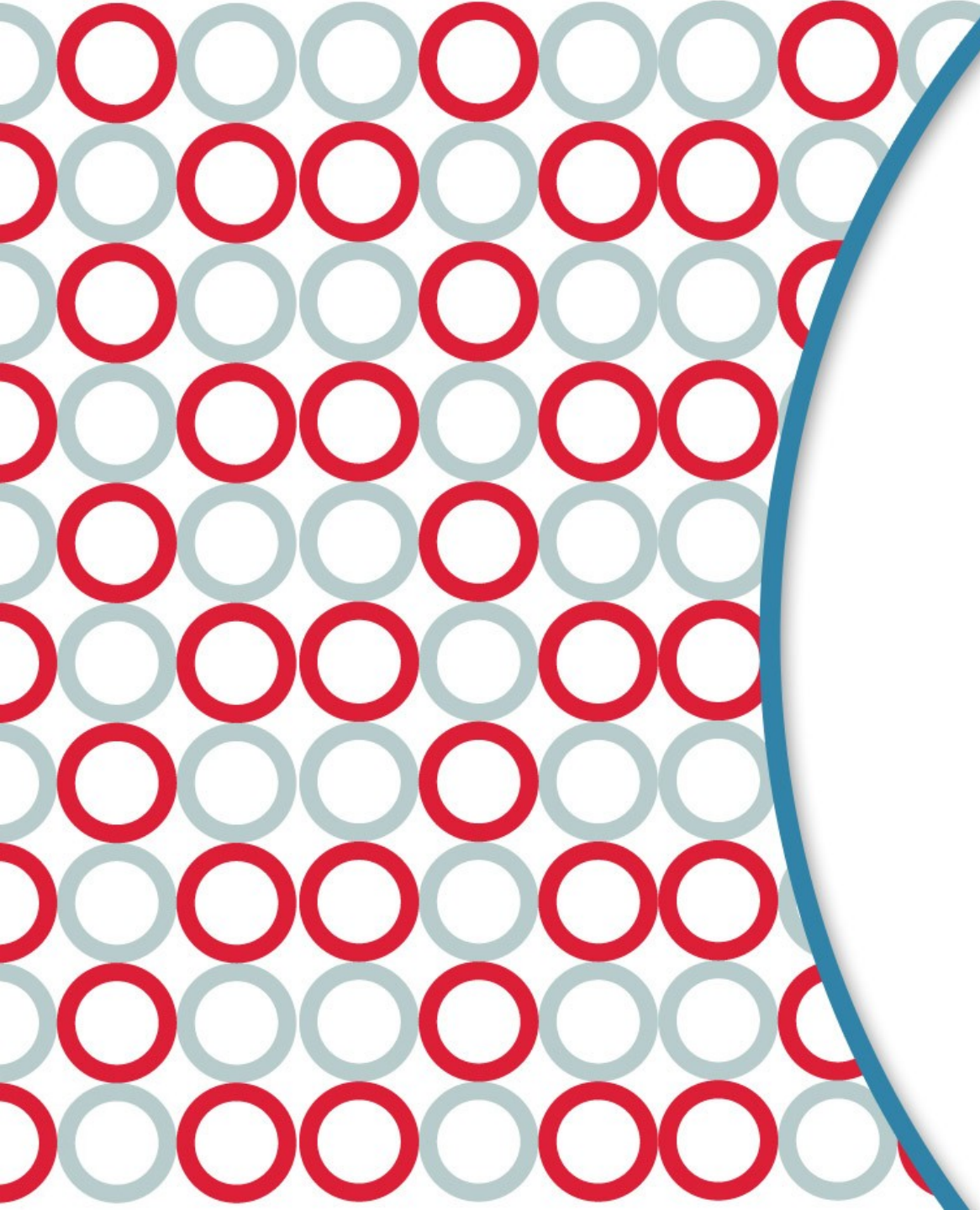

May 2019, IPT Course
Java Web Debelopment

Java Web Development

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About me

Trayan Iliev

– CEO of IPT – Intellectual Products & Technologies

– Oracle® certified programmer 15+ Y

– end-to-end reactive fullstack apps with Java, ES6/7, TypeScript, Angular, React and Vue.js

– 12+ years IT trainer

– Voxxed Days, jPrime, jProfessionals, BGOUG, BGJUG, DEV.BG speaker

– Organizer RoboLearn hackathons and IoT enthusiast (http://robolearn.org)

What Will You Learn in the Course?

- Java fundamentals – 4 h
- OOP principles – 4 h
- String Processing, Data Formatting, Resource Bundles, Regular Expressions – 6 h
- Generics and Collections – 6 h
- Java I/O (Files, Streams) – 8 h
- Threads & Concurrency – 8 h
- Functional programming and lambda expressions – 4 h
- The Stream API – 4 h
- Build tools (basics) – Ant vs Maven vs Gradle – 4 h

What Will You Learn in the Course? (cont.)

- WWW introduction (IP addresses, Ports, DNS, Proxy, Hosts file), Cookies, HTTP, Ajax – 4 h
- Servlet container, Servlets, JSPs, EL, JSTL – 8 h
- Serialization & deserialization (JAXB) – 4 h
- Web Services (Soap, Rest, XML, JSON) – 14 h
- Introduction to Spring. DI, AOP and MVC – 14 h
- SOLID principles, Popular Patterns, – 4 h
- Relational databases and transactions, SQL basics – 8 h
- Unit testing with JUnit. Object mocking. – 8 h

Course Schedule

- Block 1: 9.00 - 11.00
- Pause: 11.00 - 11.15
- Block 2: 11.15 - 13.15
- Lunch: 13.15 - 14.00
- Block 3: 14.00 - 16.00
- Pause: 16.00 - 16.15
- Block 4: 16.15 - 17.45 (till 17.30 in Mondays)

- Training – Monday, Tuesday, Thursday, Friday
- Course projects & problem solving – Wednesday
- Thursday morning – evaluation

Where to Find the Code?

Java Web Development projects and examples are available @ GitHub:

https://github.com/iproduct/course-java-web-development

Agenda for This Session

- Key features of Java language
- Stack and Heap (quick review)
- Literals and Operators
- Assignments and variables
- Scope
- Garbage collection
- Handling exceptions
- Common exceptions and errors

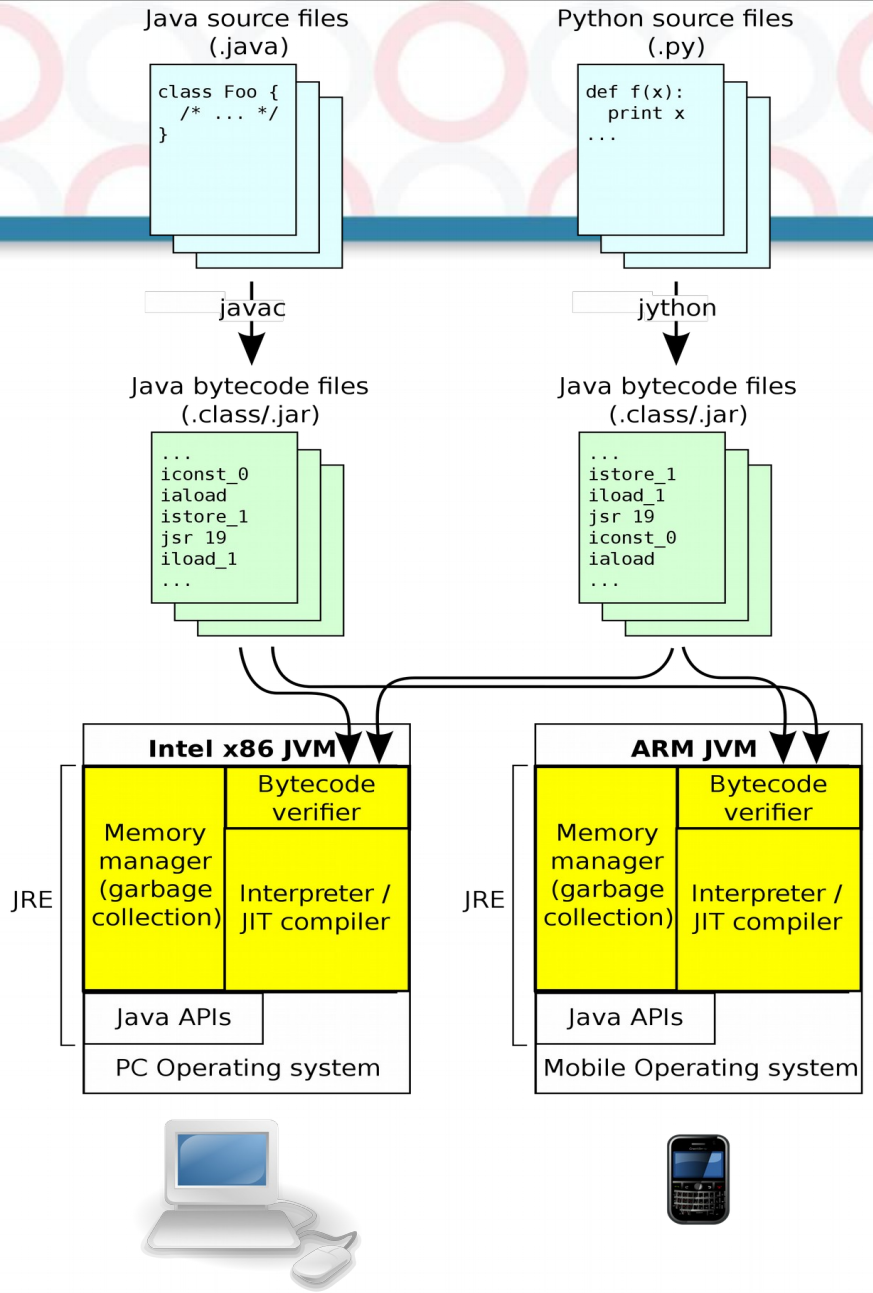
Key Features of Java Language

- Single base hierarchy - inheritance from only one parent class, with the possibility of implementation of multiple interfaces
- Garbage Collector – portability and platform independence, fewer errors
- Secure Code – separation of business logic from the error handling and exceptions
- Multithreading - easy realization of parallel processing
- Persistence – Java Database Connectivity (JDBC) and Java Persistence API (JPA)

