet terms of the OCTLA (OpenJDK Community TCK License Agreement)
- Must sign OCA (Oracle Contributor Agreement)

TCK COMPLIANCE JDK 8

DISTRIBUTIONS COMPLIANT TO THE TCK

- Bi Sheng
- Corretto
- Dragonwell
- Liberica

- Oracle JDK
- Oracle OpenJDK
- Red Hat
- SAP Machine

- Temurin
- Zulu
- Platform Prime

TCK COMPLIANCE JDK 9 AND ABOVE

DISTRIBUTIONS COMPLIANT TO THE TCK

- Corretto
- JetBrains
- Kona
- Liberica
- Microsoft

- Open Logic
- Oracle JDK
- Oracle OpenJDK
- Red Hat
- SAP Machine

- Semeru Certified
- Temurin
- Zulu
- Platform Prime



Adoptium Quality Assurance Vitality and speed test suite

(By Eclipse)

AQAVIT TEST SUITE

WHAT IT IS

• Ensures that all additional qualities are present that make it suitable for production use

AQAVIT TEST SUITE

- Ensures that all additional qualities are present that make it suitable for production use
- A collection of over 350 000 tests

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- A collection of over 350 000 tests
- Designed to test real world utilization patterns

AQAVIT TEST SUITE

- Ensures that all additional qualities are present that make it suitable for production use
- A collection of over 350 000 tests
- Designed to test real world utilisation patterns
- A suite of security and durability tests

AQAVIT COMPLIANCE JDK 8

DISTRIBUTIONS COMPLIANT TO THE AQAVIT TEST SUITE

- BiSheng
- Dragonwell
- Red Hat

- Temurin
- Zulu

AQAVIT COMPLIANCE JDK 11 AND ABOVE

DISTRIBUTIONS COMPLIANT TO THE AQAVIT TEST SUITE

- Microsoft
- Semeru Certified
- Red Hat

- Temurin
- Zulu

RECOMMENDATION

Development

ANY

Production

TCK

DIFFERENCES





COST

FREE FOR USE

- Bi Sheng
- Corretto
- Dragonwell
- Gluon GraalVM
- GraalVM Community
- GraalVM*
- JetBrains

- Kona
- Liberica
- Liberica NIK
- Mandrel
- Microsoft
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- Oracle OpenJDK
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- Trava
- Zulu



COSTPAY FOR USE

• Azul Platform Prime (based on number of cores)

COSTPAY FOR USE

- Azul Platform Prime (based on number of cores)
- IBM Semeru certified

COST PAY FOR USE

- Azul Platform Prime (based on number of cores)
- IBM Semeru certified
- GraalVM (based on number of employees*)

COSTPAY FOR USE

- Azul Platform Prime (based on number of cores)
- IBM Semeru certified
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- Oracle JDK (based on number of employees*)

DIFFERENCES



PERFORMANCE

BASELINE PERFORMANCE

- Adopt OpenJDK[†]
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- Semeru
- Temurin
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PERFORMANCE

