Java 9 - 15

Key Features and Enhancements

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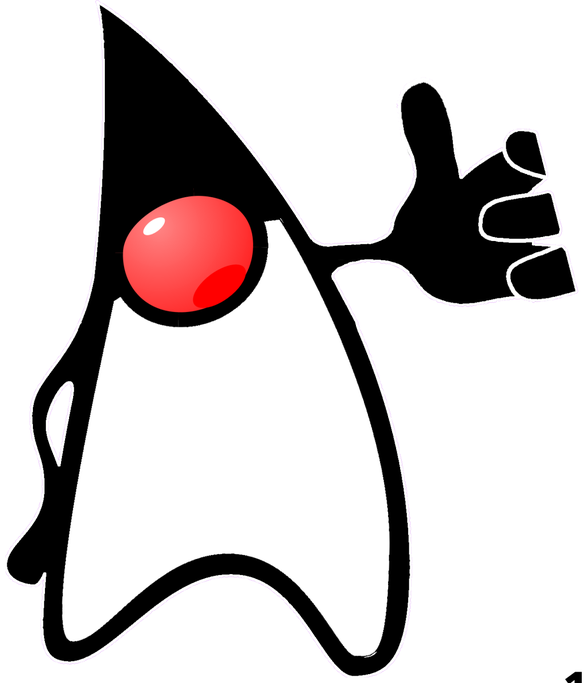

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Java 9

#WorksFineWithJavaNine

Java 9

- Released: Sep. 2017
- => Java 8 was Mar. 2014
- 150 new features and enhancements
- One of the largest upgrades to Java
- https://openjdk.java.net/projects/jdk9/
- https://speakerdeck.com/cguntur/java-9-new-features

Private Methods in Interfaces (1)

- To share common code between methods
- Methods with bodies: `static` and `default`
- `private default` & `private abstract` not valid combinations
- Originally in Java 8 experimental, dropped
- https://bugs.openjdk.java.net/browse/JDK-8071453

Writeup: https://cguntur.me/2017/09/02/java-9-features-private-interface-methods/

Private Methods in Interfaces (2)

Java support in interfaces

	Java 7	Java 8	Java 9
constants			
abstract methods			
default methods			
public static methods			
private methods			
private static methods			

Collections - Factory Methods

- Allow ease of declaration/instantiation
- Examples:
  - `List.of("one", "two");`
  - `Map.of("key1", "val1", "key2", "val2");`
- JEP 269 - Convenience Collection Factory Methods: http://openjdk.java.net/jeps/269
- https://blogs.oracle.com/java/collections-refueled

G1GC - Default Garbage Collector

- Introduced in Java 7, targeted for Java 8
- JVM now uses a Metaspace instead of PermGen
- GC focusses on garbage-heavy regions
- JEP 248 - Make G1 the default collector: http://openjdk.java.net/jeps/248
- https://speakerdeck.com/cguntur/java-garbage-collection-basics

https://docs.oracle.com/javase/9/gctuning/garbage-first-garbage-collector.htm

Version String Scheme

- Scheme in Java 9 is $MAJOR.$MINOR.$SECURITY_PATCH
- Replaces confusing mix of version and build numbers
- Deemed temporary, changes in future versions
- JEP 223 - Version-String Scheme:
  http://openjdk.java.net/jeps/223
- https://mreinhold.org/blog/forward-faster