Integrated Development Environments for Java Applications

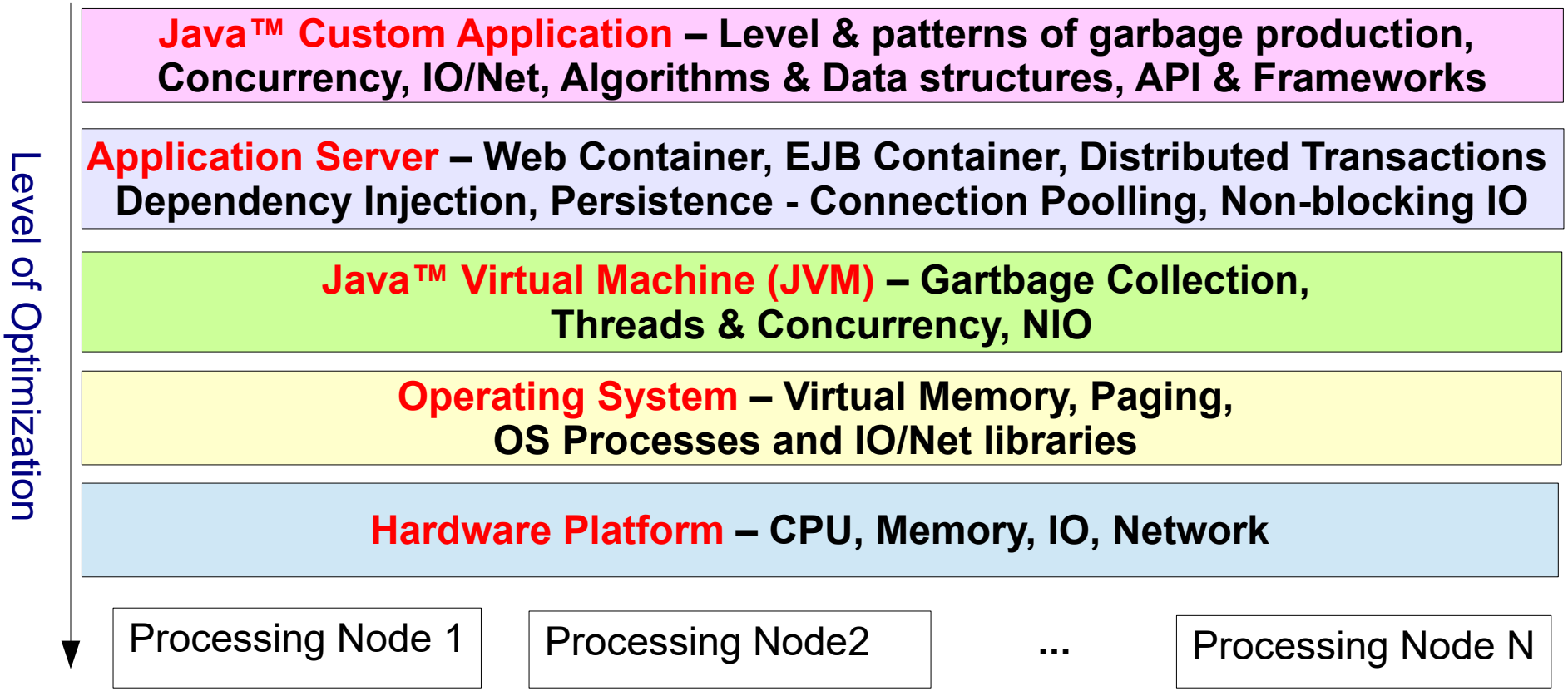
- Java™ development environment types:
  JavaSE, JavaEE, JavaME, JavaFX
- JavaSE: Java Development Kit (JDK) and Java Runtime Environment (JRE)
- Java™ compiler - javac
- Java Virtual Machine (JVM) - java
- Sourse code → Byte code
- Installing JDK 8
- Compile and run programs from the command line
- IDEs: Eclipse, IntelliJ IDEA, NetBeans

Java Virtual Machine (JVM)

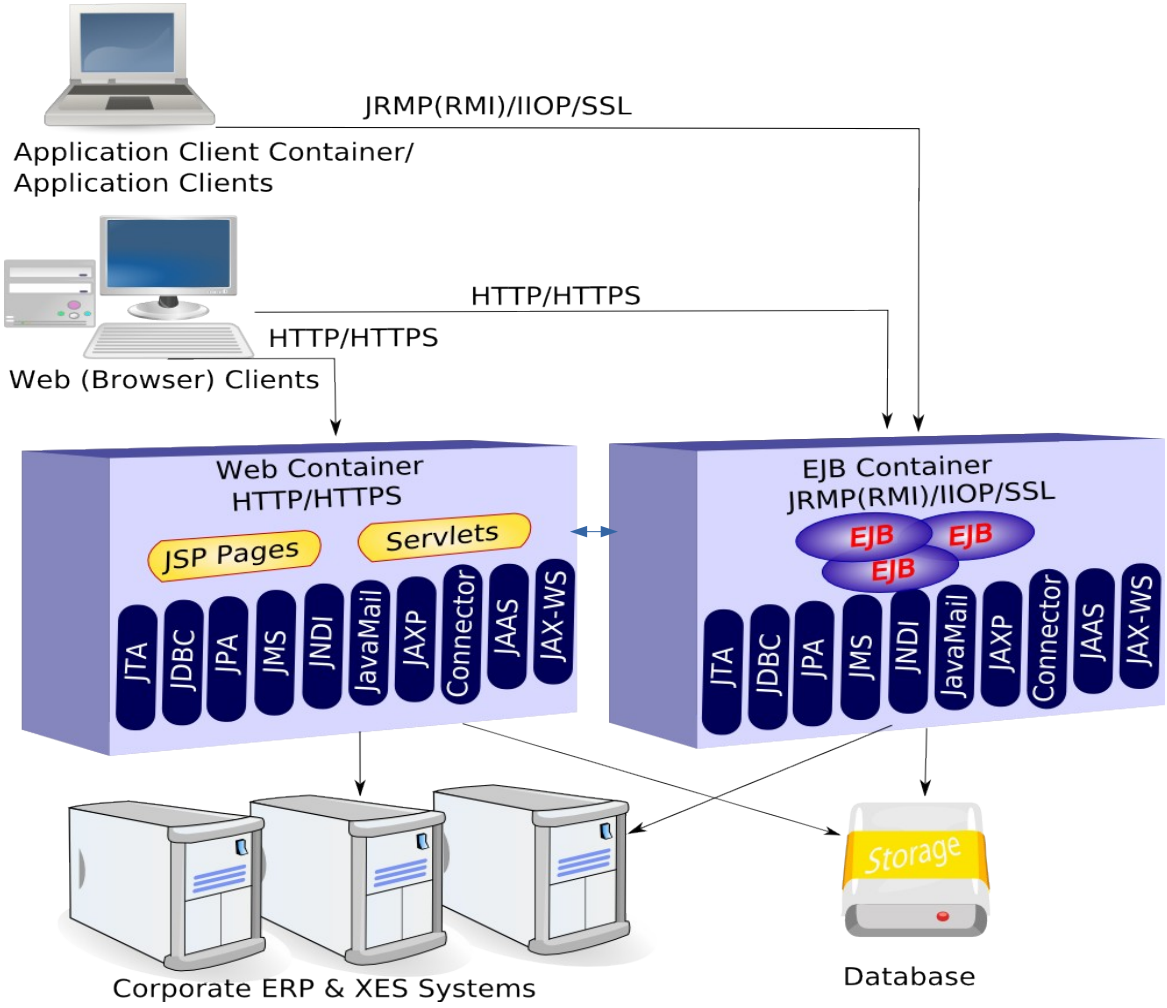


Source: http://en.wikipedia.org/wiki/File:Java_virtual_machine_architecture.svg

Java Application Stack



Java EE Architecture



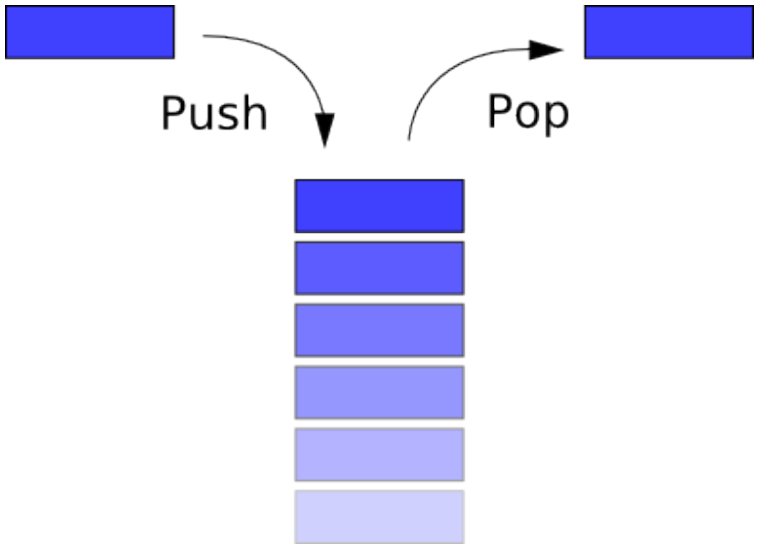
Key Elements of Java™ Language - Data Types, Variables and Constants

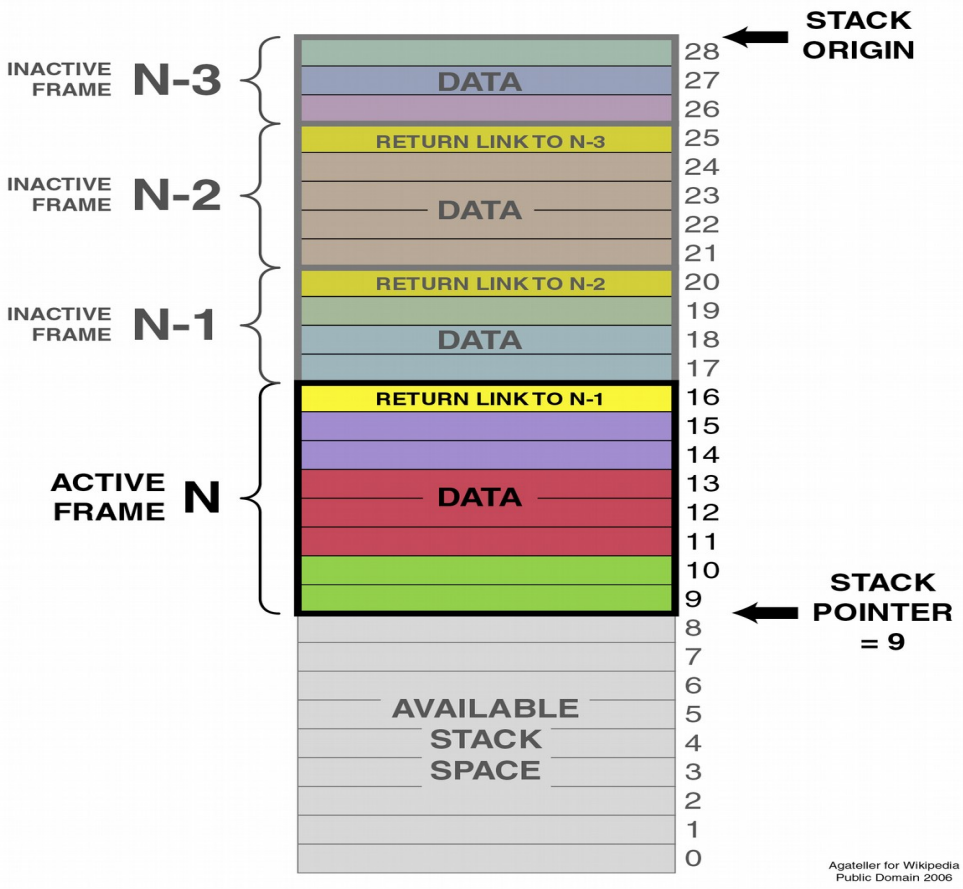
- Objects and references
- Creating objects
- Primitive and object data types
- Data Structures - arrays
- Fields and methods of an object
- Using ready libraries
- Static attributes and methods - static
- Variables and constants - final

Memory Types

- Register memory - CPU registers, fast, small numbers stored operand instructions just before treatment
- Program Stack = Last In, First Out (LIFO) – Keep primitive data types and references to objects during program execution
- Dynamically allocated memory – Heap – can store different sized objects for different periods of time, can create new objects dynamically and to be released – Garbage Collector
  - Young generation – objects that exist for short period
  - Old generation – objects that exist longer
  - ~~Permanent Generation = class definitions.~~ Java 8 Metaspace
- Constant storage, non-RAM storage (external memory)