BASELINE PERFORMANCE

MORE OR LESS THE SAME WITH SOME EXCEPTIONS







THE JVM

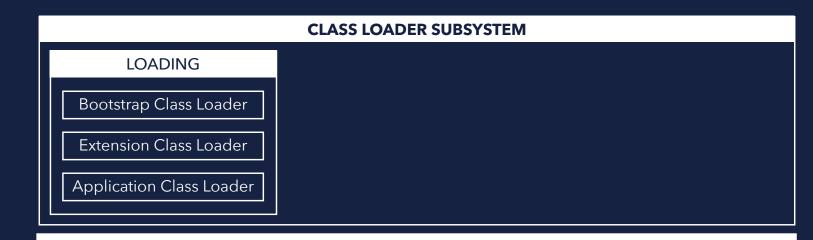
INTERNAL STRUCTURE

CLASS LOADER SUBSYSTEM

JVM MEMORY

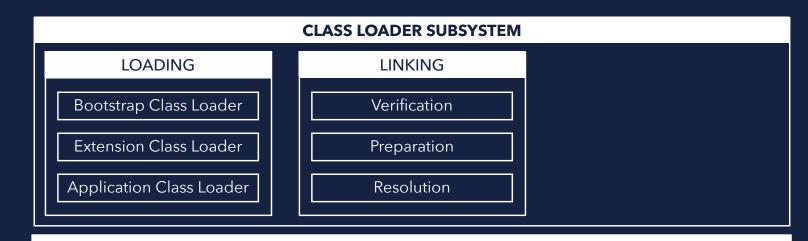
EXECUTION ENGINE

THE JVM INTERNAL STRUCTURE

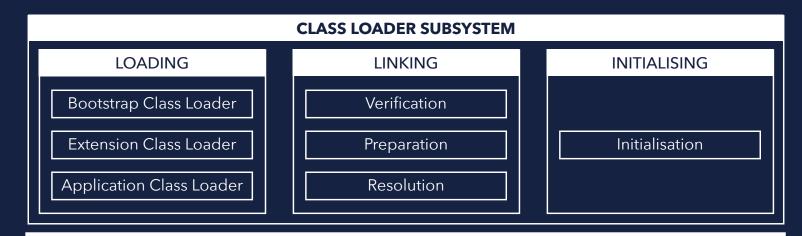


JVM MEMORY

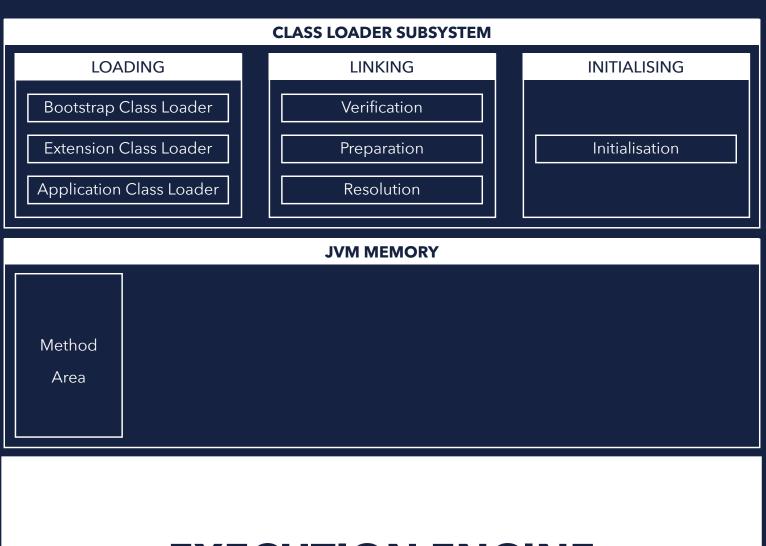
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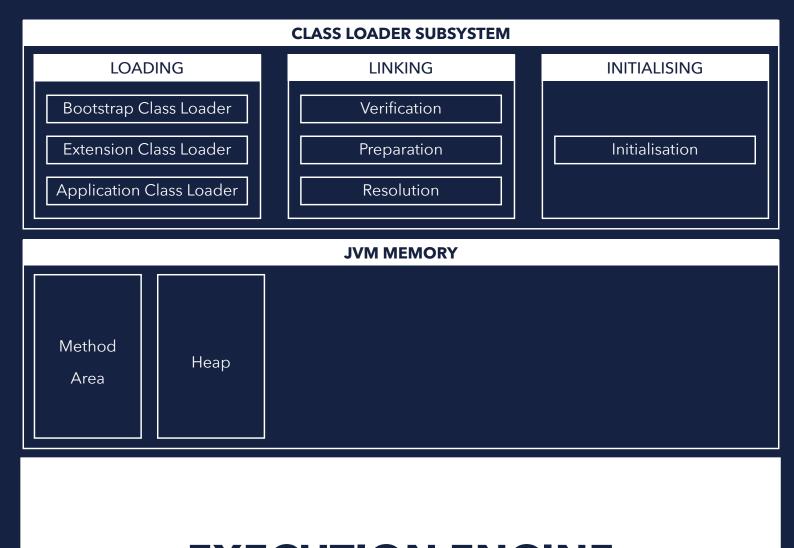


