Java Programming Performance Tips

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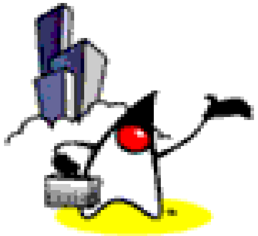
Common Pitfalls

- Primitive and Objects
- Abuse of the String class
- Creating intermediate objects
- Mutable return types
- Using the wrong collections
- Array copy

Primitives vs. Objects

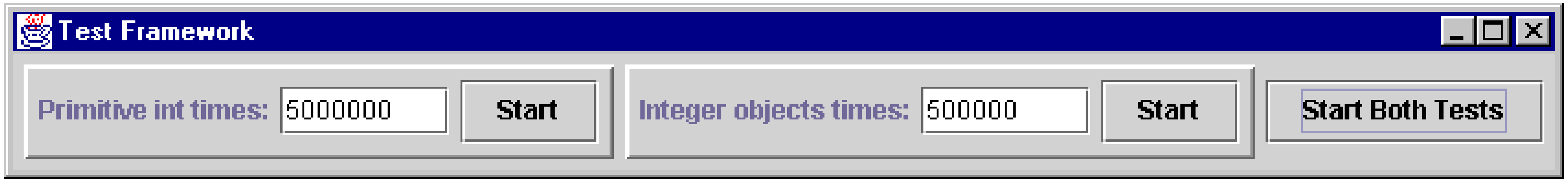


Primitives vs. Objects

```
protected void testOne(int n) {
    fPrimArray = new int[n];
    fPrimSum = 0;
    for (int i = 0; i < n; i++) {
        fPrimArray[i] = i;            // insert
        fPrimSum += fPrimArray[i];    // get
    }
}
//-------------------------------------------
protected void testTwo(int n) {
    fObjectArray = new Integer[n];
    fObjectSum = 0;
    for (int i = 0; i < n; i++) {
        fObjectArray[i] = new Integer(i);
        fObjectSum += fObjectArray[i].intValue();
    }
}
```

Primitives vs. Objects

- Primitive int performs almost 3 times fast than Integer object
  - Tested on JDK1.5.0 for running the loops 1,000,000 times
- Overall "java -server" gives better result than "java”



Primitive int times: 5000000

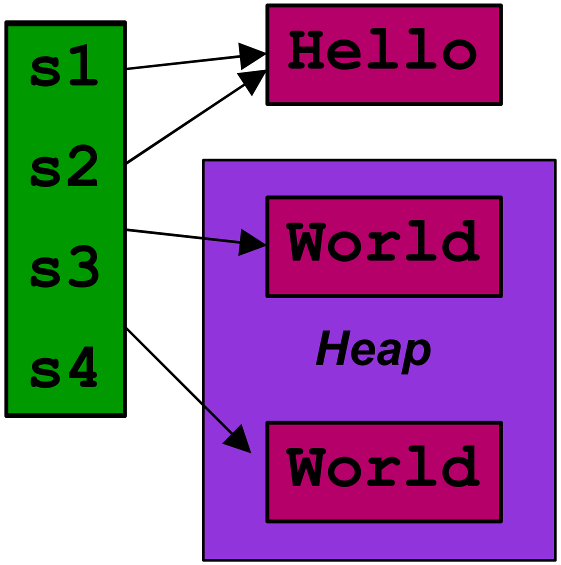
Integer objects times: 500000

String vs. StringBuffer

Two Kinds of **String** Objects

- String literals are unique to each class
  - Only one copy of each unique string
- Heap-based strings are less efficient

```
String s1 = "Hello";

String s2 = "Hello";

String s3 = new String("World");

String s4 = new String("World");

boolean b1 = (s1 == s2);

boolean b2 = (s3 == s4);

boolean b3 = s3.equals(s4);
```

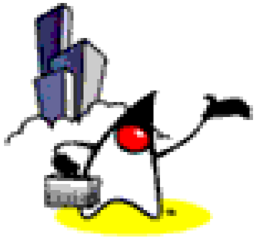


String *vs.* StringBuffer

- String objects are immutable.
- String concatenation creates multiple, intermediate representations
- Use mutable StringBuilder for all cases if no synchronization is needed
- Use mutable StringBuffer if needs synchronization

```
String badStr = new String();
StringBuffer goodBuff = new StringBuilder(1000);
for (int i = 0; i < 1000; i++) {
   badStr += myArray[i];// creates new strings
   goodBuff.append(myArray[i]); // same buffer
}
String goodStr = new String(goodBuff);
```