Program Stack





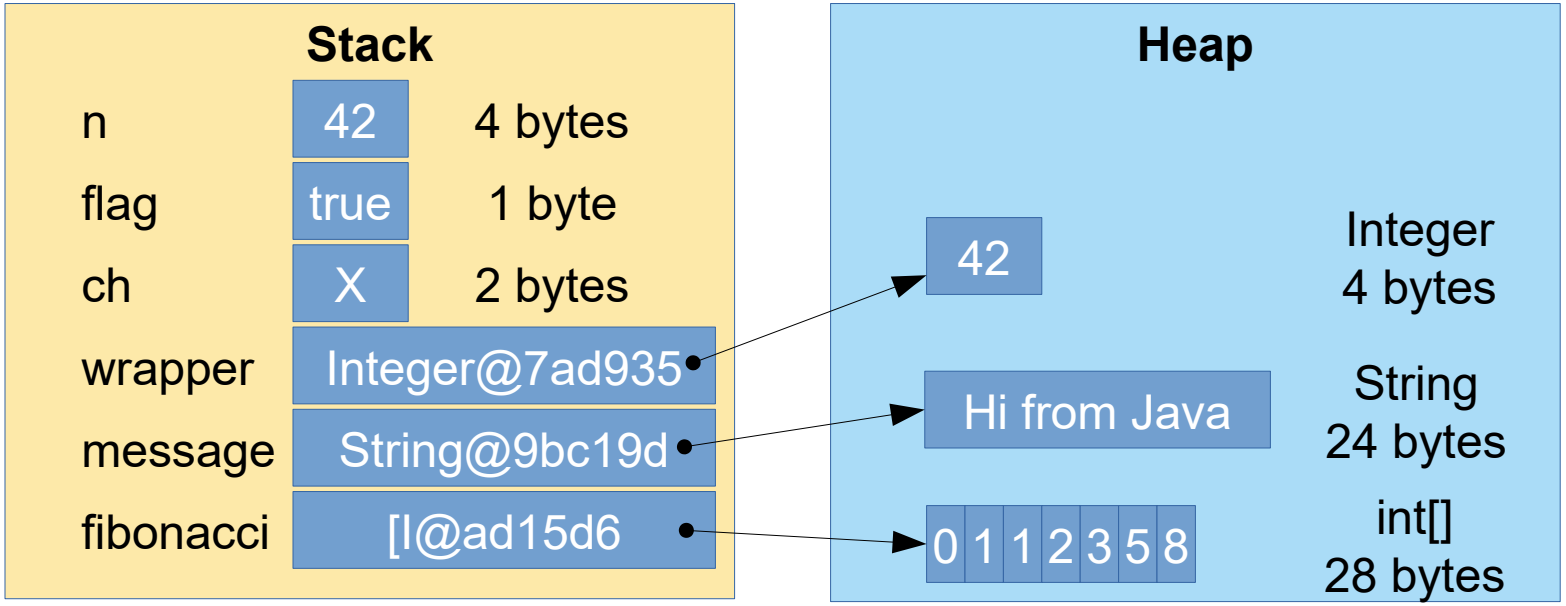
Source: http://en.wikipedia.org/wiki/File:ProgramCallStack2.png

C:\Windows\system32\cmd.exe

```
c:\CourseAdvancedJavaVerint\Temp>jstack 1612
2015-07-16 15:52:18
Full thread dump Java HotSpot(TM) 64-Bit Server VM (25.45-b02 mixed mode):

"DestroyJavaVM" #21 prio=5 os_prio=0 tid=0x0000000024b8000 nid=0x1f04 waiting on condition [0x0000000000000000]
   java.lang.Thread.State: RUNNABLE

"Thread-9" #20 prio=5 os_prio=0 tid=0x000000000bea7000 nid=0x2348 waiting for monitor entry [0x000000000d14f000]
   java.lang.Thread.State: BLOCKED (on object monitor)
        at simpletest.TwoThreadsSynchronizedCounter.lambda$0(TwoThreadsSynchronizedCounter.java:14)
        - waiting to lock <0x00000000d5e660a0> (a java.lang.Object)
        at simpletest.TwoThreadsSynchronizedCounter$$Lambda$1/424058530.run(Unknown Source)
        at java.lang.Thread.run(Thread.java:745)

"Thread-8" #19 prio=5 os_prio=0 tid=0x000000000bea5800 nid=0x6ac waiting for monitor entry [0x000000000ca2e000]
   java.lang.Thread.State: BLOCKED (on object monitor)
        at simpletest.TwoThreadsSynchronizedCounter.lambda$0(TwoThreadsSynchronizedCounter.java:14)
        - waiting to lock <0x00000000d5e660a0> (a java.lang.Object)
        at simpletest.TwoThreadsSynchronizedCounter$$Lambda$1/424058530.run(Unknown Source)
        at java.lang.Thread.run(Thread.java:745)

"Thread-7" #18 prio=5 os_prio=0 tid=0x000000000bea5000 nid=0x1ffc waiting for monitor entry [0x000000000cfcf000]
   java.lang.Thread.State: BLOCKED (on object monitor)
        at simpletest.TwoThreadsSynchronizedCounter.lambda$0(TwoThreadsSynchronizedCounter.java:14)
        - waiting to lock <0x00000000d5e660a0> (a java.lang.Object)
        at simpletest.TwoThreadsSynchronizedCounter$$Lambda$1/424058530.run(Unknown Source)
        at java.lang.Thread.run(Thread.java:745)

"Thread-6" #17 prio=5 os_prio=0 tid=0x000000000bea2000 nid=0x40c waiting for monitor entry [0x000000000cd5f000]
   java.lang.Thread.State: BLOCKED (on object monitor)
        at simpletest.TwoThreadsSynchronizedCounter.lambda$0(TwoThreadsSynchronizedCounter.java:14)
        - waiting to lock <0x00000000d5e660a0> (a java.lang.Object)
        at simpletest.TwoThreadsSynchronizedCounter$$Lambda$1/424058530.run(Unknown Source)
        at java.lang.Thread.run(Thread.java:745)

"Thread-5" #16 prio=5 os_prio=0 tid=0x000000000bea0800 nid=0x1708 waiting for monitor entry [0x000000000ceae000]
   java.lang.Thread.State: BLOCKED (on object monitor)
        at simpletest.TwoThreadsSynchronizedCounter.lambda$0(TwoThreadsSynchronizedCounter.java:14)
        - waiting to lock <0x00000000d5e660a0> (a java.lang.Object)
        at simpletest.TwoThreadsSynchronizedCounter$$Lambda$1/424058530.run(Unknown Source)
        at java.lang.Thread.run(Thread.java:745)

"Thread-4" #15 prio=5 os_prio=0 tid=0x000000000be9d000 nid=0xc0c waiting for monitor entry [0x000000000c7df000]
   java.lang.Thread.State: BLOCKED (on object monitor)
        at simpletest.TwoThreadsSynchronizedCounter.lambda$0(TwoThreadsSynchronizedCounter.java:14)
        - waiting to lock <0x00000000d5e660a0> (a java.lang.Object)
        at simpletest.TwoThreadsSynchronizedCounter$$Lambda$1/424058530.run(Unknown Source)
        at java.lang.Thread.run(Thread.java:745)

"Thread-3" #14 prio=5 os_prio=0 tid=0x000000000be9c800 nid=0x2394 waiting for monitor entry [0x000000000cc2f000]
   java.lang.Thread.State: BLOCKED (on object monitor)
```

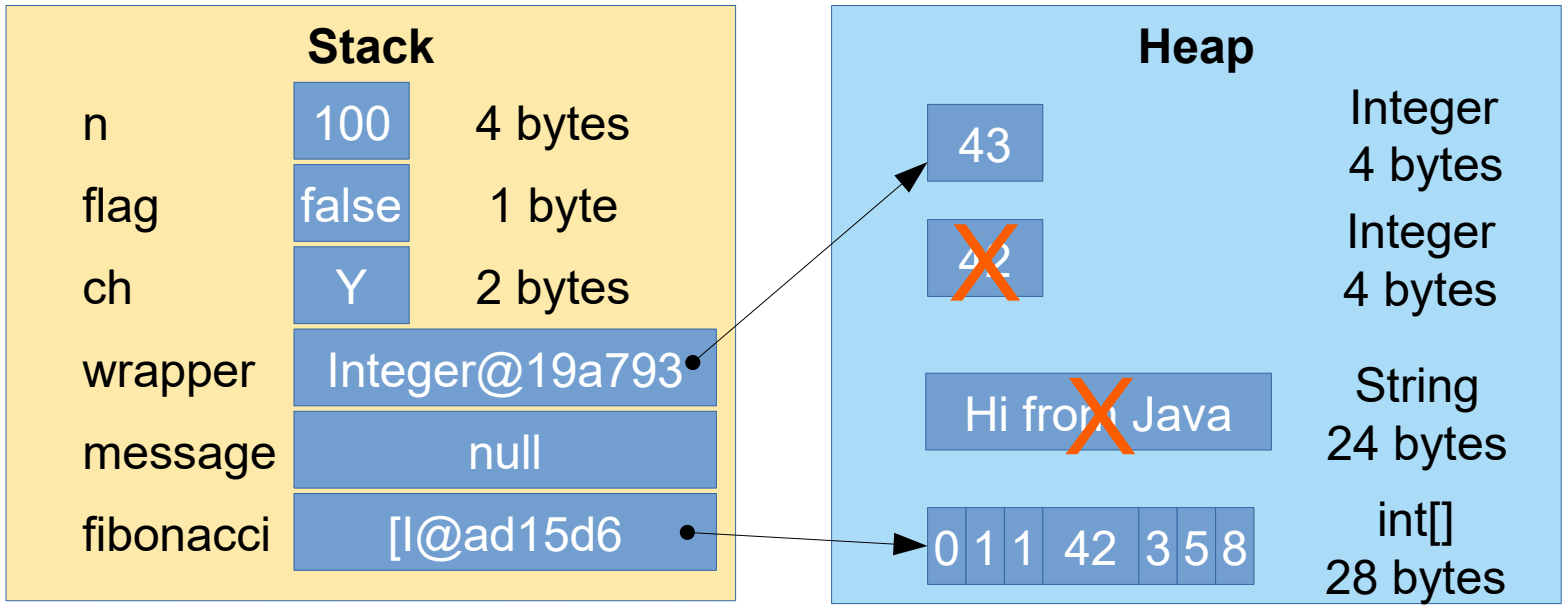
Stack and Heap (Quick Review)

```
int n = 42;
boolean flag = true;
char ch = 'X';
Integer wrapper = n;
String message = "Hi from Java!";
int[] fibonacci = { 0, 1, 1, 2, 3, 5, 8 };
```



Stack and Heap (Quick Review)

```
n = 100;
flag = !flag;
h = ++ch;
wrapper = ++wrapper;
message = null;
fibonacci[2] = 42;
```