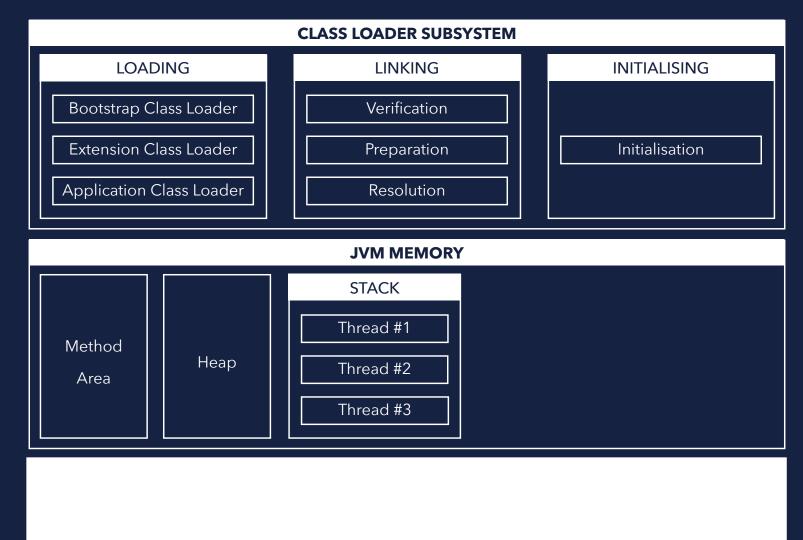
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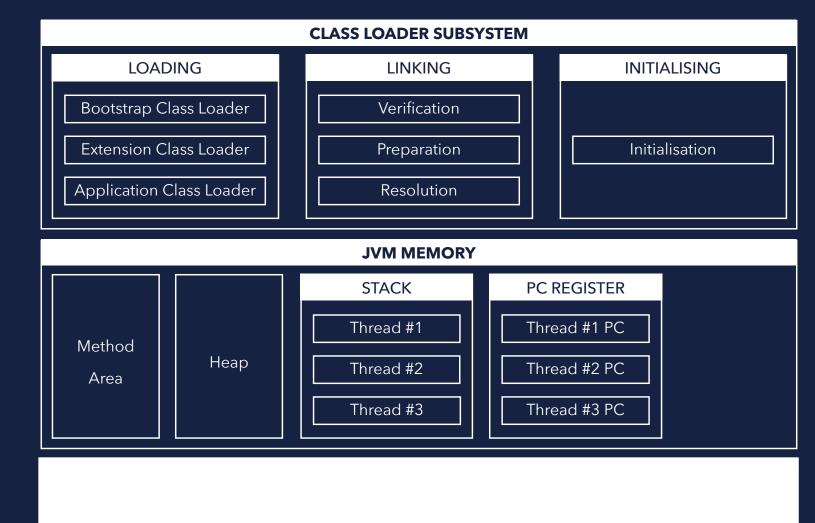


