Productive Coder

Dr Heinz M. Kabutz

The Java Specialists' Newsletter

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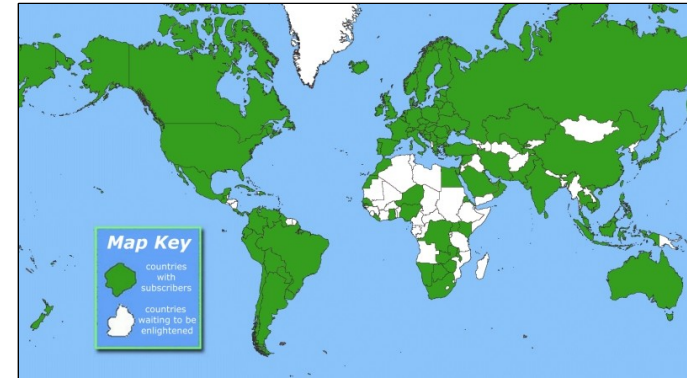and home of The Java™ Specialists' Newsletter

Productive Coder

- **How you can have more fun interacting with your machine …**

- **… and make your computer less frustrated with having you as operator** ☺

Background

- **Heinz Kabutz**
  - *The Java Specialists' Newsletter*
    - **30 000 readers in 113 countries**
  - **Taught Java to hundreds of developers**
    - **Java Patterns Course**
    - **Java 5 Delta Course**
    - http://javaspecialists.eu/courses
  - **Java Champion**
  - **Java programmer since 1997**
    - **Worked on large Java systems**
      - **500 000 – 1 000 000 LOC**

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Welcome to The Java™ Specialists' Newsletter

Casting like a Tiger [Issue 127] Java 5 adds a new way of casting that does not show compiler warnings or errors. Yet another way to shoot yourself in the foot?

Java Courses on Crete

Imagine being trained in Java™ and object orientation by the authors of The Java™ Specialists' Newsletter and Java™ Champions Dr Heinz Kabutz and Kirk Pepperdine. To add to our **inhouse Java courses** we are proud to announce the launch of our **Java Courses on Crete** with it's beautiful beaches, warm weather and great local food.

Newsletter Archive

Over 120 issues archived by date and topic. You are welcome to join our community of 20,000 java programmers in over 100 countries who receive **The Java Specialists' Newsletter** every month.

"Dr Heinz Max Kabutz publishes an Advanced Java newsletter. Not for the uninitiated, but I find something fascinating in every issue."
Bruce Eckel, Author of Thinking in Java

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Become One With Your Machine

- **Typical programmer works 60 hours per week**
  - **We all want *maximum* of 40 hours**

- **Programmer and machine should be one**
  - **Feel the machine**
  - **Understand the machine**
  - **Speak nicely to the machine ☺**

- **Human Computer Interaction is progressing slowly**
  - **You should be able to type this whilst at the same time watching TV.**
  - **When you make a typing error, you should know that you have made it without looking at the screen.**

Keyboard Skills

- **Not all programmers can touch type**

- **But it is so easy:**
  - **Each keyboard has dimple for index fingers on "F" and "J"**
  - **From there, each finger controls the buttons above and below it**

- **Initial investment of about 20 hours**

- **Try to mainly use the keyboard – minimize mouse use**
  - **Menu driven copy & paste …**

- **German Keyboard layout is bad for coding**
  - **Greek is excellent though!**

Keyboard Magic

- **Back to the basics of working with computers**

- **Applies to any language, not just Java**

- **But, Java's IDEs make this approach even more productive**

Keyboard Shortcuts

- **Memorise as many as possible**

- **Use them frequently**

- **Try to minimize mouse usage**

- **Every IDE is different**
  - **Sometimes on purpose it seems**
  - **CTRL+D in IntelliJ & Eclipse**

- **Learn vim**
  - **Productive for small jobs**
  - **Good discipline in keyboard use**

Know Your IDE

- **IntelliJ my favourite**
  - **Netbeans 6 and Eclipse narrowing gap**

- **Short demo of how to create three classes:**
  - **Flower, RarityStatus, FynbosFan**

Orothamnus zeyheri (Marsh Rose)

Which IDE ? – Does Not Matter!