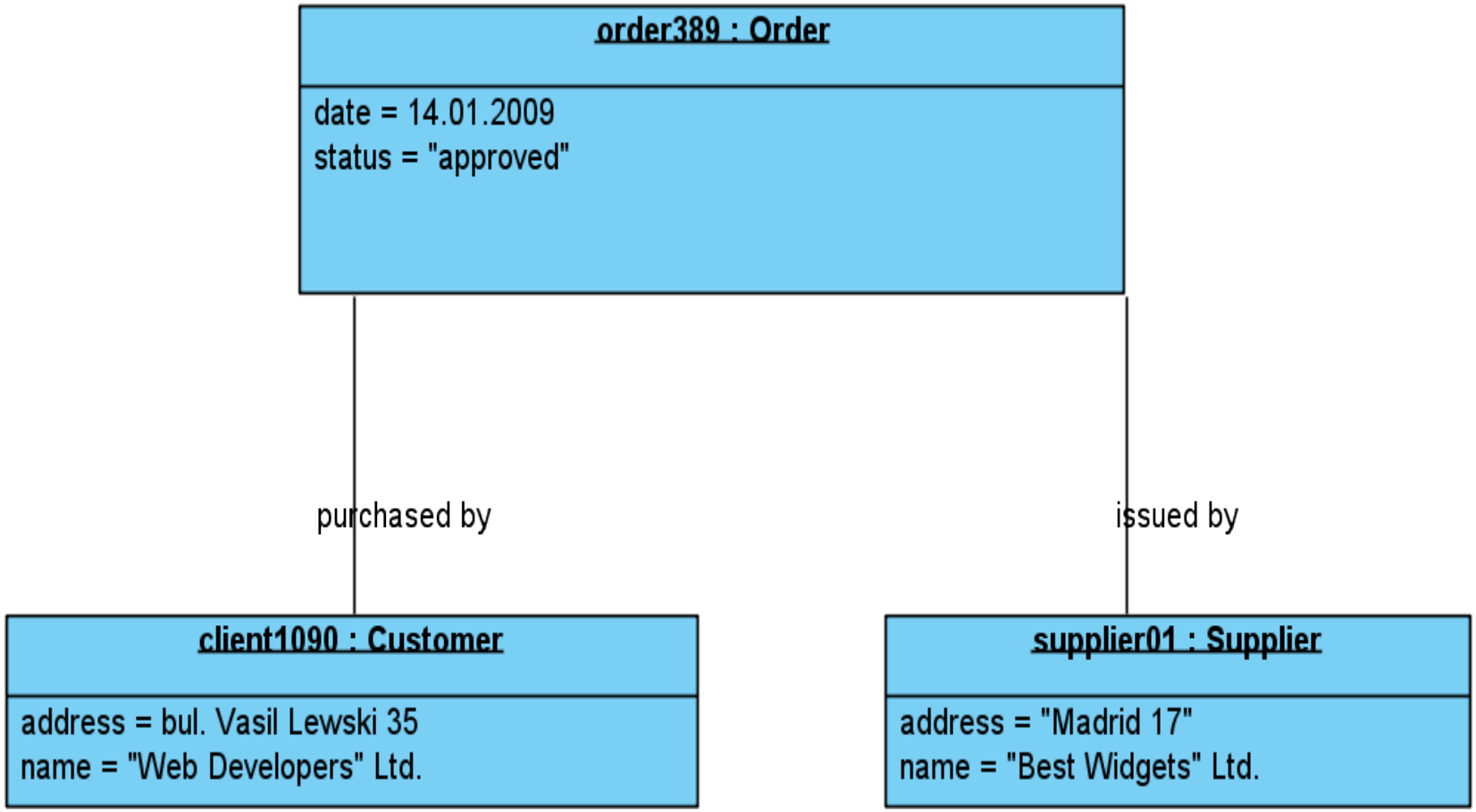
Variable Scopes

```
public class VarScopes {
    static int s1 = 25;
    int i1 = 350;
    public static void main(String[] args) {
      if(s1 > 10){
          int a = 42;
          // Only a available
          {
              int b = 108;// Both a & b are available
          }
          // Only a available, b is out of scope
      }
      // a & b are out of scope
   }
}
```

Classes, Objects and References

- Class - set of objects that share a common structure, behavior and possible links to objects of other classes = objects type
  - structure = attributes, properties, member variables
  - behaviour = methods, operations, member functions, messages
  - relations between classes: association, inheritance, aggregation, composition – modeled as attributes (references to objects from the connected class)
- Objects are instances of the class, which is their addition:
  - own state
  - unique identifier = reference pointing towards object

Object Diagram



Creating Objects

- Class String – modeling string of characters:
  - declaration:

    String s;
  - initialization (on separate line):

    s = new String(“Hello Java World”);
  - declaration + initialization:

    String s = new String(“Hello Java World”);
  - declaration + initialization (shorter form, applies only to the class String):

    String s = “Hello Java World”;

Primitive and Object Data Types

- Primitive data types, object wrapper types and default values for attributes of primitive type
  - boolean --> Boolean — false
  - char --> Character — '\u0000'
  - byte --> Byte — (byte) 0
  - short --> Short — (short) 0
  - int --> Integer — 0
  - long --> Long — 0L
  - float --> Float — 0.0F
  - double --> Double — 0.0D
  - void --> Void
- BigInteger and BigDecimal - higher-precision numbers

Object (Reference) Data Types

- Creating a class (a new data type)

  class MyClass { /* attributes and methods of the class */ }

- Create an object (instance) from the class MyClass :

  MyClass myObject = new MyClass();

- Declaration and initialization of attributes:

```
class Person {
      String name = “Anonimous”;
      int age;
}
```

- Access to attribute: Person p1 = new Person();

  p1.name = “Ivan Petrov”; p1.age = 28;

Object (Reference) Data Types

- Initialization with default values
- Value of uninitialized reference = null
- Declaring class methods

```
class Person {
    String name;
    int age;
    String setNameAndAge (String aName, int anAge) {
        name = aName;
        age = anAge;
        return “Name: “ + name + “Age: “ + age;
    }
}
```

Method Name

Arguments

Return Type

Method Body

Returning Value

Primitive Type Literals

- in decimal notation:
  int: 145, 2147483647, -2147483648
  long: 145L, -1l, 9223372036854775807L
  float: 145F, -1f, 42E-12F, 42e12f
  double: 145D, -1d, 42E-12D, 42e12d
- in hexadecimal notation:
  0x7ff, 0x7FF, 0X7ff, 0X7FF
- in octal notation: 0177
- in binary notation: 0b11100101, 0B11100101

Operators in Java - I

- Assignment operator
- Mathematical operators
- Relational operators
- Logical operators
- Bitwise operators
- String operators
- Operators for type conversion
- Priorities of operators

Operators in Java - II

- Each operator has priority and associativity - for example, + and – have a lower priority from * and /
- The priority can be set clearly using brackets (and) - for example (y – 1) / (2 + x)
- According associativity operators are left-associative, right-associative and non-associative: For example:
  x + y + z => (x + y) + z, because the operator + is left-associative
- if it was right associative, the result would be
  x + (y + z)

Operators in Java - III

- Assignment operator: **=**
  - is not symmetrical – i.e. **x = 42** is OK, **42 = x** is NOT
  - to the left always stands a variable of a certain type, and to the right an expression from the same type or type, which can be automatically converted to present
- Mathematical operators:
  - with one argument (unary): **-, ++, --**
  - with two arguments (binary): **+, -, *, /, %** (remainder)
- Combined: **+=, -=, *=, /=, %=**

  For example: **a += 2** <=> **a = a + 2**

Send Arguments by Reference and Value

- Formal and actual arguments - Example:

Static method - no **this**

Formal Argument
- copies the actual value

```
public static void incrementAgeBy10(Person p){
    p.age = p.age + 10;
}

Person p2 = new Person(23434345435L, "Petar
Georgiev", "Plovdiv", 39);
incrementAgeBy10(p2);
System.out.println(p2);
```

Actual Argument

Send Arguments by Reference and Value

- Case A: When the argument is a primitive type, the formal argument copies the actual value
- Case B: When the argument is a object type, the formal argument copies reference to the actual value
- Cases A & B: Changes in the copy (formal argument) does not reflect the actual argument
- However, if formal and actual argument point to the same object (Case B) – then **changes in properties (attribute values) of this object are available from the calling method** – i.e. we can return value from this argument

Operators in Java - IV

- Relational operators (comparison): **==, !=, <=, >=**
- Logical operators: **&&** (AND), **||** (OR) and **!** (NOT)
  - the expression is calculated from left to right only when it's necessary for determining the final outcome
- Bitwise operators: **&** (AND), **|** (OR) and **~** (NOT),

  ^ (XOR), **&=**, **|=**, **^=**
  - bitwise shift: **<<**, **>>** (preserves character), **>>>** (always inserts ziros left – does not preserve character), **<<=**, **>>=**, **>>>=**

Operators in Java - V

- Triple **if-then-else** operator:

  <boolean-expr> ? <then-value> : <else-value>

- String concatenation operator: **+**

- Operators for type conversion (type casting):

  (byte), **(short)**, **(char)**, **(int)**, **(long)**, **(float)** ...

- Priorities of operators:

  unary > binary arithmetical > relational > logical > three-argumentative operator **if-then-else** > operators to assign a value

Controlling Program Flow - I

- Conditional operator - **if-else**
- Returning Value – **return**
- Operators organizing cycle - **while, do while, for, break, continue**
- Operator to select one from many options - **switch**

Controlling Program Flow - II

- Conditional operator **if-else**:

```
if(<boolean-expr>)
   <then-statement>
```

or

```
if(<boolean-expr>)
   <then-statement>
else
    <else-statement>
```

Controlling Program Flow - III

- Returning value to exit the method: **return;** or **return <value>;**
- Operator to organize cycle **while**:

```
while(<boolean-expr>)
    <body-statement>
```

- Operator to organize cycle **do-while**:

```
do <body-statement>
while(<boolean-expr>);
```

Controlling Program Flow - IV

- Operator to organize cycle **for**:

```
for(<initialization>; <boolean-expr>; <step>)
   <body-statement>
```

- Operator to organize cycle **foreach**:

```
for(<value-type> x : <collection-of-values>)
   <body-statement-using-x>
```

Ex.:
```
for(Point p : pointsArray)
    System.out.println("(" +p.x + ", " + p.y + ")");
```

Controlling Program Flow - V

- Operators to exit block (cycle) **break** and to exit iteration cycle **continue**:

```
<loop-iteration> {
   //do some work
   continue;  // goes directly to next loop iteration
   //do more work
   break;  // leaves the loop
   //do more work
}
```

Controlling Program Flow - VI

- Use of labels with **break** and **continue**:

```
outer_label:
<outer-loop> {
    <inner-loop> {
        //do some work
        continue; // continues inner-loop
        //do more work
        break outer_label; // breaks outer-loop
        //do more work
        continue outer_label;  // continues outer-loop
}
```

Controlling Program Flow - VII

- Selecting one of several options **switch**:

```
switch(<selector-expr>) {
  case <value1> : <statement1>; break;
  case <value2> : <statement2>; break;
  case <value3> : <statement3>; break;
  case <value4> : <statement4>; break;
  // more cases here …
  default: <default-statement>;
}
```