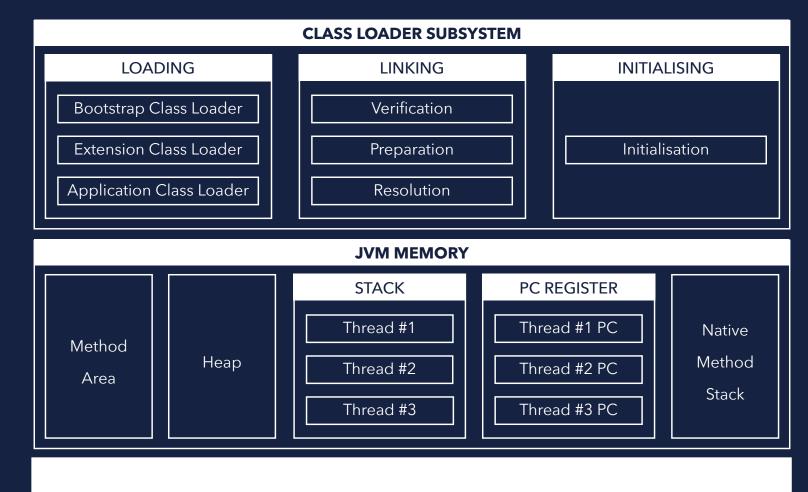
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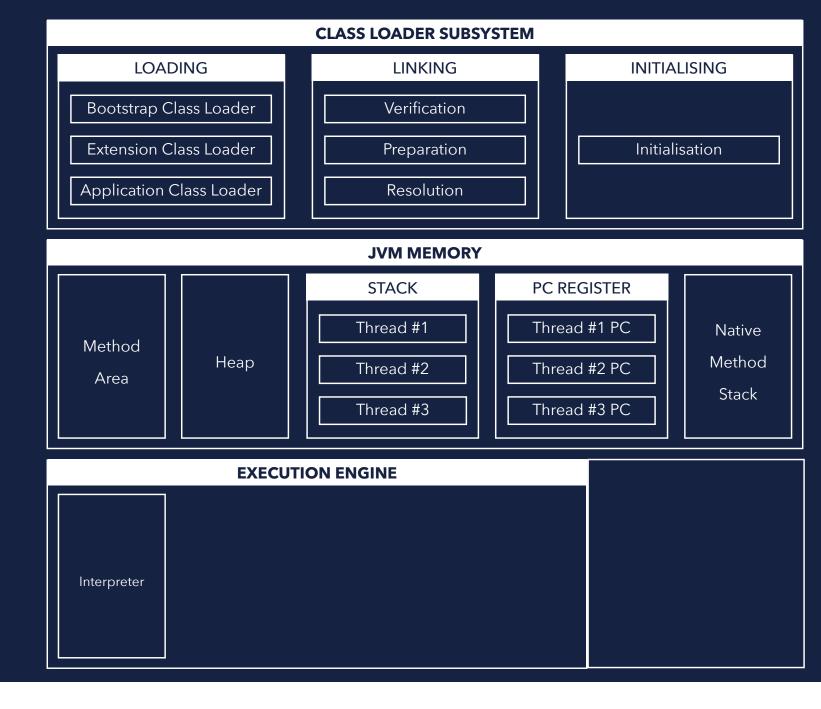