JShell - Java REPL

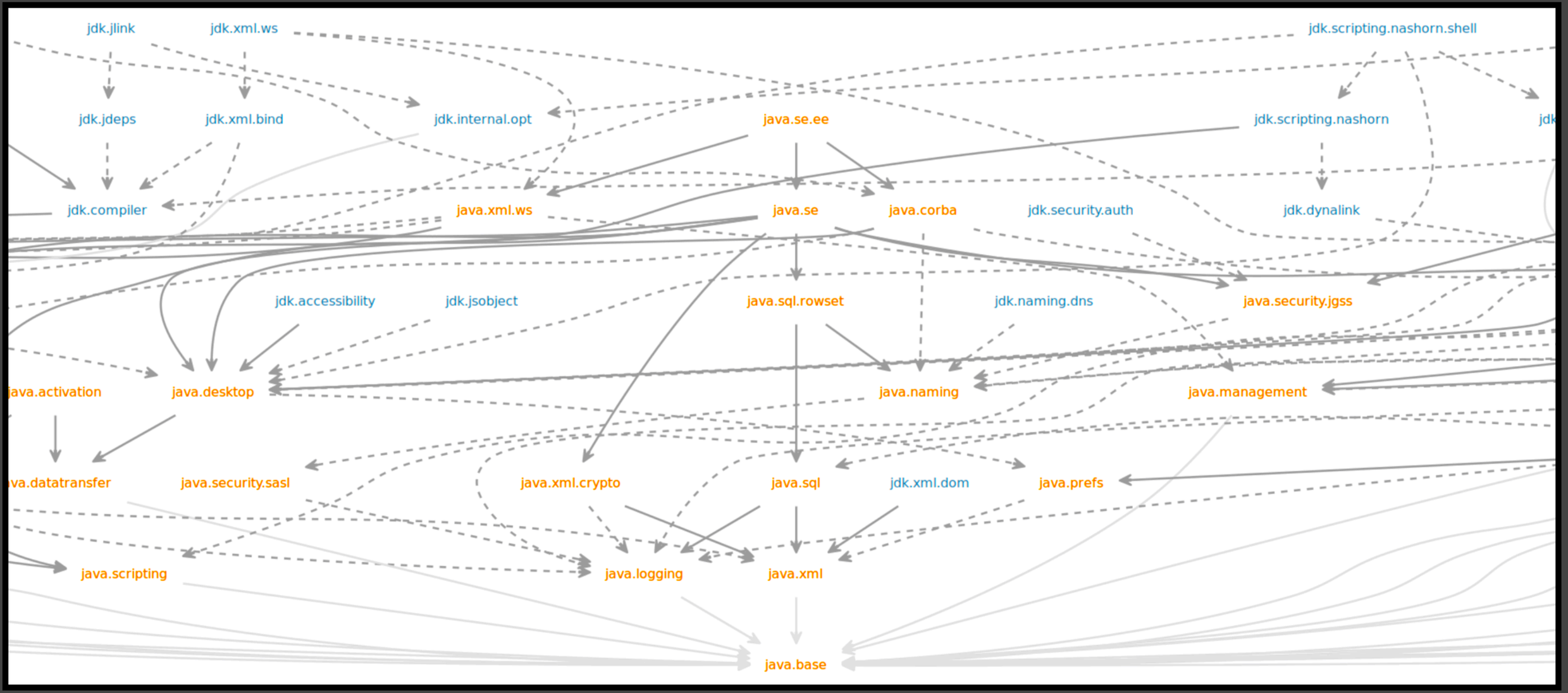
- Read-Eval-Print-Loop for a transcript evaluation
- Great teaching tool
- Originally targeted for Java 7
- Built on JShell API
- JEP 222 - jshell - The Java Shell:
  http://openjdk.java.net/jeps/222

http://cr.openjdk.java.net/~rfield/tutorial/JShellTutorial.html

Java Platform Modularity System (1)

- Reduce the large and growing java package size
- Also aims to remove/deprecate vestigial packages
- Allows splitting the JDK in smaller units (modules)
- Root module called java.base
- Dependencies packaged as .jmod files
- Module path to replace classpath

Java 9



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Java Platform Modularity System (2)

- Java 9 itself is a modular system
- Restructures JDK and JRE runtime images - as modules
- No more rt.jar and tools.jar in libs
- Enables Compact Profiles:
  http://openjdk.java.net/jeps/161
- jlink responsible for assembly and optimizing modules
- jlink produces custom runtime images

Java Platform Modularity System (3)

