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To Java SE 8, and Beyond!

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Technology Evangelist

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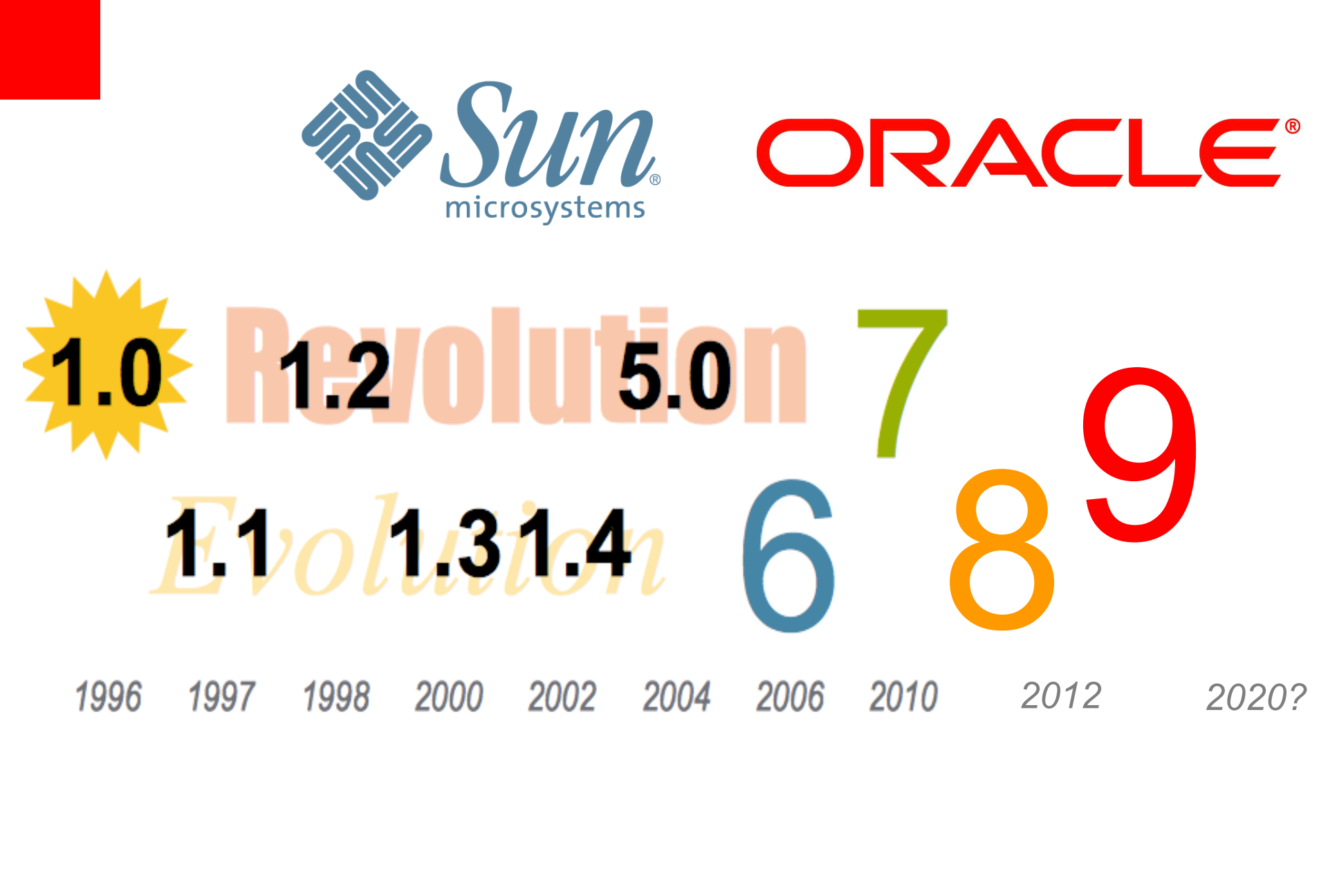
Sun microsystems
ORACLE
1.0
Revolution
1.2
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9
1.1
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Evolution
6
8
1996
1997
1998
2000
2002
2004
2006
2010
2012
2020?

Priorities for the Java Platforms

- Grow Developer Base
- Grow Adoption
- Increase Competitiveness
- Adapt to change