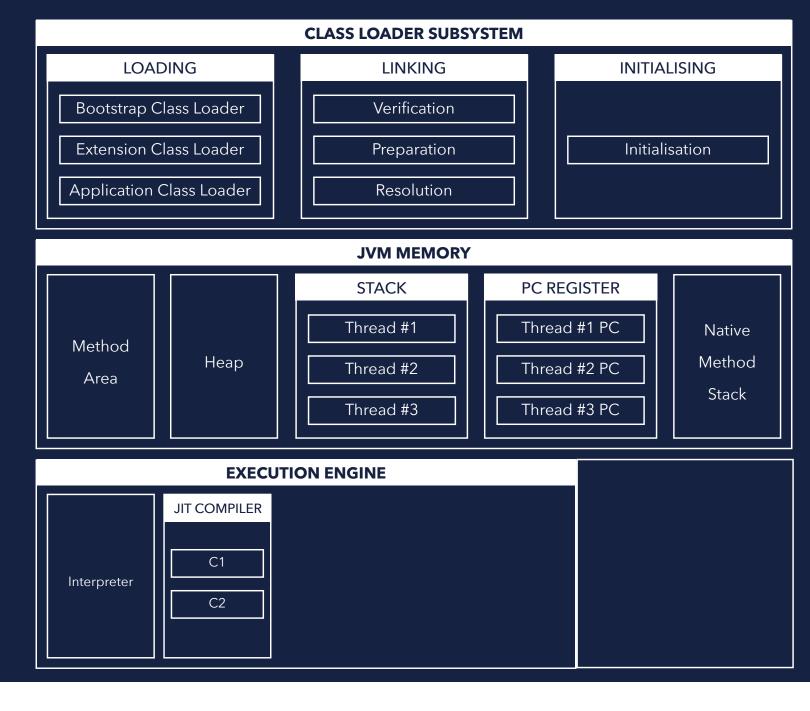






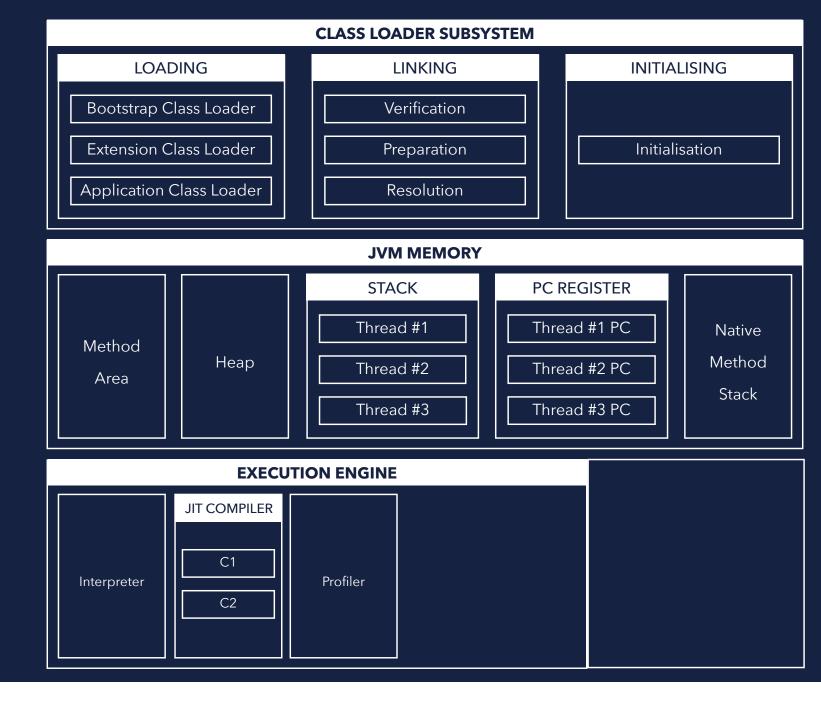


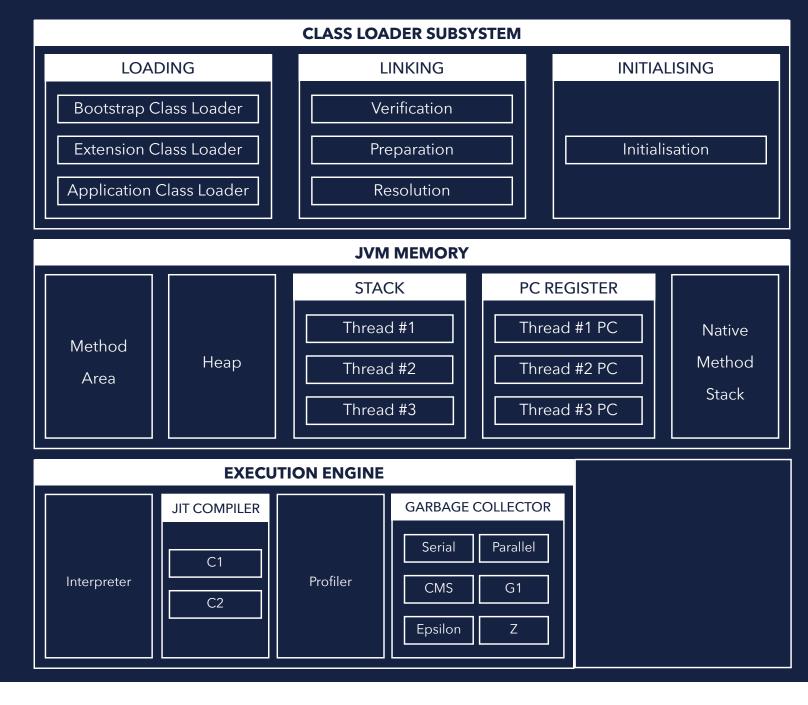




THE JVM

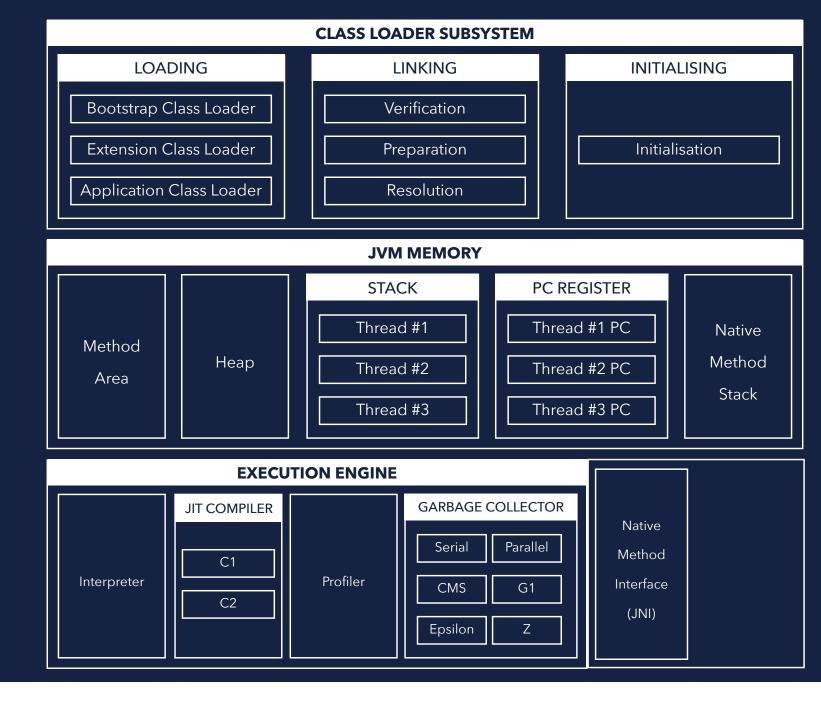