Java Collections



Java Collections

- Vector and Hashtable are synchronized on all methods
- You pay for safety whether or not you need it
  - No need if only one thread accessing the collection
- Java collection classes not synchronized by default (but can be synchronized).
  - ArrayList, LinkedList replace Vector
  - HashSet, HashMap replace Hashtable
  - Synchronization: use of wrapper classes.
    - a static factory method:
      - Collections.synchronizedList(new ArrayList())

Benchmark: ArrayList & LinkedList

```
// do also for LinkedList, Vector and Hashtable
// timing code not shown

List list = new ArrayList();
final int kNum = 50000;
for (int i = 0; i < kNum; i++)
   list.add(new Integer(i));

for (int i = 0; i < kNum; i++)
   Object result = list.get(i);

for (int i = 0; i < kNum; i++)
   list.remove(0);
```

Benchmark Results: 50,000

- Adding new elements is fast for both types of List.
- **`ArrayList`**:
  Random look up using **`get()`** is fast.
  Removing elements is slow.
- **`LinkedList`**:
  Removing or editing elements in the list is fast.
  Lookup using **`get()`** is very slow.
- **`HashSet/HashMap`**: overall very fast.
- **`Vector behaves the same as ArrayList`**
- **`Hashtable:`** overall very fast.

(sec)	ArrayList	LinkedList	HashSet	HashMap	Vector	Hashtable
Add	0.11	0.23	0.63	0.62	0.11	0.37
Get	0.01	160	0.03	0.07	0.01	0.06
Delete	5.52	0.02	0.13	0.13	5.57	0.08

Copying Array Elements

- Two ways copy elements from one array to another

```
Public class ArrayCopier {

   private double[]  fValues;
   private String[]  fLabels;
   private final int    kNum;
   //--------------------------------
   public ArrayCopier(int number)  {
      kNum = number;
      fValues = new double[kNum];
      fLabels = new String[kNum];
      for (int i = 0; i < kNum; i++) {
         fValues[i] = (double)(i*i);
         fLabels[i] = "" + i;
      }
   }
```

Two Ways To Copy Elements

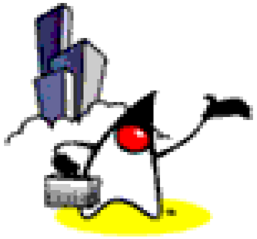
```
//---------------------------------------------
public void useLoopCopy() {
   double[] copyD = new double[kNum];
   String[] copyS = new String[kNum];
   for (int i = 0; i < kNum; i++) {
      copyD[i] = fValues[i];
      copyS[i] = fLabels[i];
   }
}

//--------------------------------------------
public void useArraycopy() {
   double[] copyD = new double[kNum];
   String[] copyS = new String[kNum];
   System.arraycopy(fValues, 0, copyD, 0, kNum);
   System.arraycopy(fLabels, 0, copyS, 0, kNum);
}
```

Array Copy Results

500, 000	Java -server (sec)	Java (sec)
Ceate arrays	0.58	0.58
For loop	0.03	0.02
Arraycopy()	0.01	0.01

- Use System.arraycopy(...) to efficiently copy elements from one array to another
- Use static methods in Arrays
  - equals(), fill(), sort()

Exception Handling



Exception Handling

- Use exceptions to make your code robust.
- Use exceptions to handle unexpected conditions.
  - Error conditions outside of your code
    - IOException, RemoteException, SQLException, ConnectException.
- Special case: do not use exceptions when normal program logic will suffice.

`try` is not free

`throw` is expensive.

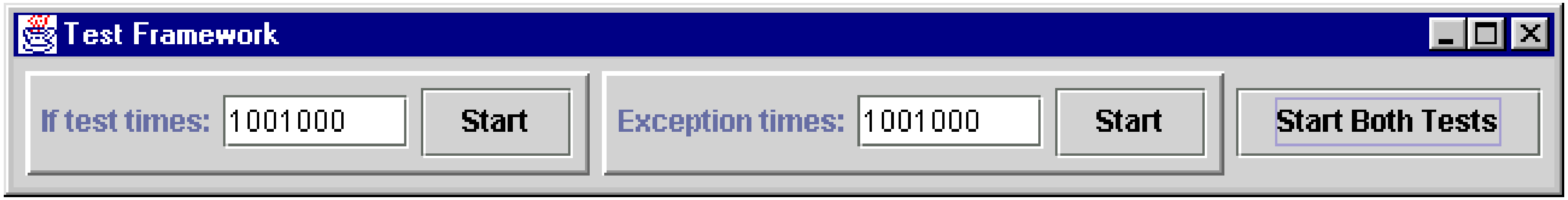
E.g., Array Out of Bounds

```
private   int[]  fArray = new int[100000];

protected void testOne(int n) {
    fSum = 0;
    for (int i = 0; i < n; i++) {
        if (i < fArray.length)
            fSum += fArray[i];
    }
}

protected void testTwo(int n) {
    fSum = 0;
    for (int i = 0; i < n; i++) {
        try {
            fSum += fArray[i];
        } catch (IndexOutOfBoundsException e) {}
    }
}
```