Evolving the Language

From "Evolving the Java Language" - JavaOne 2005

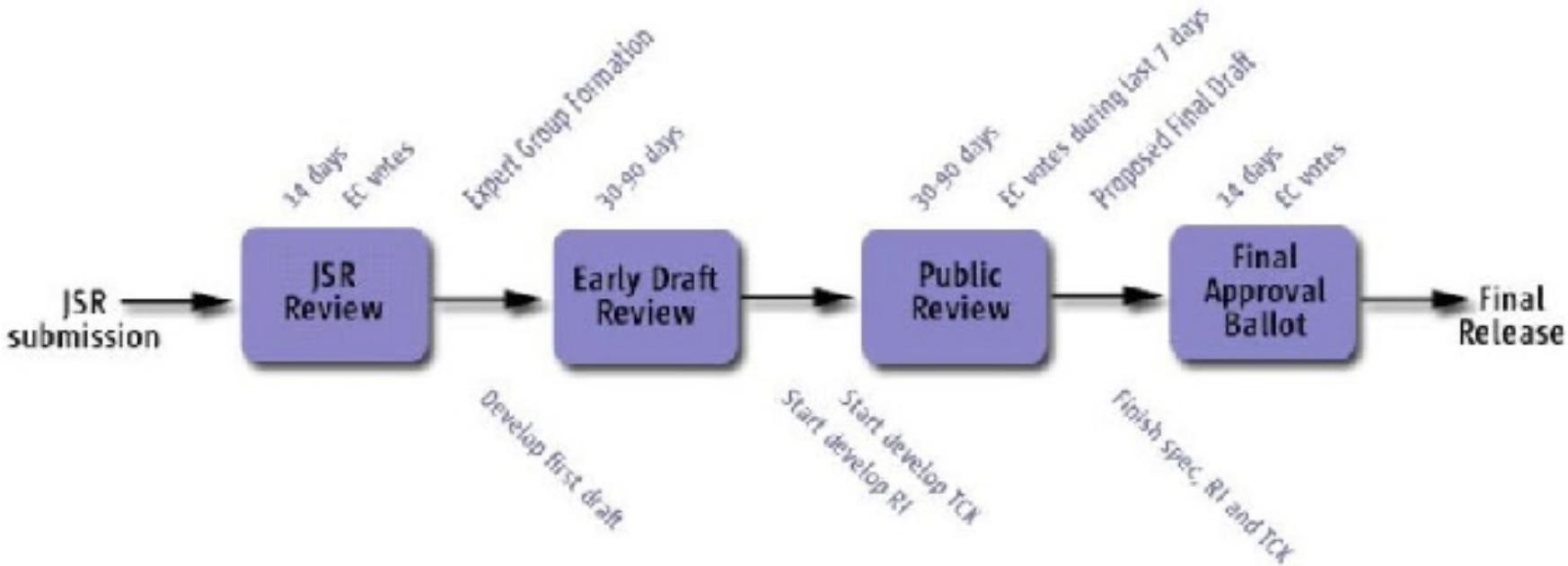
- Java language principles
  - Reading is more important than writing
  - Code should be a joy to read
  - The language should not hide what is happening
  - Code should do what it seems to do
  - Simplicity matters
  - Every "good" feature adds more "bad" weight
  - Sometimes it is best to leave things out
- One language: with the same meaning everywhere
  - No dialects
- We will evolve the Java language
  - But cautiously, with a long term view
  - "first do no harm"

also "Growing a Language" - Guy Steele 1999
"The Feel of Java" - James Gosling 1997

How Java Evolves and Adapts

Of the community, by the community, for the community

Java Community Process



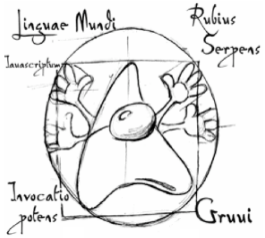
JSR-348: JCP.next

JCP Reforms

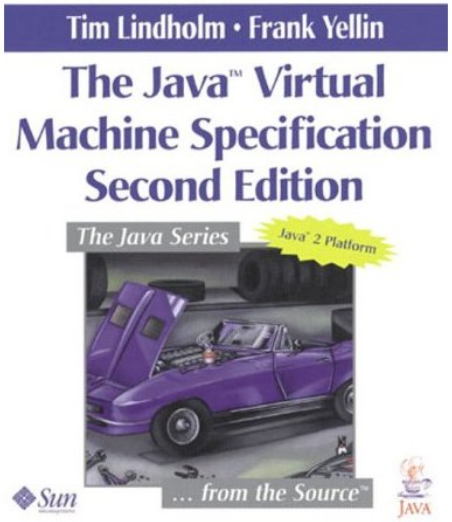
- Developers' voice in the Executive Committee
  - SOUJava
  - Goldman Sachs
  - London JavaCommunity
- JCP starting a program of reform
  - JSR 348: Towards a new version of the JCP