- **Whatever your choice, it's *your* choice**

- **Spend 10 hours getting to know keyboard shortcuts**

- **Whether Netbeans, Eclipse, IntelliJ, vim, Notepad**
  - **No, scratch that last one …**

Fingers Overtaking the Brain

- **You still need to plan**
  - **Stop & think before you start**

- **When shortcuts & fingers are too fast:**
  - **Increase speed of your brain**
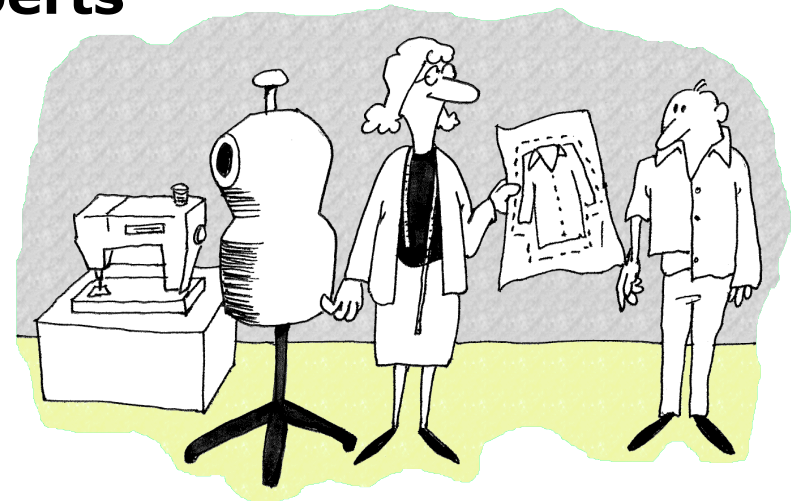 - **Think in higher level concepts, such as Design Patterns**
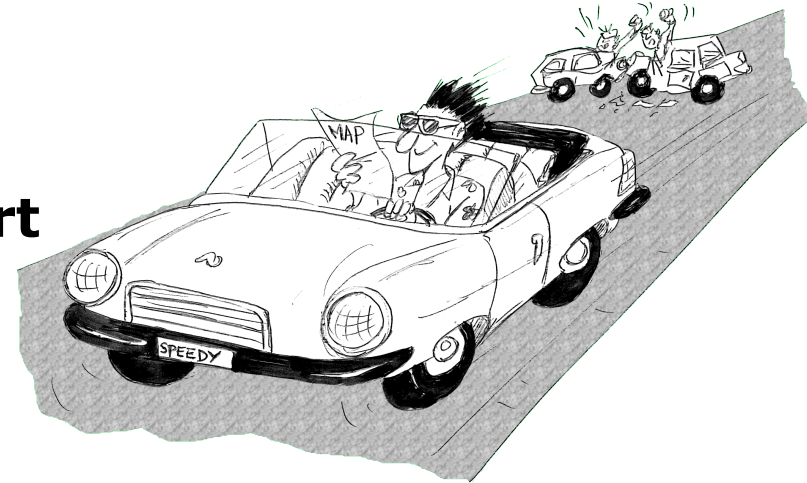
Design Patterns

- **Mainstream of OO landscape, offering us:**
  - **View into brains of OO experts**
  - **Quicker understanding of existing designs**
    - **e.g. Visitor pattern used by Annotation Processing Tool**
  - **Improved communication between developers**
  - **Readjusting of "thinking mistakes" by developers**

Vintage Wines

- **Design Patterns are like good red wine**
  - **You cannot appreciate them at first**
  - **As you study them you learn the difference between *plonk* and vintage, or bad and good designs**
  - **As you become a connoisseur you experience the various textures you didn't notice before**

- **Warning: Once you are hooked, you will no longer be satisfied with inferior designs**

"Houston, We Have a Problem"

- **"Our lead developer has left"**
  - **Software works most of the time**
  - **We have to fix it, and add some features ...**

- **How do you start?**
  - **What code is dead?**
    - **Stories of whole teams working on dead code for years**
  - **Where are the unit test?**
  - **Where could access control be tighter?**
  - **What portion of code is commented?**
  - **How can I find bad code? Copy & paste code?**

Initial Investigation

- **Check where comments are missing**
  - **Doclet that checks that all elements are documented**
    http://javaspecialists.eu/archive/newsletter.do?issue=049

- **Find fields that are not private**
  - **Doclet that runs through your code and finds non-private fields**
    http://javaspecialists.eu/archive/newsletter.do?issue=035

- **Count number of classes, lines of code per class**
  - **Aim is for average of less than 100 lines per class**
  - **One of my customers had one Java class > 30000 LOC**

- **Run code coverage tool against unit tests**

What are Realistic Values?