JPMS (JSR 376):
http://openjdk.java.net/projects/jigsaw/spec/

JEP 261 - Module System:
http://openjdk.java.net/jeps/261

JEP 200 - The Modular JDK:
http://openjdk.java.net/jeps/200

JEP 220 - Modular Run-Time Images:
http://openjdk.java.net/jeps/220

JEP 260 - Encapsulate Internal APIs:
http://openjdk.java.net/jeps/260

Other Important enhancements

- java.util.Optional - new methods added
- java.util.stream.Stream - new methods added
- java.util.concurrent.* - reactive and futures
- Compact Strings - major fixes to compressed strings
- Deprecation - added forRemoval & since attributes
- Compiler - new flags to compile (--release)

Java 10

#WorksWhenOnJavaTen

Java 10

- Released: Mar. 2018
- First release in the 6-month release model
- Fewer features and enhancements
- Marked as a feature-release, not LTS
- https://openjdk.java.net/projects/jdk/10/

Local Variable Type Inference (1)

- Introduction of var as a variable type
- Examples:
  - `var list = new ArrayList<String>(); // infers ArrayList<String>`
  - `var stream = list.stream(); // infers Stream<String>`
- Requires initialization of the variable
- JEP 286 - Local-variable Type Inference: http://openjdk.java.net/jeps/286

Local Variable Type Inference (2)

- Incorrect Examples:

```
var x; // cannot infer type for local
var f = () -> { }; // cannot infer type for local
var g = null; // cannot infer type for local
var k = { 1 , 2 }; // cannot infer type for local
(var x, var y) -> x.process(y) // not supported
```

https://openjdk.java.net/projects/amber/LVTIstyle.html

Application Class-Data Sharing

- Improves startup and memory footprint
- Extends existing CDS (JDK 5) to application classes
- Allows loading to custom class loaders as well
- Use -XX:+UseAppCDS to enable Application CDS
- JEP 310 - Application Class-Data Sharing: http://openjdk.java.net/jeps/310

Experimental Java-Based JIT Compiler

- Enables Graal Ahead-of-time JIT Compiler
- First step for Project Metropolis
- Extends the compiler via a JVM Compiler Interface
- Use with -XX:+UseJVMCICompiler to enable
- JEP 317 - Experimental Java-Based JIT Compiler: http://openjdk.java.net/jeps/317

Metropolis: http://mail.openjdk.java.net/pipermail/announce/2017-September/000233.html

Time-Based Release Versioning

- New scheme: $FEATURE.$INTERIM.$UPDATE.$PATCH
- Also added a java.version.date System property
- Make it easy for a developer to figure out how old a release is
- JEP 322 - Time-Based Release Versioning: http://openjdk.java.net/jeps/322

Other Features

- JEP-296: Consolidate the JDK Forest into a Single Repository
- JEP-304: Garbage-Collector Interface
- JEP-307: Parallel Full GC for G1
- JEP-312: Thread-Local Handshakes
- JEP-313: Remove the Native-Header Generation Tool (javah)
- JEP-314: Additional Unicode Language-Tag Extensions
- JEP-316: Heap Allocation on Alternative Memory Devices
- JEP-319: Root Certificates

Java 11

#WorksLikeHeavenWithJavaEleven

Java 11

- Released: Sep. 2018
- Marked as Long Term Support release, not FR
- https://openjdk.java.net/projects/jdk/11/

Local-Variable Syntax for Lambda Parameters

- Fixes issues with var usage in lambda parameters
- Great addition for annotating params in lambdas
- Examples:
  - `(var x, var y) -> x.process(y) // Works in Java 11`
  - `(@Nonnull var x, @Nullable var y) -> x.process(y)`
- JEP 323 - Local-Variable Syntax for Lambda Parameters: http://openjdk.java.net/jeps/323

Launch Single-File Source-Code Programs

- Enables launching a single file Java program
- Automatically compiles and runs Java file
- Example: `java HelloWorld.java` (no need for `javac`)
- Great tool for students and new beginners
- JEP 330 - Launch Single-File Source-Code Programs: http://openjdk.java.net/jeps/330