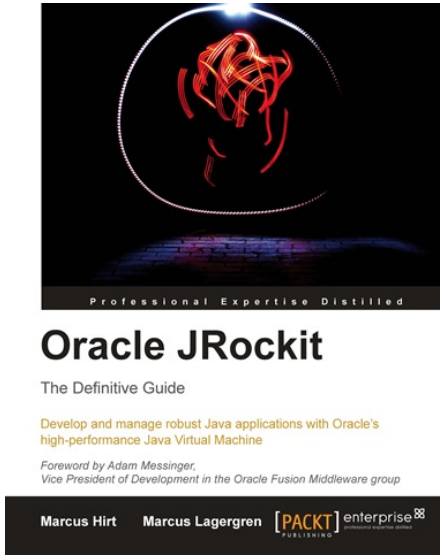
Java SE 7 Release Contents

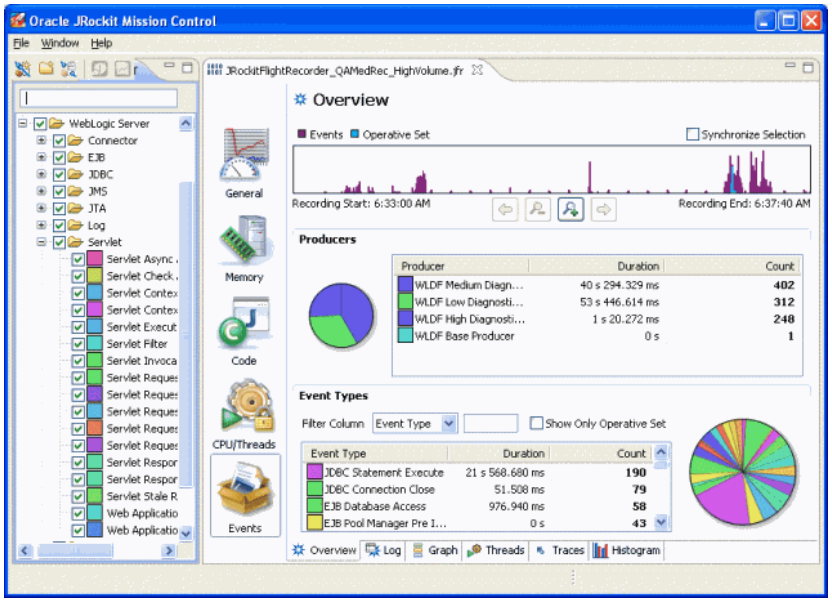
- Java Language
  - Project Coin (JSR-334)
- Class Libraries
  - NIO2 (JSR-203)
  - Fork-Join framework, ParallelArray (JSR-166y)
- Java Virtual Machine