	# Classes	Total LOC AVG/STDEV	Uncommented Elements
Project 1 South Africa	1359	263790 194 / 337	24291 18 per class
Project 2 Germany	442	62393 141 / 149	7298 17 per class
Ideal	1000	80260 80 / 61	1000 max 1 per class

- **Beware, LOC is only a *rough* measurement**

Comments Should Explain "Why"

- **Should not just be:** *Method getName returns the name.*

- **Switch off automatic comment generation**

- **Either fill in comments properly, or leave them out**

- **Method names and parameters should be descriptive**

- **"Why I don't read your code comments ..."**
  - **Most misunderstood newsletter**
  - http://javaspecialists.eu/archive/newsletter.do?issue=039
  - **I do write my own comments, but about "why" not "what"**
  - **But, I seldom find projects with well-written comments**

Comments: java.awt.color.ColorSpace

- **Rather insightful comment in JDK 1.3:**

```java
/**
 * Returns the name of the component given the
 * component index
 */
public String getName (int idx) {
  /* REMIND - handle common cases here */
  return new String(
    "Unnamed color component("+idx+")");
}
```

- **What is "REMIND" supposed to tell us?**

Comments: java.awt.color.ColorSpace

- **In JDK 1.4, more comments, but still the question**

```
/**
 * Returns the name of the component given the
 * component index.
 * @param idx The component index.
 * @return The name of the component at the
 * specified index.
 */
public String getName (int idx) {
  /* REMIND - handle common cases here */
  return new String(
    "Unnamed color component("+idx+")");
}
```

Comments: java.awt.color.ColorSpace

- **Java 5**

```
/** Returns the name of the component given the
 * component index.
 * @param idx The component index.
 * @return The name of the component at the
 * specified index.
 * @throws IllegalArgumentException if idx is less
 * than 0 or greater than numComponents – 1 */
public String getName (int idx) {
  /* REMIND - handle common cases here */
  if ((idx < 0) || (idx > numComponents - 1)) {
     throw new IllegalArgumentException(
       "Component index out of range: " + idx);
  }
  return new String(
    "Unnamed color component("+idx+")");
}
```

Comments: java.awt.color.ColorSpace

- **Java 6**

```
/** Returns the name of the component given the
 * component index.
 * @param idx The component index.
 * @return The name of the component at the
 * specified index.
 * @throws IllegalArgumentException if idx is less
 * than 0 or greater than numComponents – 1 */
public String getName (int idx) {
 /* REMIND - handle common cases here */
 if ((idx < 0) || (idx > numComponents - 1)) {
    throw new IllegalArgumentException(
      "Component index out of range: " + idx);
 }
 if (compName == null) {
    switch (type) {
      case ColorSpace.TYPE_XYZ:
      compName = new String[] {"X", "Y", "Z"}; break;
```

Commenting Out Code

- **Source Control Systems**

  - **Have been around for decades**

- **Don't duplicate work done by source control**

- **If code is dead, delete it, don't comment it out**

Funny Comments

Shouldn't that be ObjectInputStream?

- **JDK 1.3: java.io.ObjectStreamClass**
  ```java
  private final static Class[] NULL_ARGS = {};
  //WORKAROUND compiler bug with following code.
  //static final Class[]OIS_ARGS={ObjectInpuStream.class};
  //static final Class[]OOS_ARGS={ObjectOutpuStream.class};
  private static Class[] OIS_ARGS = null;
  private static Class[] OOS_ARGS = null;
  private static void initStaticMethodArgs() {
    OOS_ARGS = new Class[1];
    OOS_ARGS[0] = ObjectOutputStream.class;
    OIS_ARGS = new Class[1];
    OIS_ARGS[0] = ObjectInputStream.class;
  }
  ```

- **"The compiler team is writing useless code again ..."**
  - http://javaspecialists.eu/archive/newsletter.do?issue=046

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"Wonderfully Disgusting Hack"

- **JDK 1.4: java.awt.Toolkit**
  ```
  static boolean enabledOnToolkit(long eventMask) {
      // Wonderfully disgusting hack for Solaris 9
  ```