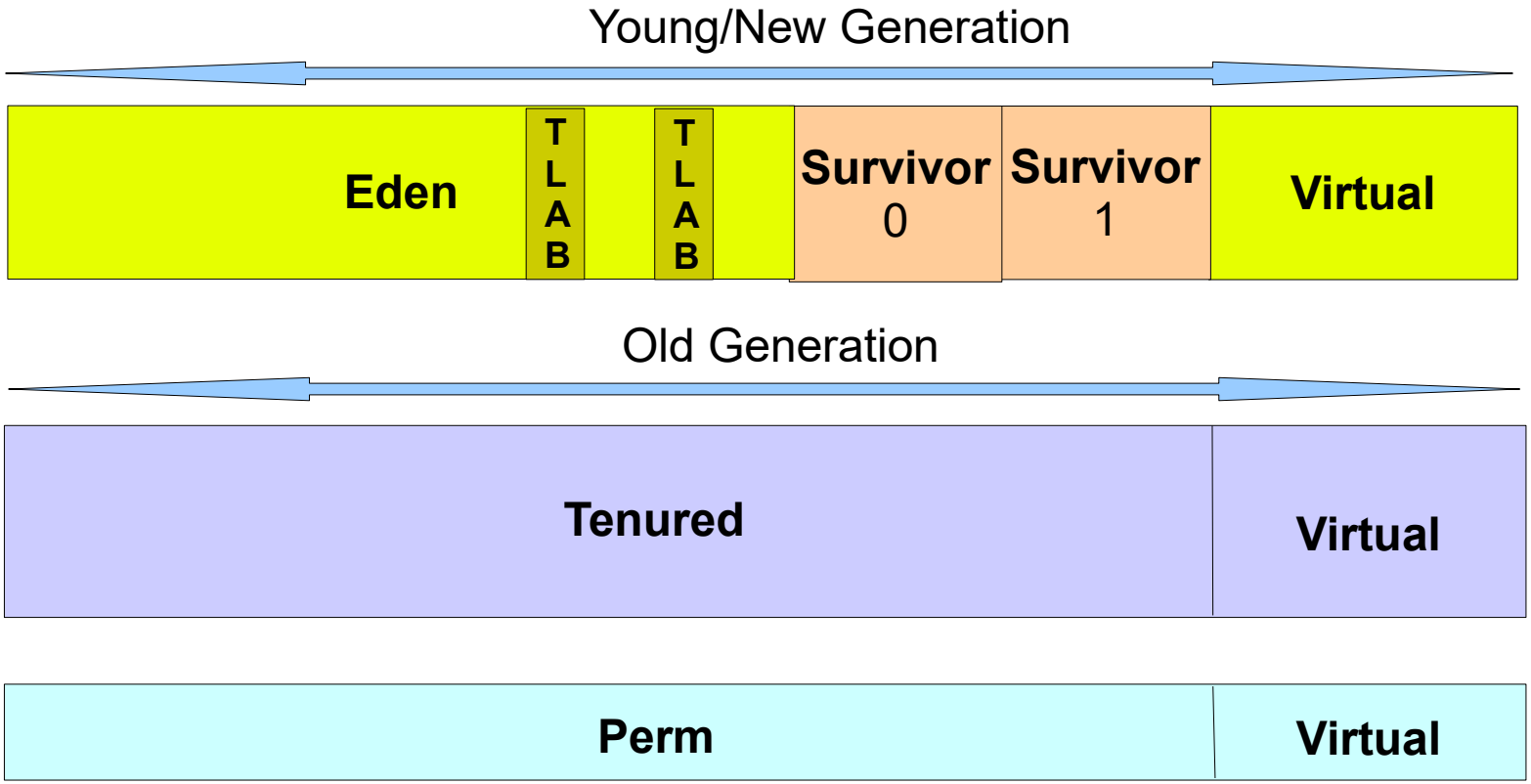
Garbage Collection – Main Concepts

- Client and Server VMs (≠ JIT Compiliers & Defaults), x86, x64
- Generational Garbage Collection – Young, Old & ~~Permanent~~ (in Java 8 → Metaspace) – Weak generational hypothesis:
  - Most of the objects become unreachable soon;
  - Small number of references exist from old to young objects.
- Java™ 8 JVM Ergonomics and Behavior-Based Tuning
  - **Throughput** – **-XX:GCTimeRatio=<N>**
    GC_Time / Application_Time = 1 / (1 + <N>)
  - **Maximum Pause Time** – **-XX:MaxGCPauseMillis=<N>**
  - **Memory Footprint** – if the above two golas are met, garbage collector reduces the size of the heap until one of the goals (invariably the throughput goal) cannot be met.

Weak Generational Hypothesis

- Young Generation. Most newly allocated objects are allocated in the young generation, which is typically small and collected frequently. Since most objects in it are expected to die quickly, the number of objects that survive a young generation collection (also referred to as a minor collection) is expected to be low. In general, minor collections are very efficient because they concentrate on a space that is usually small and is likely to contain a lot of garbage.
- Old Generation. Objects that are longer-lived are eventually promoted, or tenured, to the old generation (see Figure 1). This generation is typically larger than the young generation and its occupancy grows more slowly. As a result, old generation collections (also referred to as major collections) are infrequent, but when they do occur they are quite lengthy.

Garbage Collection – Main Concepts



Garbage Collection – Basic Settings

- JVM Heap options

-Xms – Heap area size when starting JVM

-Xmx – Maximum heap area size

-Xmn, -XX:NewSize – размер на young generation (nursery)

-XX:MinHeapFreeRatio=<N> **-XX:MaxHeapFreeRatio=<N>**

-XX:NewRatio – Ratio of New area and Old area

-XX:NewSize **-XX:MaxNewSize** – New area size <= Max

-XX:SurvivorRatio– Ratio of Eden area and Survivor area

-XX:+PrintTenuringDistribution – treshold and ages of New gen

-XX:PermSize -XX:MaxPermSize – Initial/Max Permanent generation heap size (not supported in Java 8)

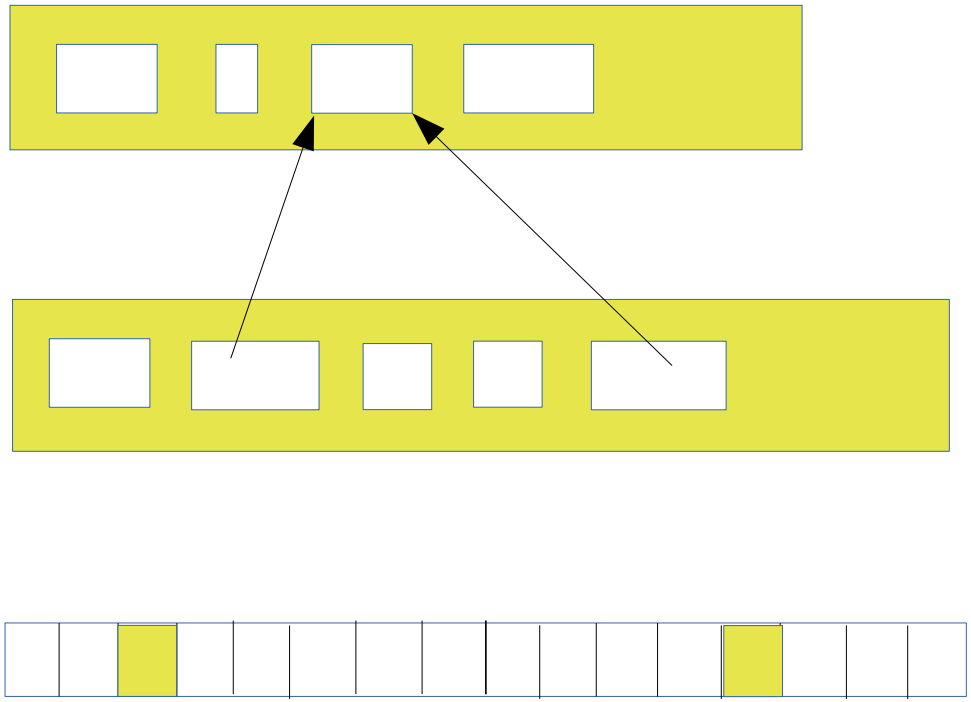
GC Strategies and Settings

- Serial GC **-XX:+UseSerialGC**
- Parallel GC **-XX:+UseParallelGC**
  -XX:ParallelGCThreads=<N>
- Parallel Compacting GC **-XX:+UseParallelOldGC**
- Conc. Mark Sweep CMS GC **-XX:+UseConcMarkSweepGC**
  -XX:+UseParNewGC
  -XX:+CMSParallelRemarkEnabled
  -XX:CMSInitiatingOccupancyFraction=<N>
  -XX:+UseCMSInitiatingOccupancyOnly
- G1 **-XX:+UseG1GC** -XX:+UnlockExperimentalVMOptions(J6)

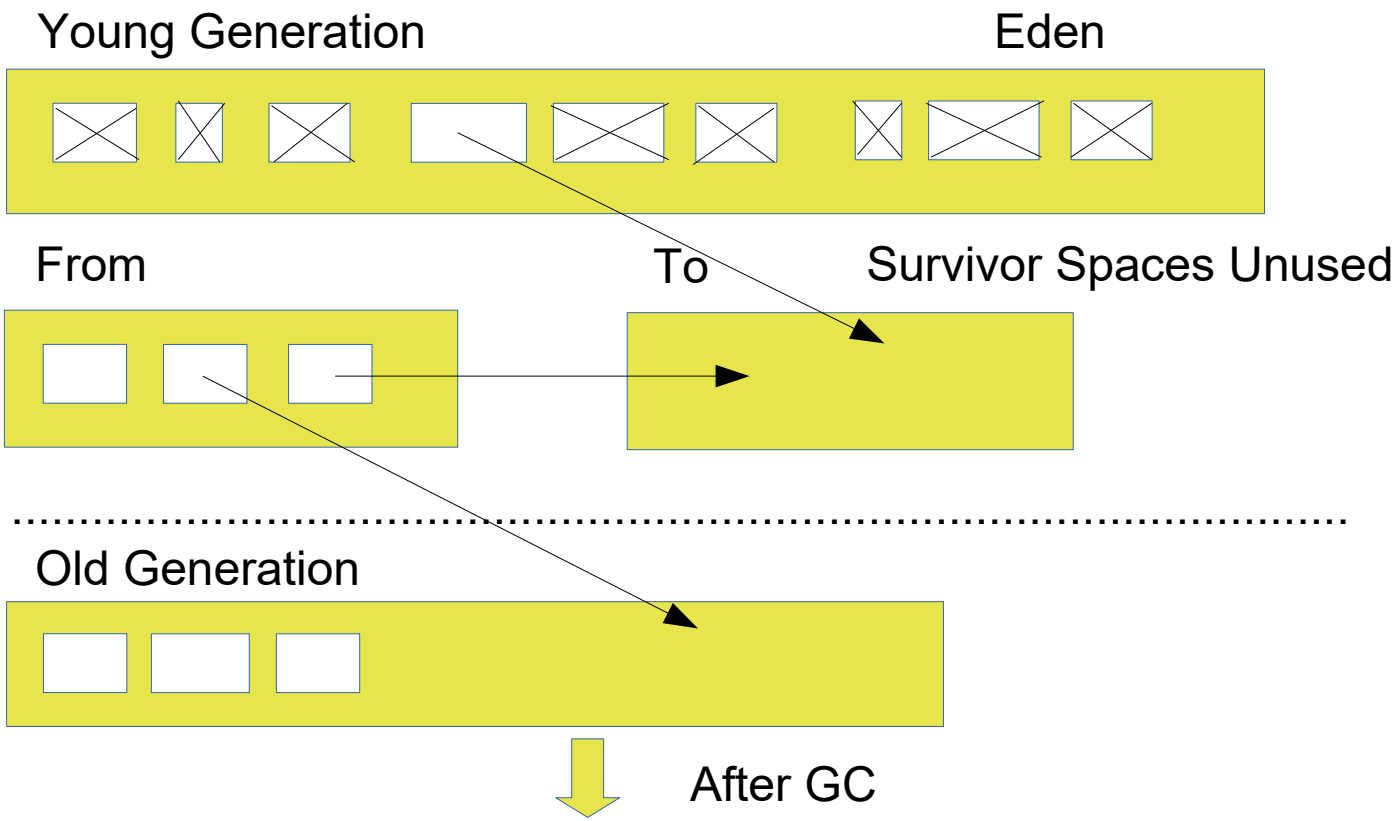
Additional GC Tuning Options

- Generation size adjustments:
  -XX:YoungGenerationSizeIncrement=<Y> (default 20%)
  -XX:TenuredGenerationSizeIncrement=<T> (default 20%)
  -XX:AdaptiveSizeDecrementScaleFactor=<D> (X/D=def. 5%)
- **java** -XX:+PrintFlagsFinal <GC options> -version | grep MaxHeapSize
- **-XX:-UseGCOverheadLimit** –switch off the OutOfMemoryError behavior when >= 98% of the total time is spent in garbage collection and less than 2% of the heap is recovered
- G1 **-XX:InitiatingHeapOccupancyPercent=<N>** percentage(0-100)