  - The DaVinci Machine project (JSR-292)
  - InvokeDynamic bytecode
- Miscellaneous things
- JSR-336: Java SE 7 Release Contents



JVM Convergence







The (Performance) Free Lunch Is Over

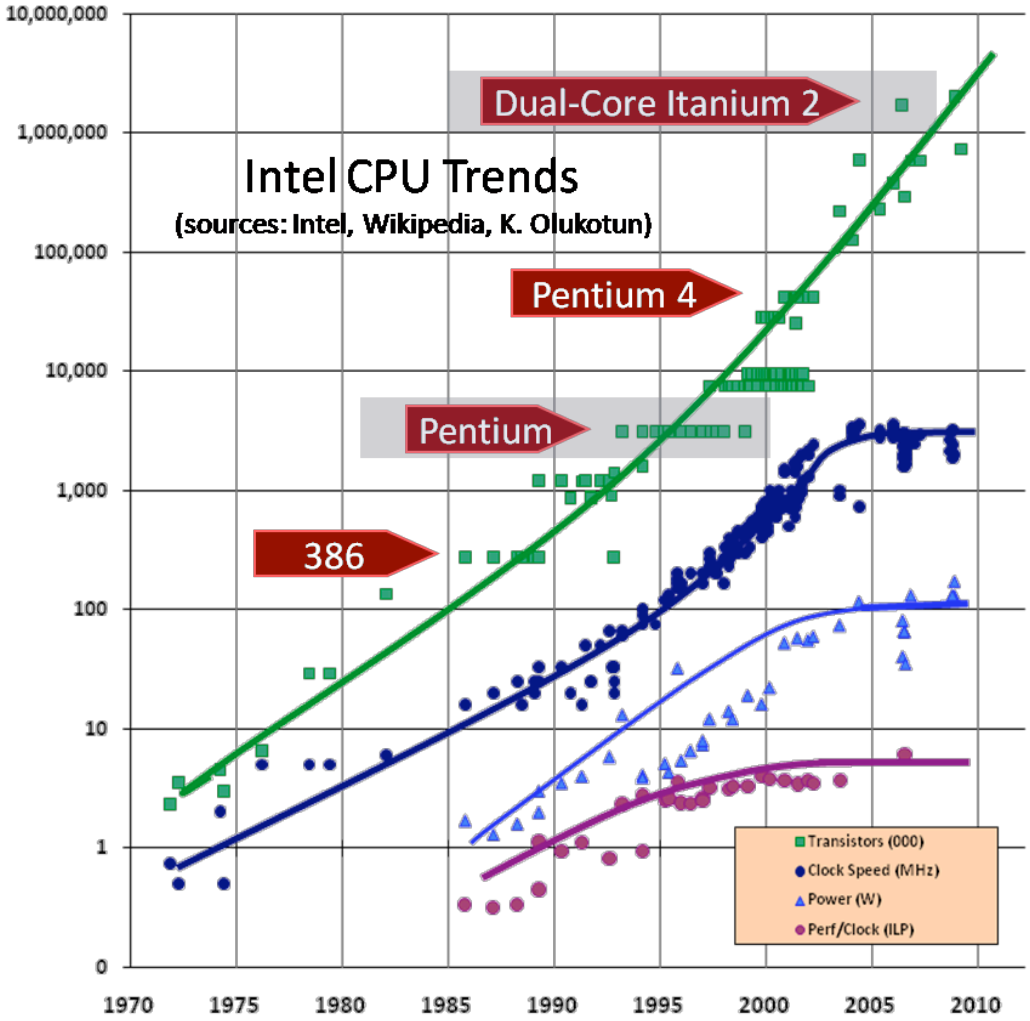
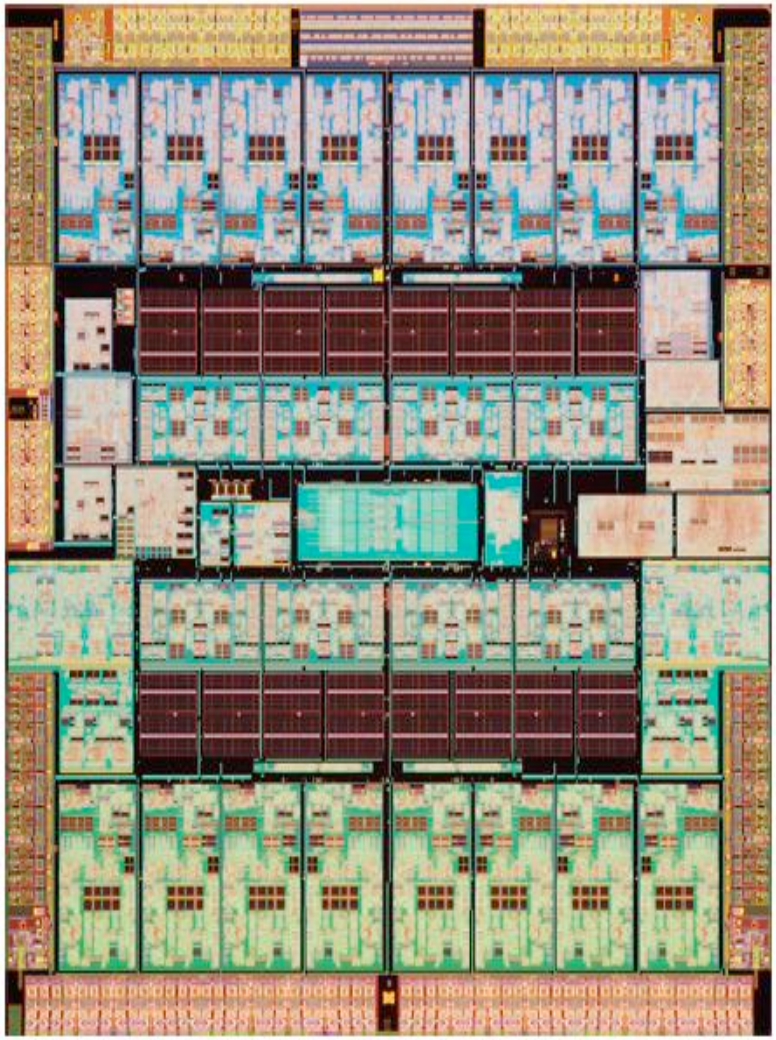