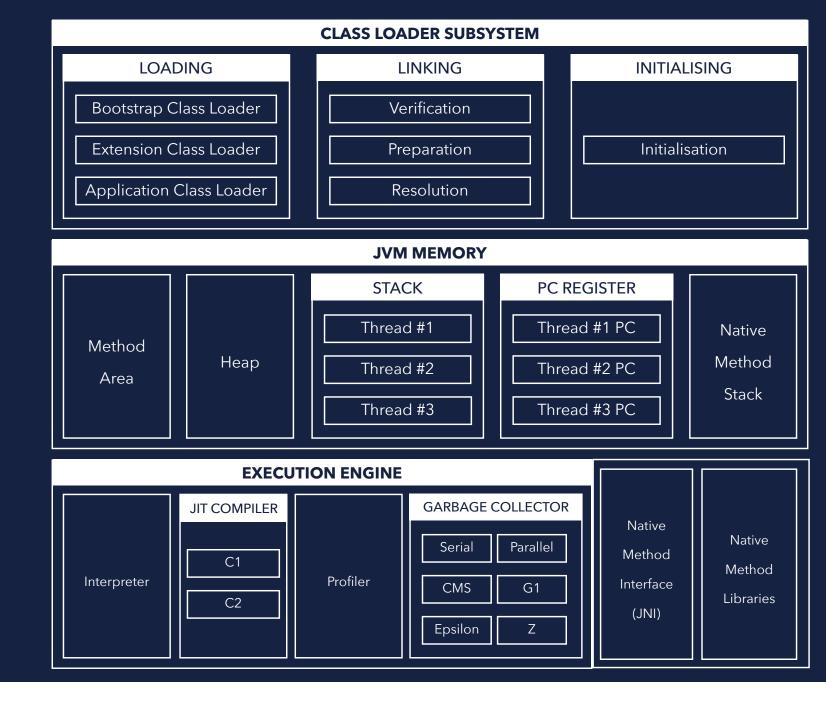
THE JVM

INTERNAL STRUCTURE

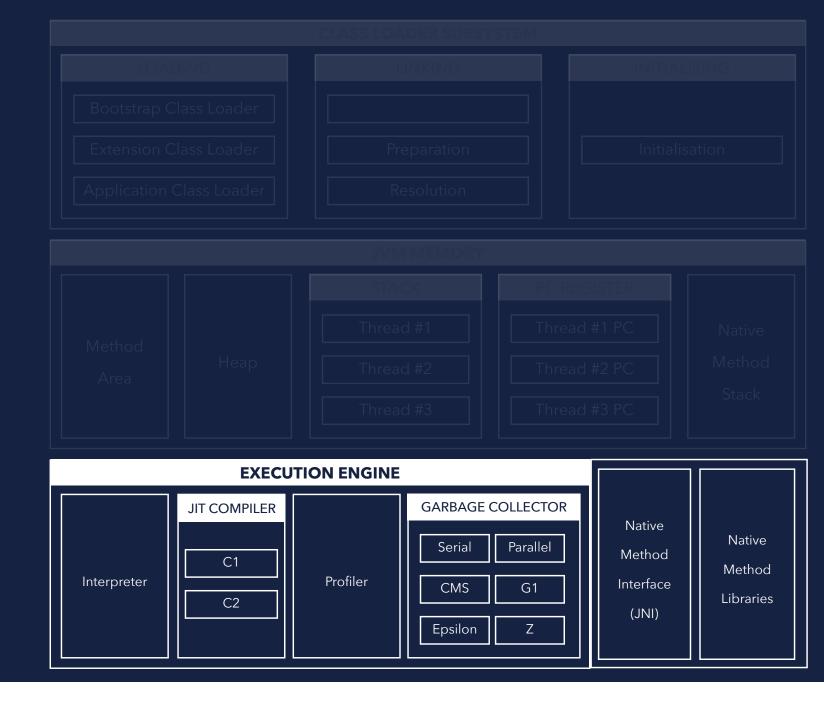


THE JVM

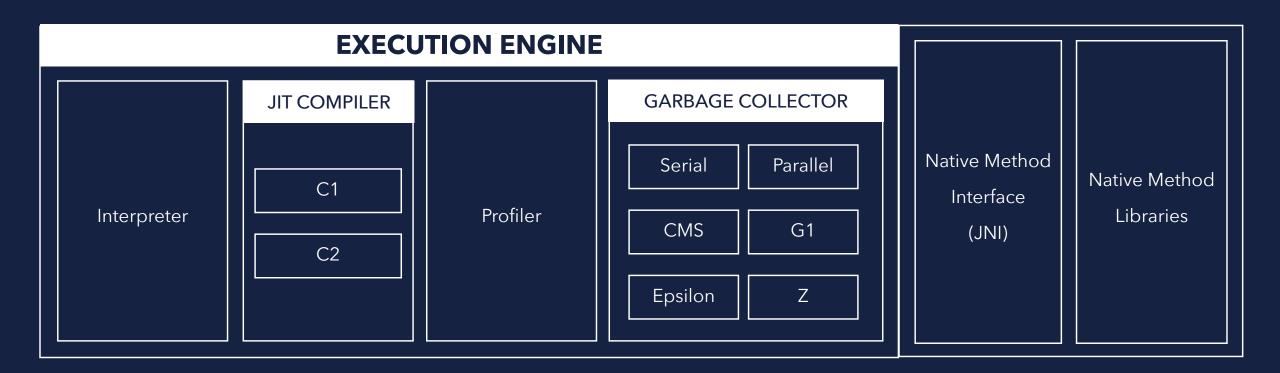
INTERNAL STRUCTURE