- **This made me think:**
  1. **All software contains hacks.**
  2. **I would prefer to know about them.**
  3. **Only a real developer would write "hack" into his comments.**
  4. **Rather use Java than black-box proprietary solution with hundreds of undocumented hacks**

- **"Wonderfully Disgusting Hack"**
  - http://javaspecialists.eu/archive/newsletter.do?issue=077

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Before You Change Any Code…

- **Refactoring is dangerous!**

- **You must have good unit tests**
  - **And great skill if you don't have unit tests…**

- **Also system tests**

- **In troubled projects, unit tests often absent**

Real-Life Case Study

- **Customer has kindly agreed for you to see his code**

- **Domains, names, etc. have been altered**

- **This is not the *worst* I have had to work with**

Real-Life Example

- **Company <u>someone.com</u> has Java application**

- **Single programmer has left**

- **Features must be added and bugs fixed**

- **Initial stats:**

	# Classes	Total LOC AVG / STDEV	Uncommented Elements
Someone.com	97	19478 201 / 181	2461 25 per class

Better Metrics

- **Fanout (FO)**
  - **Number of other classes used in**
    - **Fields**
    - **Parameters**
    - **Local variables**
    - **Return**
    - **Throws**
  - **Primitives and supertypes not counted**
  - **Recommended maximum of 15**
  - **Warning sign: Large number of "import" statements**

Better Metrics

- **Halstead Program Length (HPLen)**
  - **Halstead Software Science metric**
    - **Calculated per class**
    - **'Number of Operators' + 'Number of Operands'**
  - **Maximum of 2000**
  - **Average should be much less**

Better Metrics

- **Maximum Size Of Operation (MSOO)**
  - **Counts maximum size of operations for a class**
  - **Method size determined by cyclomatic complexity**
    - **number of** if**,** for **and** while **statements**
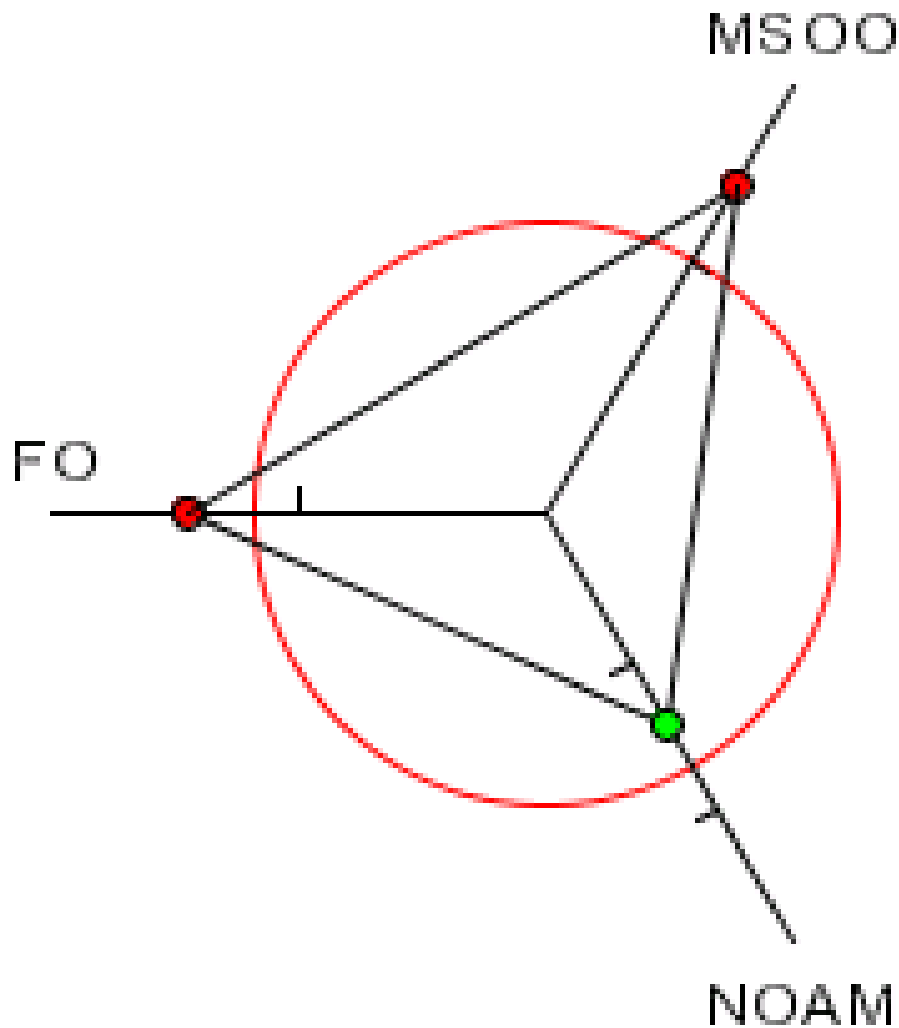 - **Finds overly complex, badly factored methods**