Image courtesy of Herb Sutter



SPARC T1 (2005)

8 x 4 = **32**

SPARC T2 (2007)

8 x 8 = **64**

SPARC T3 (2011)

16 x 8 = **128**

Multi-core Clients

Phone ... Tablet ... Desktop

2 ... 4 ..... 8 .....

2002 2004 2006 2008 2010 2012

Big Disclaimer

The syntax used in the following slides may change

Caveat emptor

```
class Student {
   String name;
   int gradYear;
   double score;
}

Collection<Student> students = ...;
```

```
Collection<Student> students = ...;

double max = Double.MIN_VALUE;

for (Student s : students) {
    if (s.gradYear == 2011)
        max = Math.max(max, s.score);
}
```

```
Collection<Student> students = ...;

double max = Double.MIN_VALUE;

for (Student s : students) {
    if (s.gradYear == 2011)
        max = Math.max(max, s.score);
}
```

```
Collection<Student> students = ...;

max = students.filter(new Predicate<Student>() {
                 public boolean op(Student s) {
                     return s.gradYear == 2011;
                 }
             }).map(new Extractor<Student, Double>() {
                 public Double extract(Student s) {
                     return s.score;
                 }
             }).reduce(0.0, new Reducer<Double, Double>() {
                 public Double reduce(Double max, Double score) {
                   return Math.max(max, score);
                 }
             });
```

Inner Classes Are Imperfect Closures

- Bulky syntax
- Unable to capture non-final local variables
- Transparency issues
  - Meaning of return, break, continue, this
- No non-local control flow operators

Single Abstract Method (SAM) Types

- Lots of examples in the Java APIs
  - **`Runnable, Callable, EventHandler, Comparator`**

```
foo.doSomething(new CallbackHandler() {
  public void callback(Context c) {
    System.out.println(c.v());
  }
});
```

- Noise:Work ratio is 5:1
- Lambda expressions grow out of the idea of making callback objects easier

```
Collection<Student> students = ...;

max = students.filter((Student s) -> s.gradYear == 2011)
              .map((Student s) -> s.score)
              .reduce(0.0,
                (Double max, Double score) ->
                   Math.max(max, score));

max = students.filter(s -> s.gradYear == 2011)
              .map(s -> s.score)
              .reduce(0.0, Math#max);

max = students.parallel()
              .filter(s -> s.gradYear == 2011)
              .map(s -> s.score)
              .reduce(0.0, Math#max);
```

Lambda Expression Examples

```
(Context c) -> System.out.println(c.v());

c -> System.out.println(c.v());  // Inferred

int x -> x + 1
```