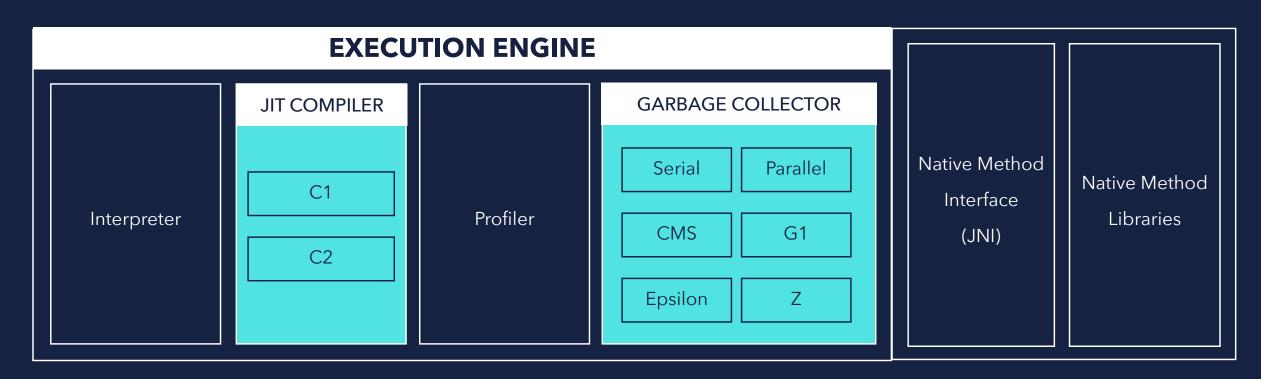
HIGH PERFORMANCE



HIGH PERFORMANCE



HIGH PERFORMANCE



CAN BE REPLACED

HIGH PERFORMANCE

• Azul Platform Prime (Different compiler and garbage collector)