Remove the Java EE and CORBA Modules

- Removes Java EE & CORBA modules deprecated in Java 9
- Source code deleted from OpenJDK repository
- Binaries do not include these deleted modules
- Related to the separation of Java SE and Jakarta EE
- JEP 320 - Remove the Java EE and CORBA Modules: http://openjdk.java.net/jeps/320

Epsilon Garbage Collector

- Experimental No-Op memory allocator without any GC
- Very useful for:
  - Performance testing
  - Memory pressure testing
  - Extremely short-lived jobs
  - Other deeper JVM development
- JEP 318 - Epsilon: A No-Op Garbage Collector: http://openjdk.java.net/jeps/318

Z Garbage Collector

- Experimental Low latency scalable garbage collector
- Main features:
  - Guaranteed pause times (10ms)
  - Handles range of small (few MB) to very large memory (TBs)
  - Foundation for future GC features and optimizations
  - Concurrent, single-generation, region-based, NUMA-aware, compacting collector
- JEP 333 - ZGC: A Scalable Low-Latency Garbage Collector: http://openjdk.java.net/jeps/333

Other Features (1)

- JEP-181: Nest-Based Access Control
- JEP-309: Dynamic Class-File Constants
- JEP-315: Improve Aarch64 Intrinsics
- JEP-321: HTTP Client (Standard)
- JEP-324: Key Agreement with Curve25519 and Curve448
- JEP-327: Unicode 10

Other Features - continued

- JEP-328: Flight Recorder
- JEP-329: ChaCha20 and Poly1305 Cryptographic Algorithms
- JEP-331: Low-Overhead Heap Profiling
- JEP-332: Transport Layer Security (TLS) 1.3
- JEP-335: Deprecate the Nashorn JavaScript Engine
- JEP-336: Deprecate the Pack200 Tools and API

Java 12

#TheBestDelvelsJavaTwelve

Java 12

- Released: Mar. 2019
- Marked as a feature-release, not LTS
- https://openjdk.java.net/projects/jdk/12/

Switch Expressions (Preview)

- Preview for switch used as statement or expression

```
public class Quarter {

    public static void main(String[] args) {

        Month month = Month.SEPTEMBER;

        int quarter = switch (month) {
            case JANUARY, FEBRUARY, MARCH     -> 1;
            case APRIL, MAY, JUNE             -> 2;
            case JULY, AUGUST, SEPTEMBER      -> 3;
            case OCTOBER, NOVEMBER, DECEMBER -> 4;
        };

        System.out.println("-->  Q" + quarter);
    }
}
```

-> Q3

- JEP 325 - Switch Expressions (Preview): http://openjdk.java.net/jeps/325

Compact Number Formatting

```
public class TwitterStats {

    public static void main(String[] args) {
        final Locale locale = new Locale( language: "en", country: "US");

        NumberFormat impressions = NumberFormat
                .getCompactNumberInstance( locale: locale, formatStyle: SHORT);
        impressions.setMaximumFractionDigits(1);


        NumberFormat followers = NumberFormat
                .getCompactNumberInstance( locale: locale, formatStyle: LONG);
        followers.setMaximumFractionDigits(2);

        System.out.println("~ "
                + impressions.format( number: 76092) + " impressions & "
                        + followers.format( number: 2011) + " followers");
    }
}
```

```
~ 76.1K impressions & 2.01 thousand followers
```

- JDK-8188147 - Compact Number Formatting support:
  https://bugs.java.com/bugdatabase/view_bug.do?bug_id=8188147

Shenandoah Garbage Collector

- Experimental Tiny & consistent pause-time garbage collector
- Main features:
  - Adds an indirection pointer to every Java object
  - Concurrent marking and compacting
  - Optimized to never interrupt the running program
  - Pause Java threads only to scan thread stacks to find & update object graph
- JEP 189 - Shenandoah: A Low-Pause-Time Garbage Collector: http://openjdk.java.net/jeps/189

Microbenchmark Suite

- Based on the Java Microbenchmark Harness (JMH)
- Eases the addition, build and running of new benchmarks
- Targeted for continuous performance testing
- JEP 230 - Microbenchmark Suite:
  http://openjdk.java.net/jeps/230