Target Types

- Rule #1: Only in a context where it can be converted to a SAM type

```
CallBackHandler cb =
    (Context c) -> System.out.println(c.v());

x -> x + 1;

Runnable r = () -> System.out.println("Running”);
executor.submit(() -> System.out.println("Running”));

Object o = () -> 42;   // Illegal, not a SAM type
```

Lambda Bodies

- Rule #2: A list of statements just like in a method body, except no break or continue at the top level. The return type is inferred from the unification of the returns from the set of return statements
- Rule #3: ‘this’ has the same value as ‘this’ immediately outside the Lambda expression
- Rule #4: Lambdas can use ‘effectively final’ variables as well as final variables (compiler inferred)

```
Collection<Student> students = ...;

double max =          // Lambda expressions
  students.filter(Students s -> s.gradYear == 2010})
          .map(Students s -> s.score })
          .reduce(0.0, Math#max);


interface Collection<T> {
   int add(T t);
   int size();
   void clear();
   ...
}
```

How to extend an interface in Java SE 8

tells us this method extends the interface

```
public interface Set<T> extends Collection<T>
{

    public int size();

  ...    // The rest of the existing Set methods


    public extension T reduce(Reducer<T> r)
      default Collections.<T>setReducer;
}
```

Implementation to use if none exists for the implementing class

```
Collection<Student> students = ...;

double max =          // Lambda expressions
  students.filter(Students s -> s.gradYear == 2010)
          .map(Students s -> s.score )
          . reduce(0.0, Math#max);

interface Collection<T> {  // Default methods
   extension Collection<E> filter(Predicate<T> p)
        default Collections.<T>filter;

   extension <V> Collection<V> map(Extractor<T,V> e)
        default Collections.<T>map;

   extension <V> V reduce()
        default Collections.<V>reduce;
}
```

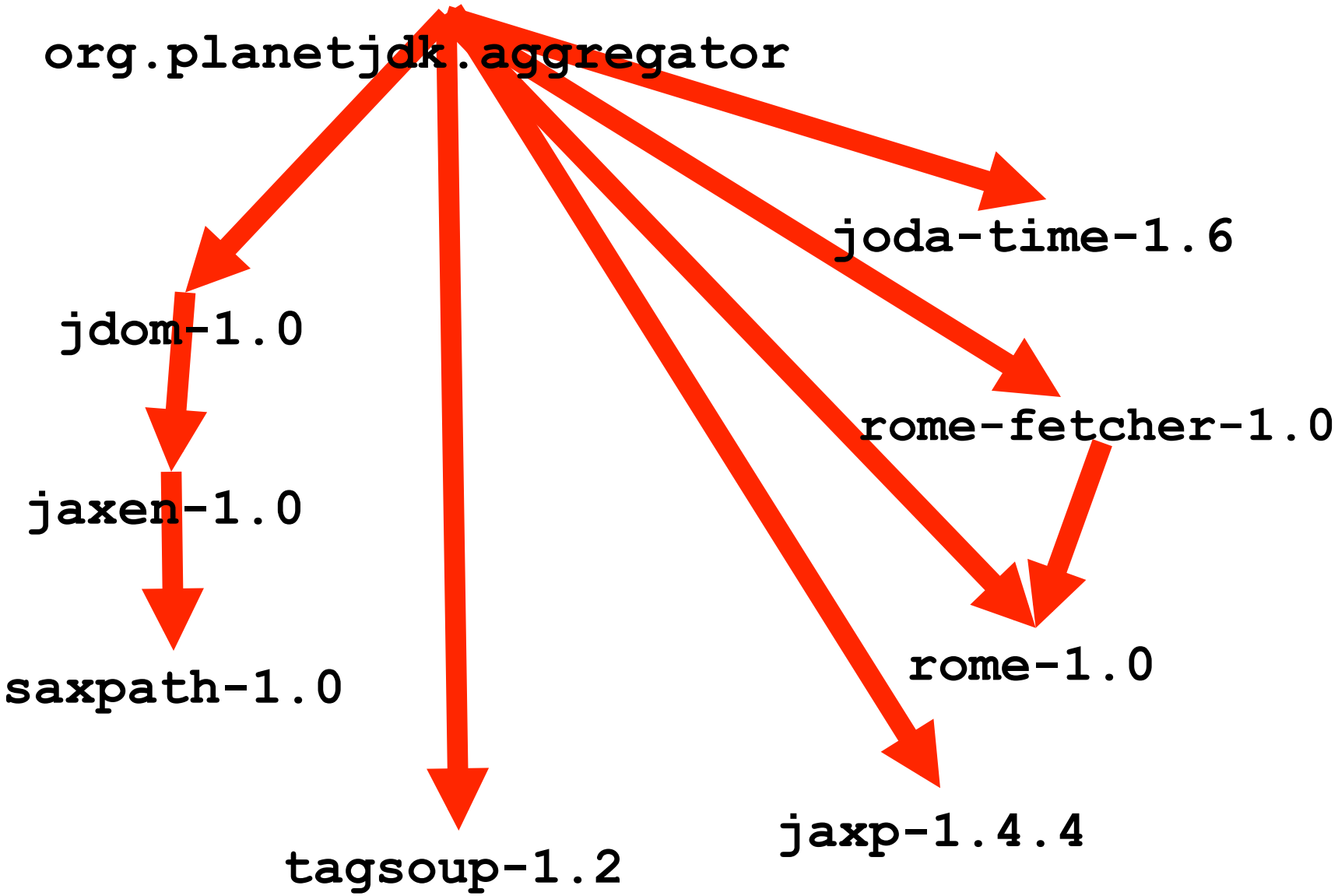
```
$ java org.planetjdk.aggregator.Main
```

```
$ java -cp $APPHOME/lib/jdom-1.0.jar:
$APPHOME/lib/jaxen-1.0.jar:
$APPHOME/lib/saxpath-1.0.jar:
$APPHOME/lib/rome.jar-1.0.jar:
$APPHOME/lib/rome-fetcher-1.0.jar:
$APPHOME/lib/joda-time-1.6.jar:
$APPHOME/lib/tagsoup-1.2.jar:
org.planetjdk.aggregator.Main
```

```
$ java -cp $APPHOME/lib/jdom-1.0.jar:
$APPHOME/lib/jaxen-1.0.jar:
$APPHOME/lib/saxpath-1.0.jar:
$APPHOME/lib/rome.jar-1.0.jar:
$APPHOME/lib/rome-fetcher-1.0.jar:
$APPHOME/lib/joda-time-1.6.jar:
$APPHOME/lib/tagsoup-1.2.jar:
org.planetjdk.aggregator.Main
```