HIGH PERFORMANCE

- Azul Platform Prime (Different compiler and garbage collector)
- Oracle GraalVM (Different compiler)

DIFFERENCES



FEATURES

AMAZON CORRETTO

AMAZON CORRETTO

• SNAPSTART (Faster startup through CRaC and Firecracker esp. for lambdas)

FEATURES

• STANDARD + EXTENDED EDITION

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- JWARMUP (Experimental faster startup by caching compiler optimizations)

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- ELASTIC HEAP (GC feature that returns memory of Java heap to operating system)

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- JWARMUP (Experimental faster startup by caching compiler optimisations)
- ELASTIC HEAP (GC feature that returns memory from Java heap to operating system)
- WISP2 (Stackful, symmetric coroutine at JVM level)

FEATURES

TENCENT KONA

TENCENT KONA

• SPECIALISED ON ARM

TENCENT KONA

- SPECIALISED ON ARM
- KONA FIBERS IN JDK 8 and JDK 11 (Coroutine compatible with Loom)

TENCENT KONA

- SPECIALISED ON ARM
- KONA FIBERS IN JDK 8 and JDK 11 (Coroutine compatible with Loom)
- ZGC FOR ARM (ZGC implementation for ARM architecture)

FEATURES

BELLSOFT LIBERICA

BELLSOFT LIBERICA

• JAVAFX (JDK comes bundled with Java FX)

FEATURES

BELLSOFT LIBERICA NIK

BELLSOFT LIBERICA NIK

• JAVAFX (GraalVM build comes bundled with Java FX)

BELLSOFT LIBERICA NIK

- JAVAFX (GraalVM build comes bundled with Java FX)
- NATIVE DESKTOP APPS

FEATURES

GLUON GRAALVM

• JAVAFX (GraalVM build comes bundled with Java FX)

- JAVAFX (GraalVM build comes bundled with Java FX)
- NATIVE DESKTOP APPS

- JAVAFX (GraalVM build comes bundled with Java FX)
- NATIVE DESKTOP APPS
- NATIVE ANDROID APPS

- JAVAFX (GraalVM build comes bundled with Java FX)
- NATIVE DESKTOP APPS
- NATIVE ANDROID APPS
- NATIVE IOS APPS

FEATURES

• COMMUNITY + ENTERPRISE EDITION

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- POLYGLOT VM (Support for Java, JavaScript, Python, R and Ruby)

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- GRAAL AOT COMPILER (Ahead of time compilation to native images)

FEATURES

• COMMUNITY + CERTIFIED EDITION

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- OPENJ9 / J9 JVM (Faster startup, lower memory consumption)

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- JIT SERVER (Decoupled, remote JIT compiler)

FEATURES

MICROSOFTJDK

MICROSOFT JDK

• NOESCAPE (Experimental feature to decrease latency, improve throughput)

FEATURES

• JAVAFX (JDK comes bundled with Java FX)

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- CODE INVENTORY (Create inventory about code running in production)

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- CODE INVENTORY (Create inventory about code running in production)
- CRaC (Coordinate Restore at Checkpoint)

ALTERNATIVES

• FALCON JIT COMPILER (Replacement for C2 compiler with higher performance)

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- C4 GARBAGE COLLECTION (Pauseless garbage collection even on large heaps)

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ARE ALL THOSE BUILDS OF OPEN JDK REALLY DIFFERENT?

TECHNICALLY...

NOT REALLY...!

SERVICE, SUPPORT, COST...

PROBABLY YES...!

SO CHOOSE WISELY WHEN SELECTING A JDK