Better Metrics

- **Number Of Added Methods (NOAM)**
  - **Counts the number of operations added by a class**
    - **Inherited and overridden operations are not counted**
  - **Absolute maximum is 50**
    - **Maybe too generous?**
  - **Large value means subclass is too different to superclass**

What do the Metrics Say?

Encapsulation

- **Encapsulation is more than private fields**
  - **Though all non-constant fields should be private**

- **Getters and Setters often break encapsulation**

- **What is the difference between public getName() and setName() methods and making field public?**
  - **Yes, you can check input values**
  - **Fundamental problem – we are not delegating responsibility**
    - **E.g. Entity Beans History**

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Non-private Fields

- **Search with Doclet**
  - http://javaspecialists.eu/archive/newsletter.do?issue=035

- **Output:**
  Non-private data members:
  public com.someone.gui.InfoFrame:
      java.lang.StringBuffer buffer
  public com.someone.gui.TableMap:
      protected javax.swing.table.TableModel model
  public com.someone.io.DelimitedFileDataSource:
      protected java.lang.String[][] data
      protected int index
  public com.someone.io.DelimitedFileReader:
      protected java.lang.String fileName
      protected java.lang.String[] headers
      protected int numberOfFields

Found 203 non-private non-constant fields

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Fixing the Code

- **Either make them all private and see what breaks**
  - **Kind of tedious**

- **Or use a tool to tighten field access control**
  - **Made me into an IntelliJ convert**
  - **Short demonstration …**

- **Rerun the doclet: 104 non-private fields**
  - **An improvement from 203!**

- **Now real work begins – why are they not private?**

Immutable Fields

- **Fields should be marked "final" where possible**
  - http://javaspecialists.eu/archive/newsletter.do?issue=025

- **Immutable objects are easier to work with**
  - **Helps discover bugs**
  - **Synchronization is easier**

- **Garbage collector copes well with short-lived objects**

- **A class with descriptive long names**

```java
public class SessionConnectorWithRetryAtLeastThreeTimes {
  private String connectionNameReceivedFromInternet;
  private int numberOfTimesThatWeShouldRetryAtLeast;
}
```

Add a Constructor

```
public class SessionConnectorWithRetryAtLeastThreeTimes {
  private String connectionNameReceivedFromInternet;
  private int numberOfTimesThatWeShouldRetryAtLeast;
  public SessionConnectorWithRetryAtLeastThreeTimes(
      String c, int n) {
    connectionNameReceivedFromInternet = c;
    numberOfTimesThatWeShouldRetryAtLeast = n;
  }
}
```

- **Problem – we need to read the comments to know what c and n are**

Use the Classic "this." Assignment

- **It compiles and runs, but one field is not initialised**

```java
public class SessionConnectorWithRetryAtLeastThreeTimes
   { private String connectionNameReceivedFromInternet;
   private int numberOfTimesThatWeShouldRetryAtLeast;
   public SessionConnectorWithRetryAtLeastThreeTimes(
         String connectionNameReoeivedFromInternet,
         int numberOfTimesThatWeShouldRetryAtLeast) {
      this.connectionNameReceivedFromInternet =
         connectionNameReceivedFromInternet;
      this.numberOfTimesThatWeShouldRetryAtLeast =
         numberOfTimesThatWeShouldRetryAtLeast;
   }
}
```

Make Fields Final

- **Making them final shows the problem:**
  - Parameter `connectionNameReoeivedFromInternet`

- **So, make all fields as private and final as possible**

- **Search for non-final fields using a Doclet**
  - **Not published, but easy to write**
  - **In our example, 644 fields were non-final**

- **Again, fix either one class at a time, or use a tool**
  - **Quick demonstration with IntelliJ – by hand takes longer**
  - **We now have 380 non-final fields left**

How Final is "final"?