Other Features

- JEP-334: JVM Constants API
- JEP-340: One AArch64 Port, Not Two
- JEP-344: Abortable Mixed Collections for G1
- JEP-346: Promptly Return Unused Committed Memory from G1

Java 13

#AllGreenWithJavaThirteen

Java 13

- Released: Sep. 2019
- Marked as a feature-release, not LTS
- https://openjdk.java.net/projects/jdk/13/

Dynamic CDS Archives

- Extends AppCDS to archive at application exit
- Further speeds up startup times
- CDS and AppCDS were static, Dynamic CDS is an addition
- Use -XX:ArchiveClassesAtExit=my.jsa - to enable
  Use -XX:SharedArchiveFile=my.jsa - to load
- JEP 350 - Dynamic CDS Archives:
  http://openjdk.java.net/jeps/350

Switch Expressions (Preview)

- 2nd Preview for switch used as statement or expression

```
public class Quarter {

    public static void main(String[] args) {

        Month month = Month.SEPTEMBER;

        int quarter = switch (month) {
            case JANUARY, FEBRUARY, MARCH:    yield 1;
            case APRIL, MAY, JUNE:            yield 2;
            case JULY, AUGUST, SEPTEMBER:     yield 3;
            case OCTOBER, NOVEMBER, DECEMBER: yield 4;
        };

        System.out.println("-->  Q" + quarter);
    }
}
```

-> Q3

- JEP 354 - Switch Expressions (Preview): http://openjdk.java.net/jeps/354

Text Blocks (Preview)

- Preview for multi-line text blocks

```
@Test
void noTalksYet() {
    String expected = """
        <conference name="OracleCodeOne">
        </conference>
    """;

    String actual = XmlHelper.generateXml();

    assertEquals( expected: expected,  actual: actual);
}
```

- JEP 355 - Text Blocks (Preview):
  http://openjdk.java.net/jeps/355

Other Features

- JEP-351: ZGC: Uncommit Unused Memory
- JEP-353: Reimplement the Legacy Socket API

Java 14

#AllTestsGreenWithJavaFourteen

Java 14

- Released: Mar. 2020
- Marked as a feature-release, not LTS
- Many new and exciting features !!!
- https://openjdk.java.net/projects/jdk/14/

Pattern Matching for instanceof (Preview)

- Replaces the need to cast once instance is confirmed
- Example:

```
if (obj instanceof String s) {
    // can use s here
} else {
    // can't use s here
}
```

- JEP 305 - Pattern matching for instanceof (Preview): http://openjdk.java.net/jeps/305

Helpful NullPointerExceptions

- Offer helpful information about the premature termination of a program
- Example:

```
a.b.c.i = 99;
```

- Results in:

```
Exception in thread “main" java.lang.NullPointerException:
 Cannot read field "c" because "a.b" is null at Prog.main(Prog.java:5)
```

- JEP 358 - Helpful NullPointerExceptions:
  http://openjdk.java.net/jeps/358

Algebraic Data Types - Records

- Introduction of algebraic data types into Java, with records
- Immutable data objects with built in constructors and accessors

```
record Range(int lo, int hi) {
  public Range {
    if (lo > hi)  /* referring here to the implicit constructor parameters */
      throw new IllegalArgumentException(String.format("(%d,%d)", lo, hi));
  }
}
```

- JEP 359 - Records (Preview): https://openjdk.java.net/jeps/359

Other Features

- JEP-361: Switch Expressions (Standard)
- JEP-345: NUMA-Aware Memory Allocation for G1
- JEP-349: JFR Event Streaming
- JEP-352: Non-Volatile Mapped Byte Buffers
- JEP-362: Deprecate the Solaris and SPARC Ports
- JEP-363: Remove the Concurrent Mark Sweep (CMS) Garbage Collector