- What happens when n is larger than the array?

Logic vs. Exceptions

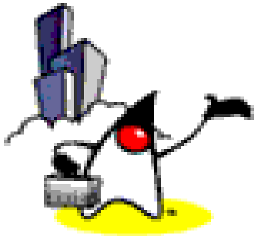
- Test used array with 1,000,000 primitive ints.
- When exceed array bounds ("# overrun"):
  - logic faster than exceptions (HotSpot).



If test times: 1001000

Exception times: 1001000

Thread Synchronization



Thread Synchronization

- Spraying around the synchronized keyword doesn’t ensure your code is thread-safe
- Synchronization has a cost
  - Methods execute more slowly, because acquiring and releasing a monitor lock is expensive
  - Synchronization may cause deadlock
- Use synchronized key word:
  - only for critical section
  - hold lock as short a time as possible

Synchronize Critical Section

- E.g., **shared resource** is an customer account. Certain methods called by multiple threads.
- **Hold monitor lock for as short a time as possible**.

```
synchronized double getBalance() {
   Account acct = verify(name, password);
   return acct.balance;
}
```

Lock held for long tin

```
double getBalance() {
   synchronized (this) {
      Account acct = verify(name, password);
      return acct.balance;
   }
}
```

Equivalent to above

Current object is locked

```
double getBalance() {
   Account acct = verify(name, password);
   synchronized (acct) { return acct.balance};
}
```

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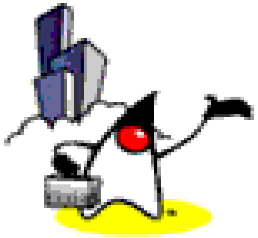
Only acct object is locked – for shorter tim

Writing to Console



Be Careful with println()

- Hiding console windows when not needed
- Control the debugging code

  pass debug option on command line

  test debug boolean before writing to console

  set debug = false for shipping code

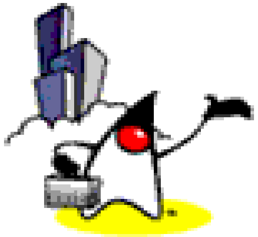
```
   //use boolean to control debugging message
static final boolean debug = true;
   if (debug) {
      debug("debugBar: " + X + Y + "error message");
}

public static void debug(String a) {
      System.err.println(a); }
```

Using JDBC

- Use JDBC PreparedStatement for SQL commands instead of ordinary statements
- Combining a number of related SQL operations into a single JDBC transactions
  - set “auto commit” mode to false.
    - setAutoCommit(false)
  - SQL statement executes are bundled into a single transaction.
    - ExecuteUpdate()

Perceived Performance



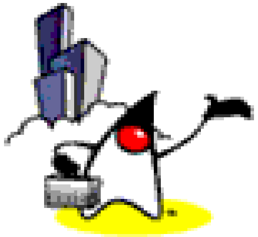
Perceived Performance

- GUI applications:
  - How fast something *feels*, not how fast it is
- Ways to improve how fast your users feel without actually making anything run faster
  - Changing the mouse cursor to a waiting cursor
  - Using multiple background threads
  - Showing the progress bar

Perceived Performance

- Start up time:
  - Lazy initialization is often useful.
  - Applets:
    - Use Jar files to minimize requests.
    - Install on client system if possible.
    - Obfuscators and size reduction tools.
    - Run empty applet to get VM loaded.
  - Applications:
    - Separate initialization thread.
    - Minimize dependencies for start screen.

Byte code reduction



Byte Code Reduction

- Package: compressed Jar files
- Optimize: remove unused code
- Obfuscate: E.g.,
  - getCustomerAddress() -> a()
- Vendor claims Jar file reductions of 30 - 70 % are common

Thank you!

Check JavaPassion.com Codecamps!
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