- **Sun Microsystems ambivalent:**
  - **JDK 1.1:**
    - **Access control (private, etc.) <u>not</u> checked at runtime**
    - **Final fields <u>cannot</u> be rebound at runtime**
  - **JDK 1.2:**
    - **Access control checked at runtime, setAccessible(true) overrides**
    - **Final fields <u>could be</u> rebound at runtime with reflection**
  - **JDK 1.3 + 1.4:**
    - **Final fields <u>cannot</u> be rebound at runtime**
  - **JDK 1.5 + 1.6:**
    - **Final fields <u>can be</u> rebound at runtime with reflection**
    - **Except when primitive or String fields are set at declaration time**

Java Versions: When "final" Was Final

- **Java versions and lifespans**

Version	Code Name	Release Date	Lifespan (months)	Final is final
JDK 1.1.4	Sparkler	1997-09-12	15	Yes
J2SE 1.2	Playground	1998-12-04	18	No
J2SE 1.3	Kestrel	2000-05-08	21	Yes
J2SE 1.4	Merlin	2002-02-13	31	Yes
J2SE 5.0	Tiger	2004-09-29	18	No

- **Suggestion: Treat final as if it really was ...**

  - http://javaspecialists.eu/archive/newsletter.do?issue=096

Dead Code

- **Many times I have fixed bugs in dead code**

- **Dead code should be pruned**
  1. **Make elements as private as possible**
  2. **Make fields final**
  3. **Search for dead code and delete**
  4. **GOTO 1**

After Pruning Dead Code

- **Rerun the doclets:**
  - **89 classes (down by 8)**
  - **16879 LOC (down by 2599)**
  - **79 non-private fields (down by 25)**
  - **324 non-final fields (down by 56)**

Back to Comments

- **Strip out useless comments and commented-out code**
  - **Source Control System is doing source control**
  - **Don't duplicate effort!**
  - **Root of problem is fear**

- **If commented code looks useful, leave a note**
  - **E.g.   // CodeComment removed**
  - **Coder can look in source control system for CodeComment**

- **Our system now has 14505 LOC**
  - **Originally 19478 – reduced by over 25%**

Depth of Inheritance Hierarchy

- **Complexity of code can be related to hierarchy depth**

- **Overly deep hierarchies should be avoided**

- **You can check the depth with this simple tool**
  - http://javaspecialists.eu/archive/newsletter.do?issue=121

- **Try beat our record:**
  - **Proprietary code: hierarchy depth of 10**
  - **Open Source: Hierarchy depth of 12**
    - **Rob Mulcahey, Current Inc, Colorado Springs**
    - `org.apache.batik.dom.svg.SVGOMAltGlyphElement`

Exception Handling

- **Quick manual inspection for bad exception handling**

- **Methods should not throw "Exception"**

```
private void initGui() throws Exception {
    initNorth();
    tabbedPane = new JTabbedPane();
    getContentPane().add(tabbedPane, BorderLayout.CENTER);
```

- **And the catch blocks should not be empty**

Never Catch RuntimeException

- **Code should not catch RuntimeException**

```
try {
    data = FruitspecTableModel.getColumnData(i);
} catch (RuntimeException e) {
}
```

- **Replace that with a check on the value of "i"**

- **Implies not catching Exception**

```
try {
    data = FruitspecTableModel.getColumnData(i);
} catch (Exception e) {
}
```

Sloppy Exception Handling

- ## Can cause parts of system to stop working

  - **Gives user false sense of security**

- ## All exceptions need to be noted

  - **Either logged to a file or the help desk**

- ## With Java 5 you can specify global exception handler

  - http://javaspecialists.eu/archive/newsletter.do?issue=089

  - **Nice, but does not solve the "poor coding" of empty catch blocks**

Global Exception Handling

```java
public class DefaultExceptionHandler implements
        Thread.UncaughtExceptionHandler {
  public void uncaughtException(Thread t, Throwable e) {
    // You need more robust, permanent record of problems
    JOptionPane.showMessageDialog(findActiveFrame(),
      e.toString(), "Exception Occurred",
      JOptionPane.OK_OPTION);
    e.printStackTrace();
  }
  private Frame findActiveFrame() {
    for (Frame frame : JFrame.getFrames()) {
      if (frame.isVisible()) return frame;
    }
    return null;
  }
}
```