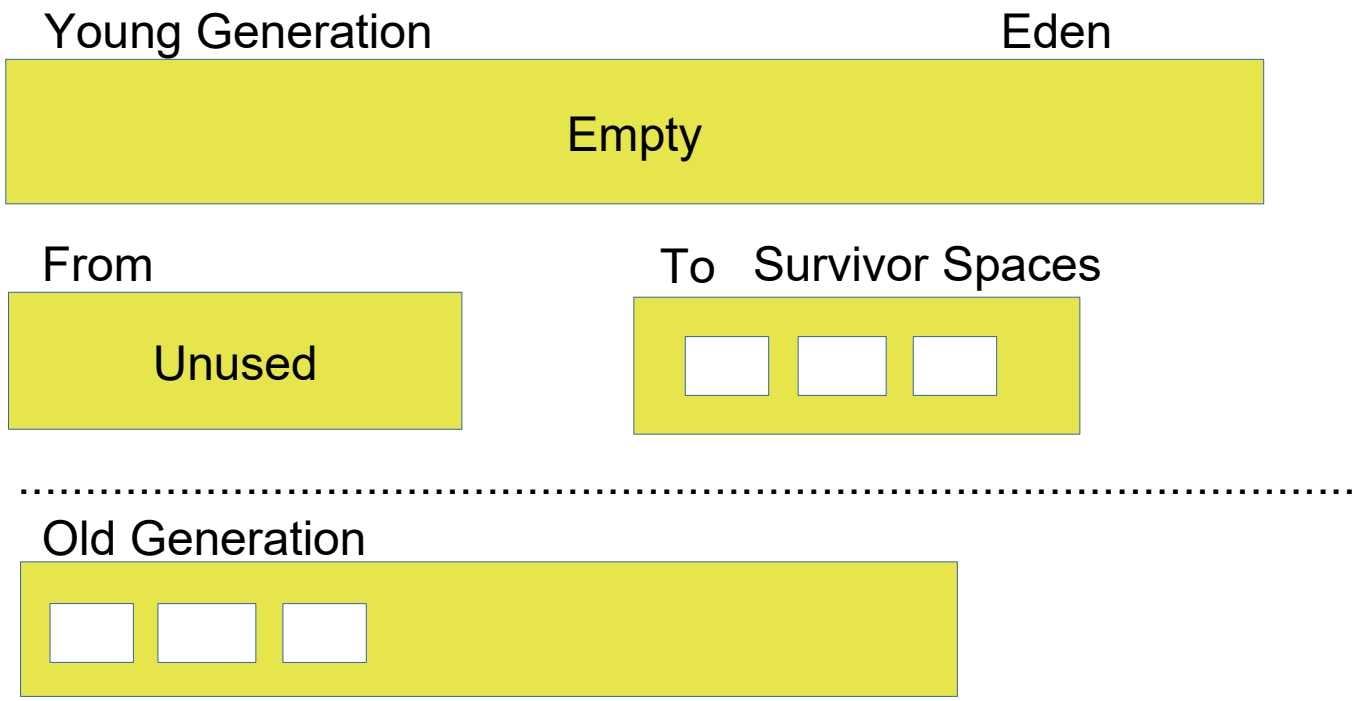
Card Table Structure



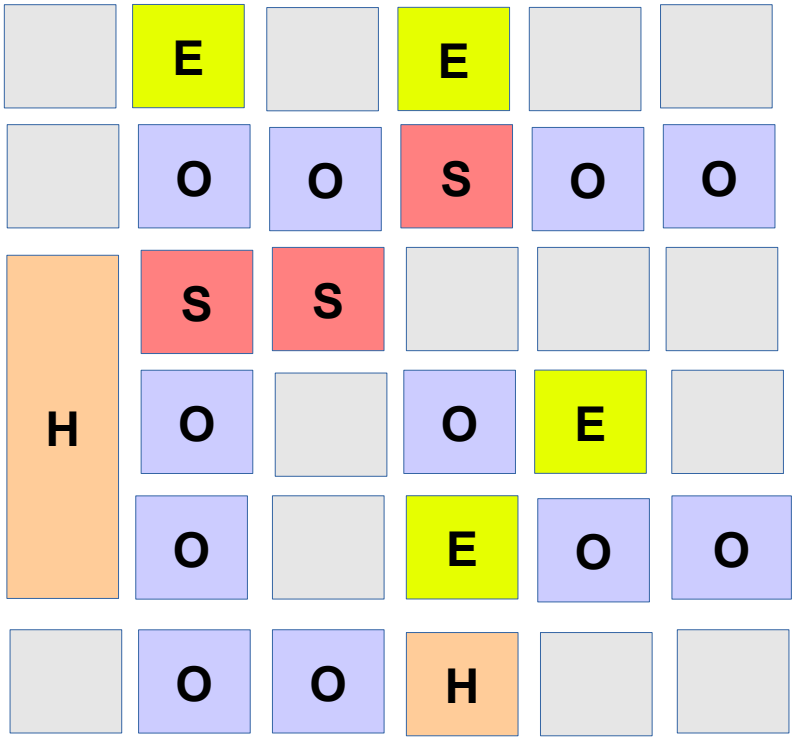
Before GC

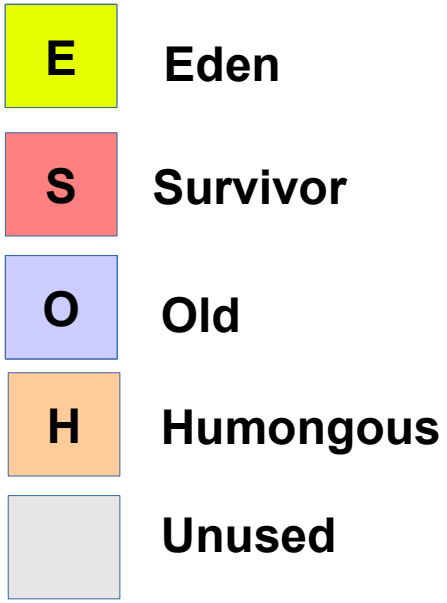


After GC



Garbage First G1 Partially Concurrent Collector

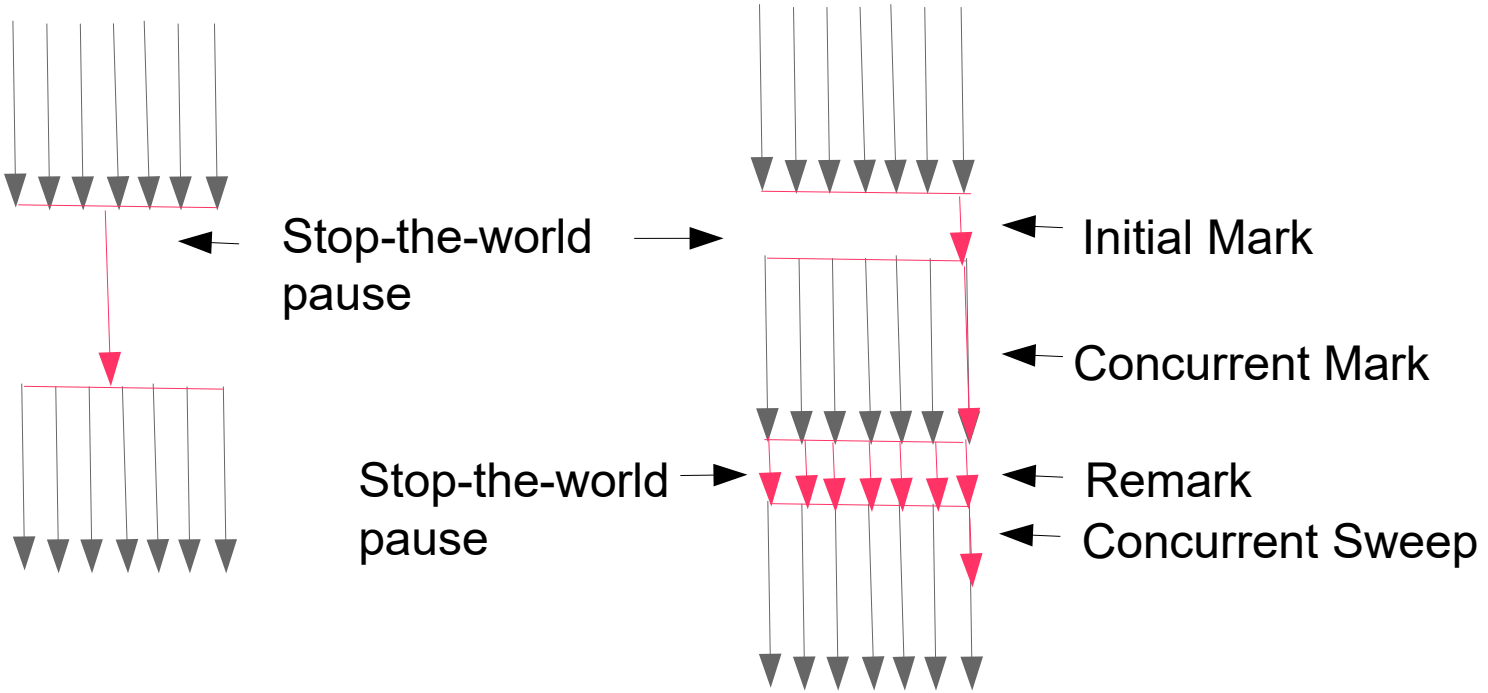




CMS GC (-XX:+UseConcMarkSweepGC)

Serial Mark-Sweep-Compact Collector

Concurrent Mark-Sweep Collector



Profiling Recommendations: GC

- **Garbage Collection** – be sure to minimize the GC interference by calling **System.gc()** several times before benchmark start. Call **System.runFinalization()** also. GC activity can be monitored using **-verbose:gc** JVM command. Another way to minimize GC interference is to use serial garbage collector using **-XX:+UseSerialGC** and same value for **-Xmx** and **-Xms**, as well as explicitly setting **-Xnm** flags.
- Use more precise **System.nanoTime()**, but be aware that the time can be reported with varying degree of accuracy in different JVM implementations.

Java Command Line Monitoring/Tuning Tools - I

- **jps** – reports the local VM identifier (**lvmid** - typically the process identifier - **PID** for the JVM process), for each instrumented JVM found on the target system.
- **jcmd** – reports class, thread and VM information for a java process: **jcmd <PID> <command> <optional arguments>**
- **jinfo** – provides information about current system properties of the JVM and for some properties allows to be set dynamically:

  jinfo -sysprops <PID>

  jinfo -flags <PID>

  jinfo -flag PrintGCDetails <PID>

  jinfo -flag -PrintGCDetails <PID> - sets -XX:-PrintGCDetails

Java Command Line Monitoring/Tuning Tools -II

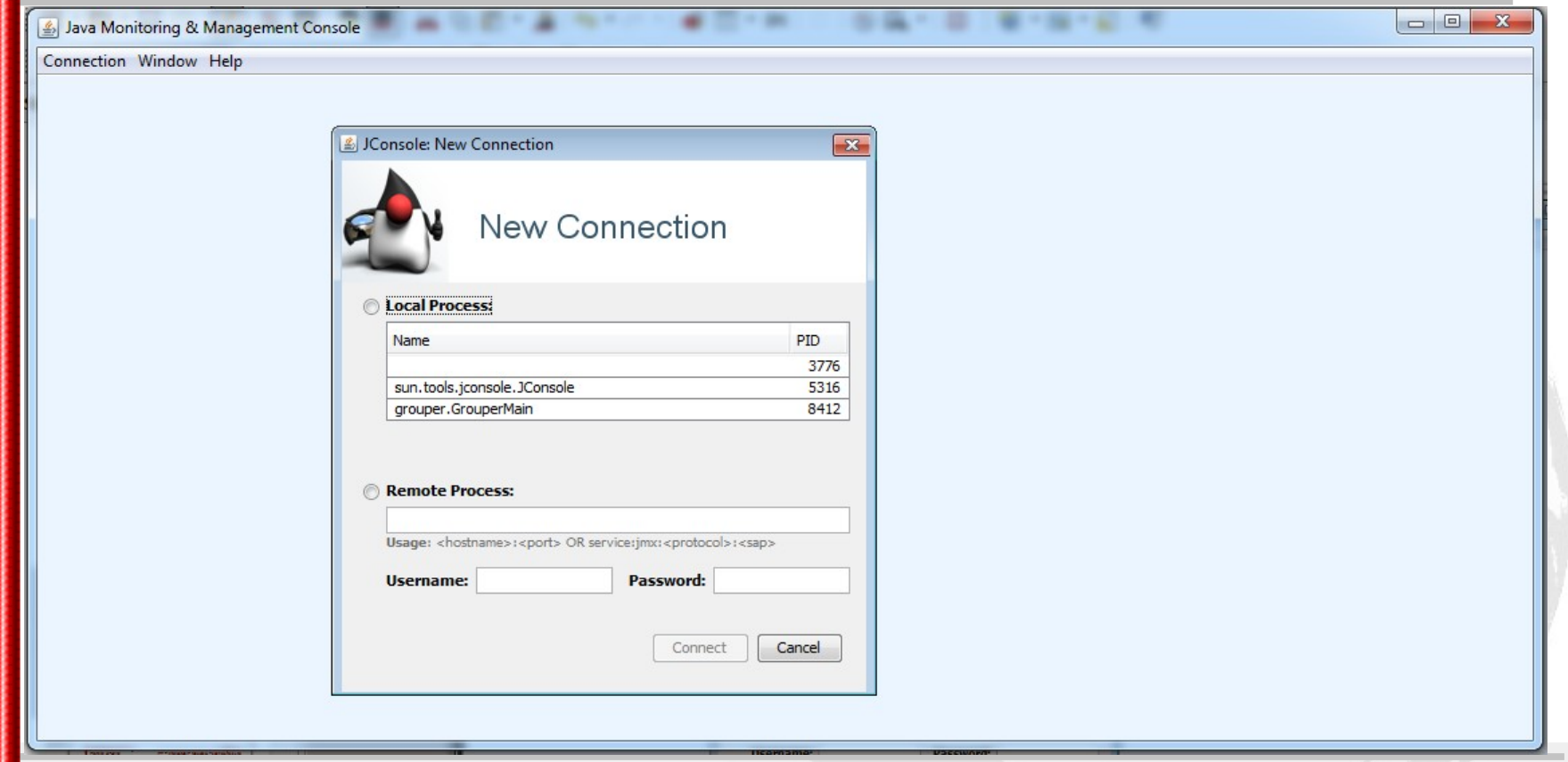
- **jstat & jstatd** – provide information about GC and class loading activities, useful for automated scripting (jstatd = RMI deamon):

  jstat [generalOption | outputOptions vmid [interval[s|ms] [count]]] Ex: **jstat -printcompilation -t -h20 4572 2s**