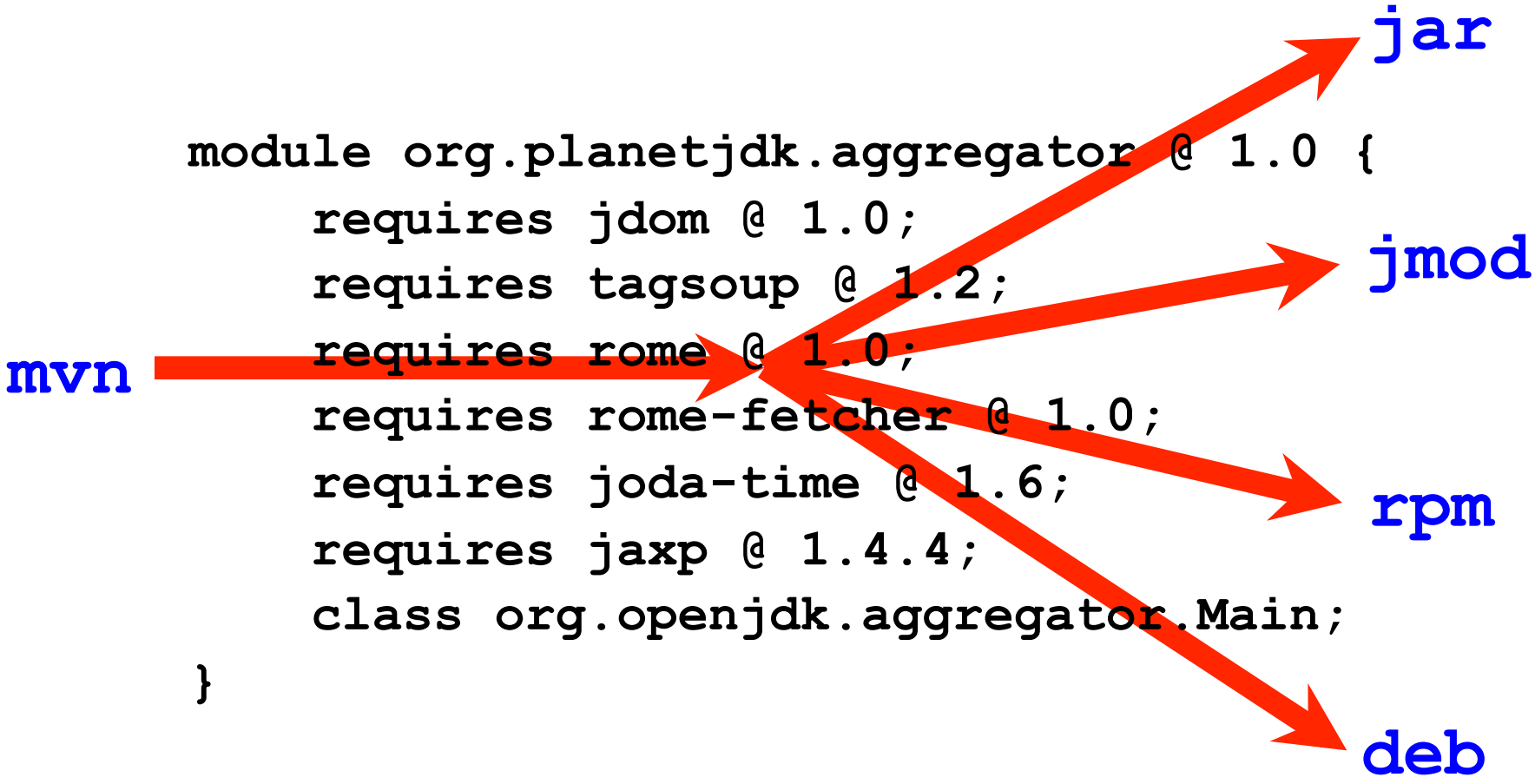
module-info.java

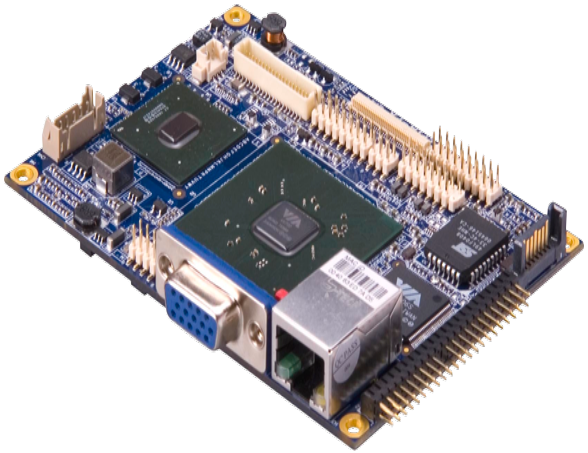
```
module org.planetjdk.aggregator @ 1.0 {
    requires jdom @ 1.0;
    requires tagsoup @ 1.2;
    requires rome @ 1.0;
    requires rome-fetcher @ 1.0;
    requires joda-time @ 1.6;
    requires jaxp @ 1.4.4;
    class org.openjdk.aggregator.Main;
}
```


org.planetjdk.aggregator
joda-time-1.6
jdom-1.0
rome-fetcher-1.0
jaxen-1.0
rome-1.0
saxpath-1.0
jaxp-1.4.4
tagsoup-1.2


classpath

```
module org.planetjdk.aggregator @ 1.0 {
    requires jdom @ 1.0;
    requires tagsoup @ 1.2;
    requires rome @ 1.0;
    requires rome-fetcher @ 1.0;
    requires joda-time @ 1.6;
    requires jaxp @ 1.4.4;
    class org.openjdk.aggregator.Main;
}
```





http://www.flickr.com/photos/thatguyfromcchs08/2300190277
http://www.flickr.com/photos/viagallery/2290654438

Java SE Profiles and Modules

- Rules for creating modules of the Java SE platform
  - Java SE base profile
  - Java SE base module
  - Component modules for separable technologies

JDK 8 – Proposed Content

Theme	Description/Content
Project Jigsaw	• Module system for Java applications and for the Java platform
Project Lambda	• Closures and related features in the Java language (JSR 335) • Bulk parallel operations in Java collections APIs (filter/map/reduce)
Oracle JVM Convergence	• Complete migration of performance and serviceability features from JRockit, including Mission Control and the Flight Recorder
JavaFX 3.0	• Next generation Java client, Multi-touch
JavaScript	• Next-gen JavaScript-on-JVM engine (Project Nashorn) • JavaScript/Java interoperability on JVM
Device Support	• Camera, Location, Compass and Accelerometer
Developer Productivity	• Annotations onTypes (JSR 308), Minor language enhancements
API and Other Updates	• Enhancements to Security, Date/Time (JSR 310), Networking, Internationalization, Accessibility, Packaging/Installation

Additional Disclaimers

- Some ***ideas*** for the Java Platform are shown on the following slides
- Large R&D effort required
- Content and timing highly speculative
- Some things will turn out to be bad ideas
- New ideas will be added
- Still, Java's future is bright (in our humble opinion)!

Java SE 9 (and beyond…)

Interoperability	• Multi-language JVM • Improved Java/Native integration
Cloud	• Multi-tenancy support • Resource management
Ease of Use	• Self-tuning JVM • Language enhancements
Advanced Optimizations	• Unified type system • Data structure optimizations
Works Everywhere and with Everything	• Scale down to embedded, up to massive servers • Support for heterogenuous compute models

Vision: Interoperability

- Improved support for non-Java languages
  - Invokedynamic (done)
  - Java/JavaScript interop (in progress – JDK 8)
  - Meta-object protocol (JDK 9)
  - Long list of JVM optimizations (JDK 9+)
- Java/Native
  - Calls between Java and Native without JNI boilerplate (JDK 9)

Vision: Cloud

- Multi-tenancy (JDK 8+)
  - Improved sharing between JVMs in same OS
  - Per-thread/threadgroup resource tracking/management
- Hypervisor aware JVM (JDK 9+)
  - Co-operative memory page sharing
  - Co-operative lifecycle, migration

Vision: Language Features

- Large data support (JDK 9)
  - Large arrays (64 bit support)
- Unified type system (JDK 10+)
  - No more primitives, make everything objects
- Other type reification (JDK 10+)
  - True generics
  - Function types
- Data structure optimizations (JDK 10+)
  - Structs, multi-dimensional arrays, etc
  - Close last(?) performance gap to low-level languages