Register with Class Thread

- **Thread.setDefaultUncaughtExceptionHandler()**

```java
public class EvenBetterGui {
  public static void main(String[] args) {
    Thread.setDefaultUncaughtExceptionHandler(
      new DefaultExceptionHandler());
    Gui gui = new Gui();
    gui.pack();
    gui.setDefaultCloseOperation(
      JFrame.EXIT_ON_CLOSE);
    gui.setVisible(true);
  }
}
```

Now Code is More Manageable

- **Now the real work starts:**
  - **Find and eliminate duplicate code**
  - **Encapsulate fields that are still non-private**
  - **Set up test environment**

- **From here, you must tread carefully**
  - **Make sure you can roll back easily**
  - **Check frequently that code still works**

Automatic Tools and Reflection

- **Java tools rely on static compilation of classes**

- **Be careful when using Reflection and Dynamic Proxies**

Check your code

- **Regularly check your own work:**
  - **Elements are properly commented**
  - **Exceptions are handled correctly**
  - **Fields are private**
  - **Fields are final where possible**
  - **Unit tests cover your code base**
  - **Look for copy & paste code**
    - **Sometimes difficult to eliminate**

Develop with Pleasure!

- **Make your code a pleasure to work with**

- **And don't be scared of fixing messy code**

Some Keystroke Hints

- **The appendix contains some hints on keyboard shortcuts in Eclipse and IntelliJ**

Eclipse

- **Create new class: Alt+Shift+N, C**

- **Autocompletion on keywords?**
  - **Type "in" followed by CTRL+Space …**
    - **Reaching Esc is awkward on the keyboard**
    - **My fingers have to leave the safety of the dimples**

- **Error or unknown symbols in Eclipse – press Ctrl+1**

- **How do I get back to the previous file without using the mouse?**
  - **Alt+left and Alt+right**

Autogenerating Java Code

- **Make constructor: Alt+S, A**
  - Parameters not in same order as fields
    - Though this may be a setting somewhere
  - Enter does not work
  - Names of parameters not the same as the fields

- **Getters / Setters: Alt+S, R**
  - Again, not in same order as fields & enter does not work

- **Main method: main Ctrl+Space**

- **Ctrl + Shift + Space shows parameters**

Eclipse Magic Keys

- **Ctrl+Space autocompletes**
  - **"syso" generates: System.out.println();**
  - **"for" generates: for (int i = 0; i < args.length; i++) {   }**
  - **Problem is that Ctrl+Space is awkward to type**

- **Ctrl+1 autofixes code**
  - **But cursor jumps all over the place ☹**

- **An IDE needs to be like a chef's knife, sharp and true**

IntelliJ IDEA

- **Create new class: In project window (Alt+1) Alt+Insert**

- **Autocompletion on keywords?**
  - **Works a bit better...**
  - **Type "in" followed by CTRL+Space ...**

- **Error or unknown symbols in IntelliJ – press Ctrl+Enter**
  - **F2 finds the next problem**

- **How do I get back to the previous file without using the mouse?**
  - **Alt+Ctrl+left and Alt+Ctrl+right**

Autogenerating Java Code

- **Make constructor: Alt+Insert**
  - **Parameters same order as fields**
  - **Names of parameters same as the fields**

- **Getters / Setters: Alt+Insert**
  - **It does what I expect**

- **equals() & hashCode(): Alt+Insert**
  - **Enter does not work that well**

- **Ctrl+plus and Ctrl+minus folds & unfolds methods**

- **Main method: psvm Tab**

IntelliJ Magic Keys

- **Ctrl + Shift + Space is intelligent autocomplete**

  - **Extremely useful**

- **Tab fills in Live Templates**

  - **"sout" generates: System.out.println();**

  - **"itar" generates: for (int i = 0; i < args.length; i++) {   }**

  - **Problem is that Ctrl+Space is awkward to type**

- **Alt+Enter autofixes code**

  - **Cursor stays in the same place** ☺

- **Ctrl+W selects wider and wider scope**

Style and Metrics Tools

- **MetricsReloaded (IntelliJ IDEA Plugin)**
  - http://www.sixthandredriver.com/metricsreloaded.html

- **Together Control Center**

- **CheckStyle**
  - http://checkstyle.sourceforge.net

- **FindBugs**
  - http://findbugs.sourceforge.net

- **Java PathFinder (from NASA)**
  - http://javapathfinder.sourceforge.net

- **Project Mess Detector (PMD)**
  - http://pmd.sourceforge.net/

Questions?

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