Other Features - continued

- JEP-364: ZGC on macOS
- JEP-365: ZGC on Windows
- JEP-366: Deprecate the ParallelScavenge + SerialOld GC Combination
- JEP-367: Remove the Pack200 Tools and API
- JEP-370: Foreign-Memory Access API (Incubator)
- JEP-343: Packaging Tool (Incubator)

Java 15

#BuildsGreenWithJavaFifteen

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Java 15

- To be released: Sep. 2020
- Marked as a feature-release, not LTS
- Once again, many new and exciting features !!!
- https://openjdk.java.net/projects/jdk/15/

Algebraic Data Types - Sealed Classes (Preview)

- Provides limited extendability to types
- Adds new modifiers of sealed and non-sealed
- The final modifier indicates a strong sealed type
- Requires a new permits clause to allow limited hierarchy
- JEP 360 - Sealed classes (Preview): http://openjdk.java.net/jeps/360

Algebraic Data Types - Records (Second Preview)

- Extends on the first preview of records
- Adds ability to create in-method local records
- Clarifies the usage of annotations on records
- JEP 384 - Records (Second Preview): http://openjdk.java.net/jeps/384

Hidden Classes

- Non-discoverable classes best for hiding implementation details.
- Supports aggressive unloading of such classes in JVM
- Great for dynamic proxies and runtime generated classes
- Not to be confused with anonymous classes
- JEP 371 - Hidden classes:
  http://openjdk.java.net/jeps/371

ZGC: No longer experimental

- Changes ZGC from experimental to product feature
- G1 GC still remains default GC
- Great for larger heap sizes, may not be great for smaller ones
- No longer needs -XX:+UnlockExperimentalVMOptions for -XX:+UseZGC
- JEP 377 - ZGC: A Scalable Low-Latency Garbage Collector: http://openjdk.java.net/jeps/377

Shenandoah GC: No longer experimental

- Changes Shenandoah from experimental to product feature
- G1 GC still remains default GC
- Great for continuous pause-less GC across most heap sizes
- No longer needs -XX:+UnlockExperimentalVMOptions for -XX:+UseShenandoahGC
- JEP 379 - Shenandoah: A Low-Pause-Time Garbage Collector: http://openjdk.java.net/jeps/379

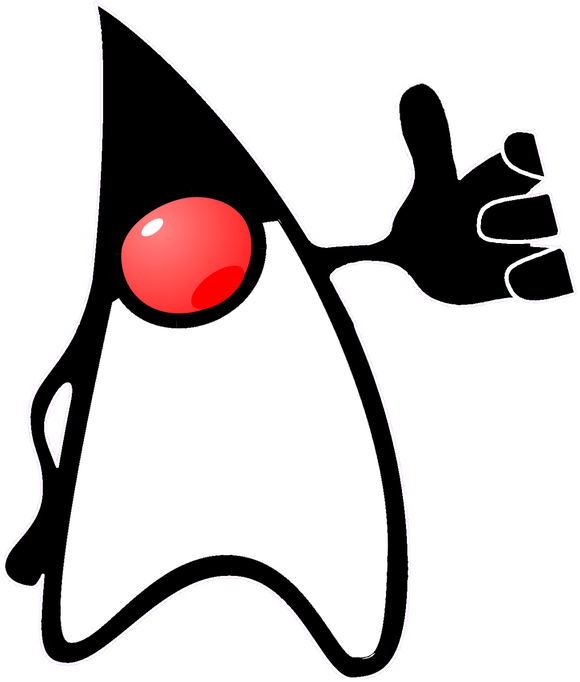
Other Features

- JEP-375: Pattern Matching for instanceof (Second Preview)
- JEP-378: Text Blocks
- JEP-339: Edwards-Curve Digital Signature Algorithm (EdDSA)
- JEP-372: Remove the Nashorn JavaScript Engine
- JEP-385: Deprecate RMI Activation for Removal

Other Features - continued

- JEP-373: Reimplement the Legacy DatagramSocket API
- JEP-374: Disable and Deprecate Biased Locking
- JEP-381: Remove the Solaris and SPARC Ports
- JEP-383: Foreign-Memory Access API (Second Incubator)

THANK YOU!



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