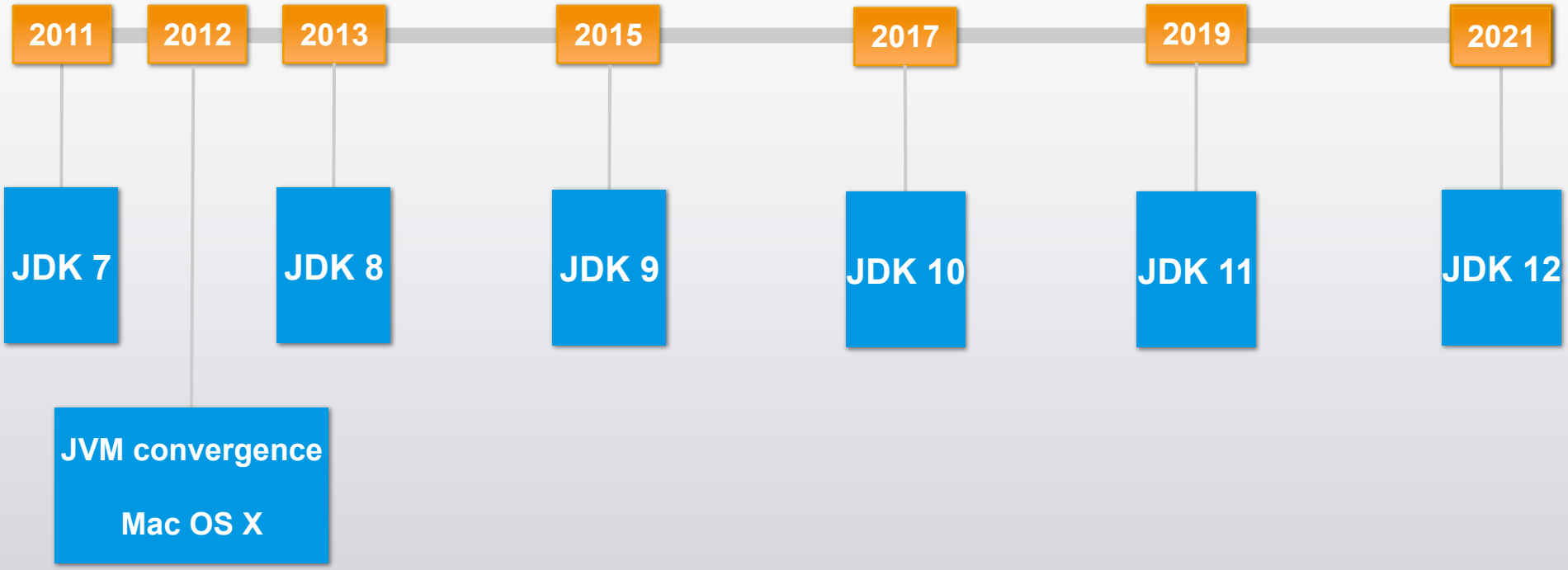
Vision: Integration

- Modern device support (JDK 8+)
  - Multitouch (JDK 8)
  - Location (JDK 8)
  - Sensors – compass, accelerometer, temperature, pressure, ... (JDK 8+)
- Heterogenous compute models (JDK 9+)
  - Java language support for GPU, FPGA, offload engines, remote PL/SQL...

The Path Forward

- Open development
  - Prototyping and R&D in OpenJDK
  - Cooperate with partners, academia, greater community
- Work on next JDK, future features in parallel
- 2-year cycle for Java SE releases

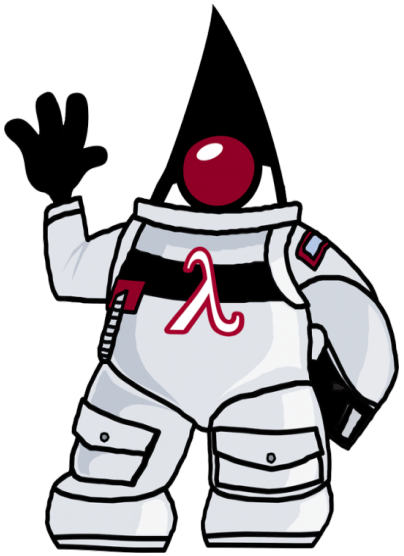
Java SE 2012 to Java 12



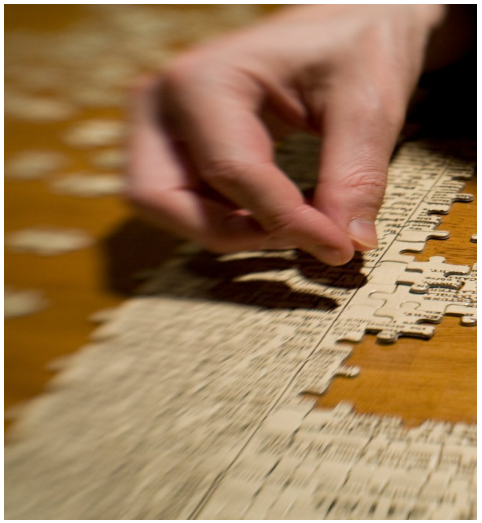
Conclusions

- The Java platform will continue to evolve
- Java SE 8 will add some nice, big features
- Expect to see more in Java SE 9 and beyond
- Java is not the new Cobol

Further Information



- Project Lambda
  - openjdk.java.net/projects/lambda



- Project Jigsaw
  - openjdk.java.net/projects/jigsaw

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