- Statistics options (part of outputOptions):

  -class - statistics on the behavior of the class loader;
  -compiler - behavior of the HotSpot Just-in-Time compiler;
  -gc - statistics of the behavior of the garbage collected heap;
  -gccapacity - capacities of the generations and their spaces;
  -gccause, -gcutil - summary of garbage collection statistics/causes;
  -gcnew, -gcnewcapacity, -gcold, -gcoldcapacity, -gcpermcapacity – Young/Old/Permanent genration stats
  -printcompilation - HotSpot compilation method statistics

Java GUI tools – JConsole



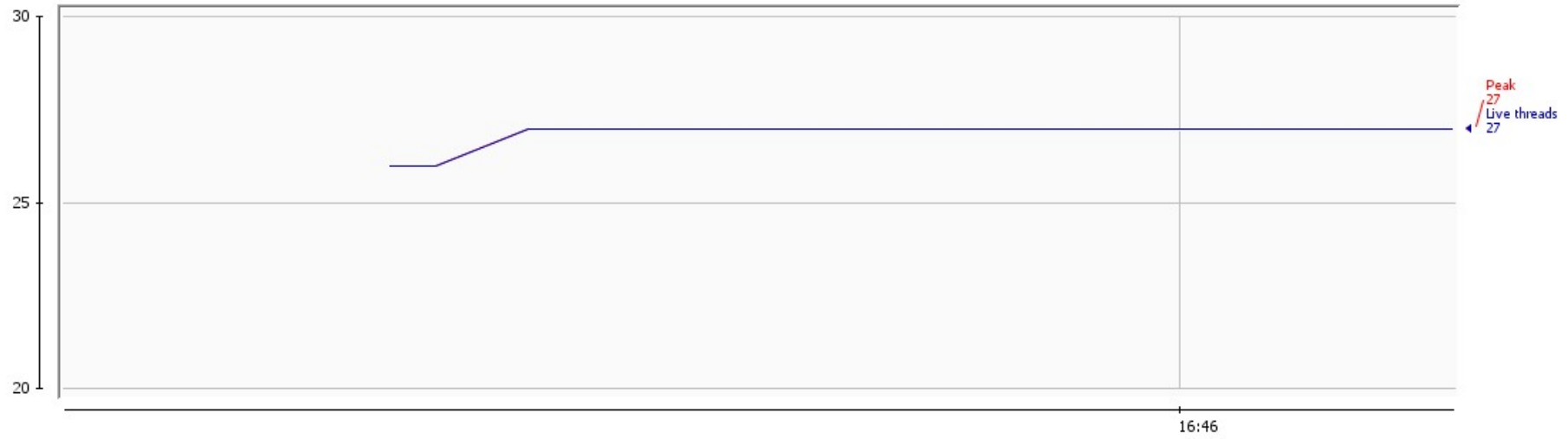
Java Monitoring & Management Console - pid: 8412 grouper.GrouperMain

Connection Window Help

Overview | Memory | Threads | Classes | VM Summary | MBeans

Time Range: All

Number of Threads



Threads

- Signal Dispatcher
- Attach Listener
- pool-1-thread-1
- pool-1-thread-2
- pool-1-thread-3
- pool-1-thread-4
- pool-1-thread-5
- pool-1-thread-6
- pool-1-thread-7
- pool-1-thread-8
- ForkJoinPool.commonPool-worker-1
- ForkJoinPool.commonPool-worker-4
- ForkJoinPool.commonPool-worker-5
- ForkJoinPool.commonPool-worker-6
- ForkJoinPool.commonPool-worker-3
- ForkJoinPool.commonPool-worker-2
- ForkJoinPool.commonPool-worker-7
- RMI TCP Accept-0
- RMI TCP Connection(1)-192.168.56.1

```
Name: pool-1-thread-1
State: RUNNABLE
Total blocked: 143,586  Total waited: 143,672

Stack trace:
java.lang.Object.wait(Native Method)
java.util.concurrent.ForkJoinTask.externalAwaitDone(ForkJoinTask.java:334)
java.util.concurrent.ForkJoinTask.doInvoke(ForkJoinTask.java:405)
java.util.concurrent.ForkJoinTask.invoke(ForkJoinTask.java:734)
java.util.Arrays.parallelSort(Arrays.java:1119)
java.util.stream.SortedOps$OfRef.opEvaluateParallel(SortedOps.java:158)
java.util.stream.AbstractPipeline.opEvaluateParallelLazy(AbstractPipeline.java:735)
java.util.stream.AbstractPipeline.sourceSpliterator(AbstractPipeline.java:471)
java.util.stream.AbstractPipeline.evaluate(AbstractPipeline.java:233)
java.util.stream.ReferencePipeline.collect(ReferencePipeline.java:499)
grouper.controller.impl.inmemory.VehicleControllerConcurentHashMapImpl.get(VehicleControllerConcurentHashMapImpl.java:93)
grouper.task.VehicleTask.call(VehicleTask.java:76)
grouper.task.VehicleTask.call(VehicleTask.java:1)
java.util.concurrent.FutureTask.run(FutureTask.java:266)
java.util.concurrent.Executors$RunnableAdapter.call(Executors.java:511)
java.util.concurrent.FutureTask.run(FutureTask.java:266)
java.util.concurrent.ThreadPoolExecutor.runWorker(ThreadPoolExecutor.java:1142)
java.util.concurrent.ThreadPoolExecutor$Worker.run(ThreadPoolExecutor.java:617)
java.lang.Thread.run(Thread.java:745)
```

Filter

Detect Deadlock

No deadlock detected

Connection Window Help

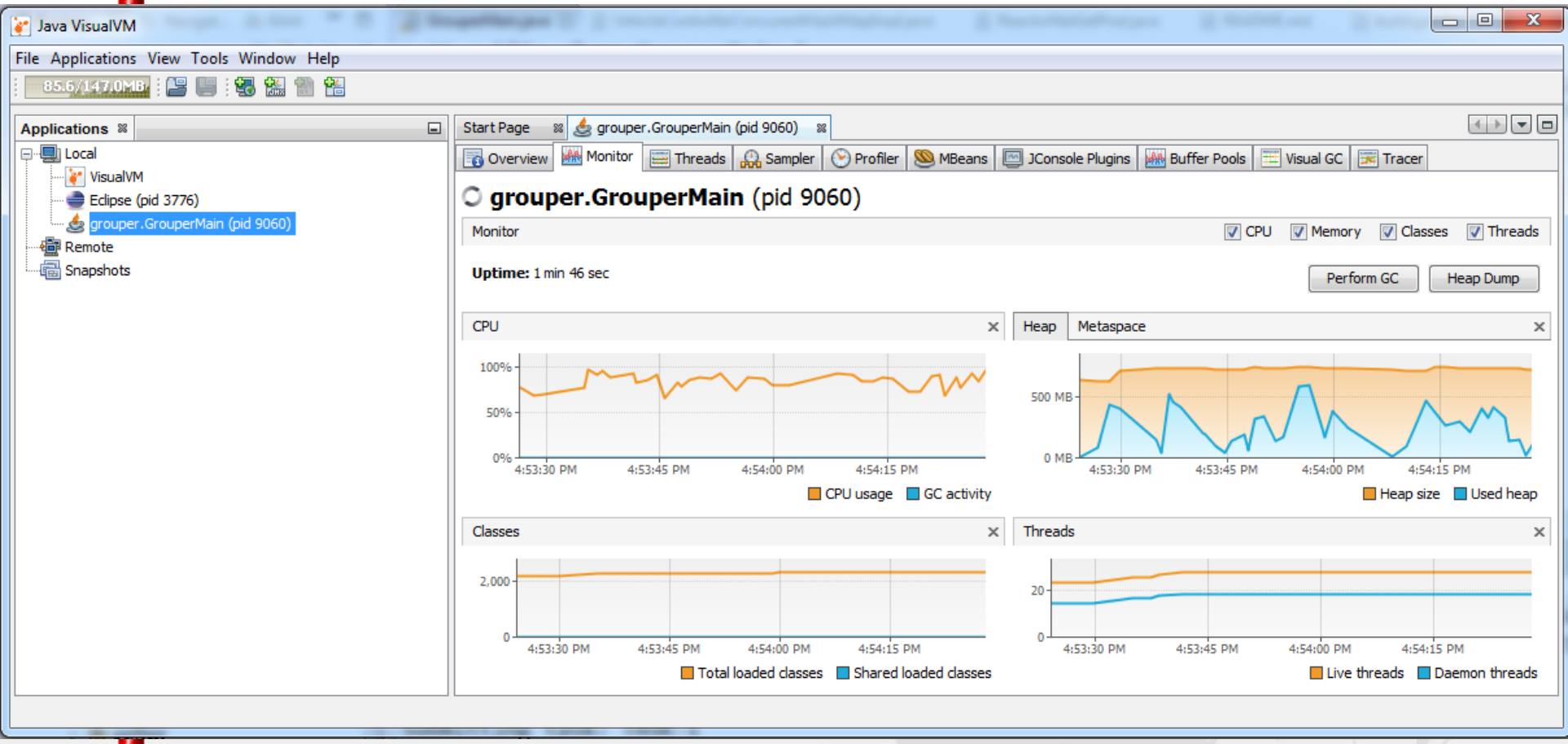
Overview | Memory | Threads | Classes | VM Summary | MBeans

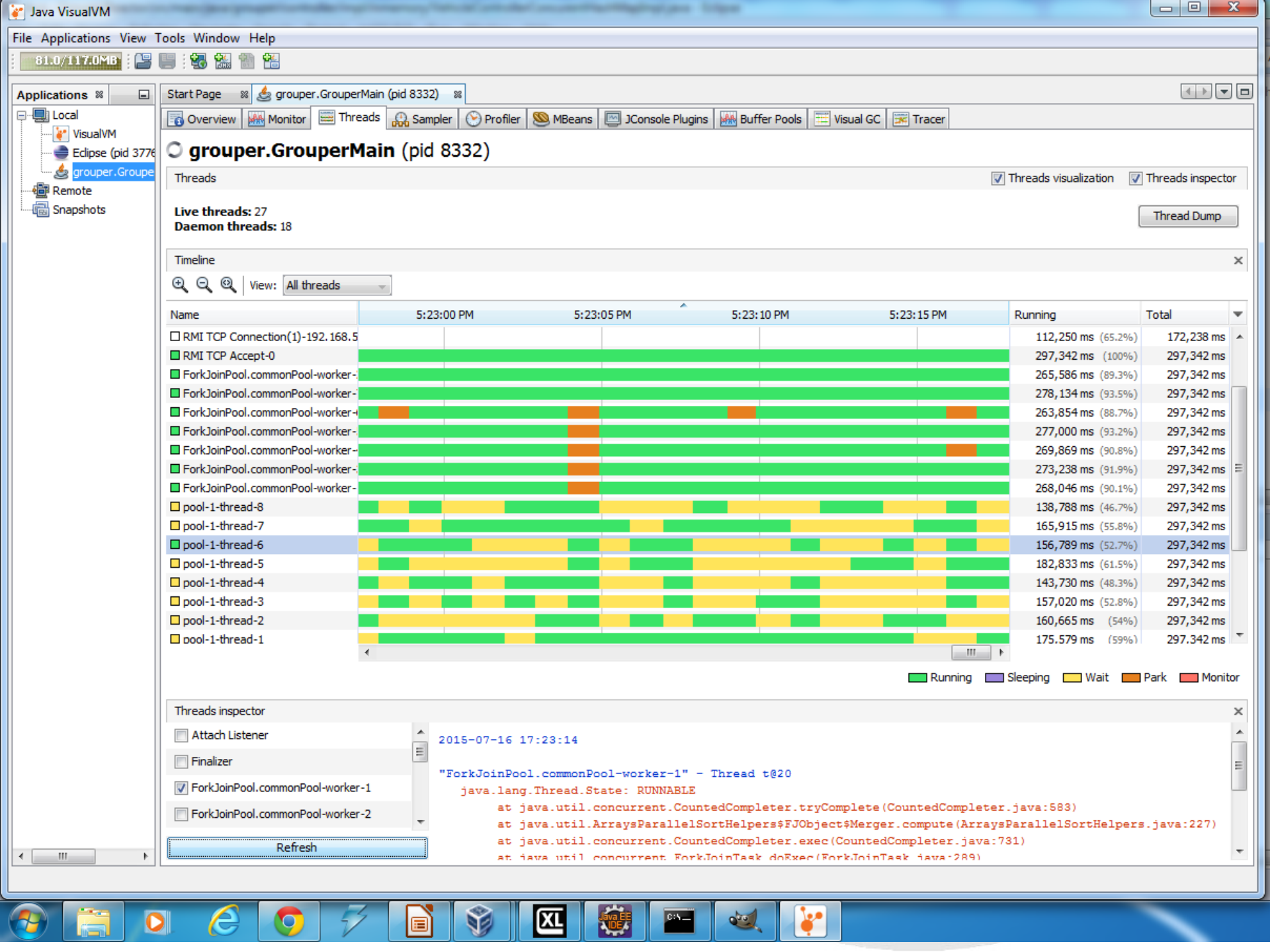
Chart: Heap Memory Usage Time Range: All Perform GC

Details

Time: 2015-07-16 16:49:30
Used: 295,252 kbytes
Committed: 474,624 kbytes
Max: 1,840,640 kbytes
GC time: 0.000 seconds on PS MarkSweep (0 collections)
1.143 seconds on PS Scavenge (455 collections)

Java GUI tools – jvisualvm




Java VisualVM
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Applications
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Eclipse (pid 3776
grouper.Groupe
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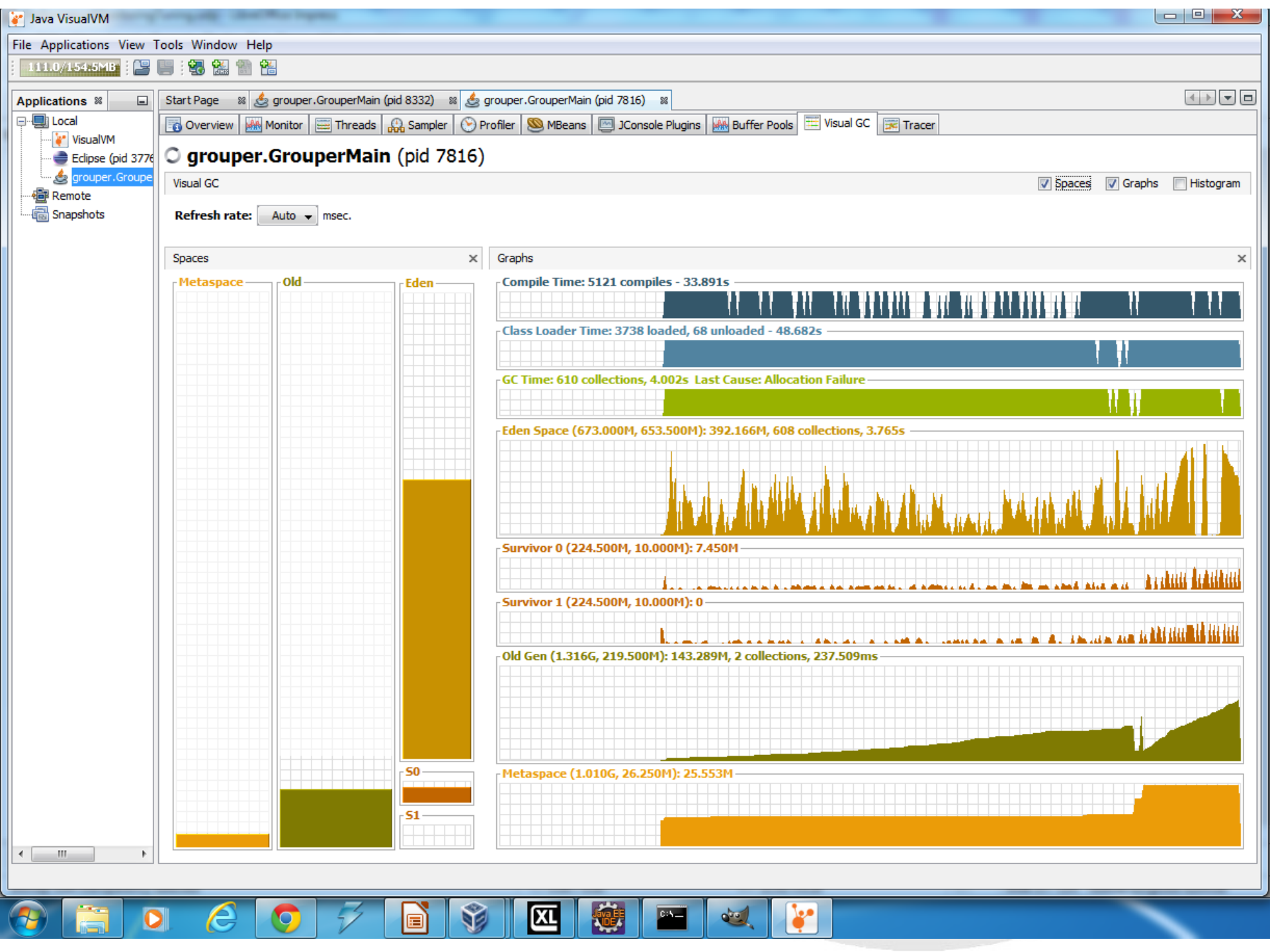
Visual GC
Tracer
grouper.GrouperMain (pid 8332)
Threads
Threads visualization
Threads inspector
Live threads: 27
Daemon threads: 18
Thread Dump
Timeline
View: All threads
Name
5:23:00 PM
5:23:05 PM
5:23:10 PM
5:23:15 PM
Running
Total
RMI TCP Connection(1)-192.168.5
RMI TCP Accept-0
ForkJoinPool.commonPool-worker-
ForkJoinPool.commonPool-worker-
ForkJoinPool.commonPool-worker-
ForkJoinPool.commonPool-worker-
ForkJoinPool.commonPool-worker-
ForkJoinPool.commonPool-worker-
ForkJoinPool.commonPool-worker-
pool-1-thread-8
pool-1-thread-7
pool-1-thread-6
pool-1-thread-5
pool-1-thread-4
pool-1-thread-3
pool-1-thread-2
pool-1-thread-1
112,250 ms (65.2%) 172,238 ms
297,342 ms (100%) 297,342 ms
265,586 ms (89.3%) 297,342 ms
278,134 ms (93.5%) 297,342 ms
263,854 ms (88.7%) 297,342 ms
277,000 ms (93.2%) 297,342 ms
269,869 ms (90.8%) 297,342 ms
273,238 ms (91.9%) 297,342 ms
268,046 ms (90.1%) 297,342 ms
138,788 ms (46.7%) 297,342 ms
165,915 ms (55.8%) 297,342 ms
156,789 ms (52.7%) 297,342 ms
182,833 ms (61.5%) 297,342 ms
143,730 ms (48.3%) 297,342 ms
157,020 ms (52.8%) 297,342 ms
160,665 ms (54%) 297,342 ms
175.579 ms (59%) 297.342 ms
Running
Sleeping
Wait
Park
Monitor
Threads inspector
Attach Listener
Finalizer
ForkJoinPool.commonPool-worker-1
ForkJoinPool.commonPool-worker-2
Refresh
2015-07-16 17:23:14
"ForkJoinPool.commonPool-worker-1" - Thread t@20
java.lang.Thread.State: RUNNABLE
at java.util.concurrent.CountedCompleter.tryComplete(CountedCompleter.java:583)
at java.util.ArraysParallelSortHelpers$FJObject$Merger.compute(ArraysParallelSortHelpers.java:227)
at java.util.concurrent.CountedCompleter.exec(CountedCompleter.java:731)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Visual GC
Spaces
Graphs
Histogram
Refresh rate:
Auto
msec.
Spaces
Metaspace
Old
Eden
S0
S1
Graphs
Compile Time: 5121 compiles - 33.891s
Class Loader Time: 3738 loaded, 68 unloaded - 48.682s
GC Time: 610 collections, 4.002s Last Cause: Allocation Failure
Eden Space (673.000M, 653.500M): 392.166M, 608 collections, 3.765s
Survivor 0 (224.500M, 10.000M): 7.450M
Survivor 1 (224.500M, 10.000M): 0
Old Gen (1.316G, 219.500M): 143.289M, 2 collections, 237.509ms
Metaspace (1.010G, 26.250M): 25.553M

Exception Handling in Java

- Obligatory exception handling in Java → secure and reliable code
- Separation of concerns: business logic from exception handling code
- Class **Throwable** → classes Error и Exception
- Generating Exceptions – keyword **throw**
- Exception handling:
  - **try – catch – finally** block
  - Delegating the handling to the caller method - **throws**

Try-Catch-Finally Block

- Оператор **try** за изпълнение на несигурен код, множество **catch** блокове за обработка на изключения и **finally** за гарантиран clean-up накрая на обработката:

```
try {
   //код, който може да генерира изключения Ex1, Ex2,  …
} catch(Ex1 ex) {  // изпълнява се само при Ex1
   //вземаме подходящи мерки за разрешаване на проблем 1
} catch(Ex2 ex) {  // изпълнява се само при Ex2
    //вземаме подходящи мерки за разрешаване на проблем 2
} finally {
    //изпълнява се винаги, независимо дали има изключение
}
```

Exception Handling in Java - II

- Реализация на собствени изключения
- Конструктори с допълнителни аргументи
- Влагане и повторно генериране на изключения – причина Cause
- Специфика при обработката на **RuntimeException** и неговите наследници
- Завършване чрез **finally**

Novelties in Exception Handling since Java 7

- Multi-**catch** clause:

```
catch (Exception1|Exception2 ex) {

    ex.printStackTrace();
}
```

- Program block **try-with-resources**

```
String readInvoiceNumber(String myfile) throws
IOException {
      try (BufferedReader input = new
            BufferedReader(new
              FileReader(myfile))) {
                  return input.readLine();
            }
}
```

Thank's for Your Attention!

Trayan Iliev

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