Productive Coder

Dr Heinz M. Kabutz

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**
  - **Lives in Greece on the Island of Crete**
  - **Java Programmer**
  - **The Java Specialists' Newsletter**
    - **50 000 readers in 121 countries**
    - **http://www.javaspecialists.eu**
  - **Java Champion**

Two Events in Crete

- **Java Specialists Symposium Crete 29 Aug - 1 Sep**
  - **"Open Spaces" conference**
  - **Title "Making Java Fun Again"**
  - **Free entry, but seats are limited**
- **Java Specialists Master Course Crete 5-8 Sep**
  - **Advanced Java Course for Java experts**
  - **€2500 per seat**
  - **You may also attend this remotely**

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 …
- European keyboard layouts bad for coding
  - Semicolon and curly braces
  - Use Dvorak or US keyboard layouts and type blindly

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

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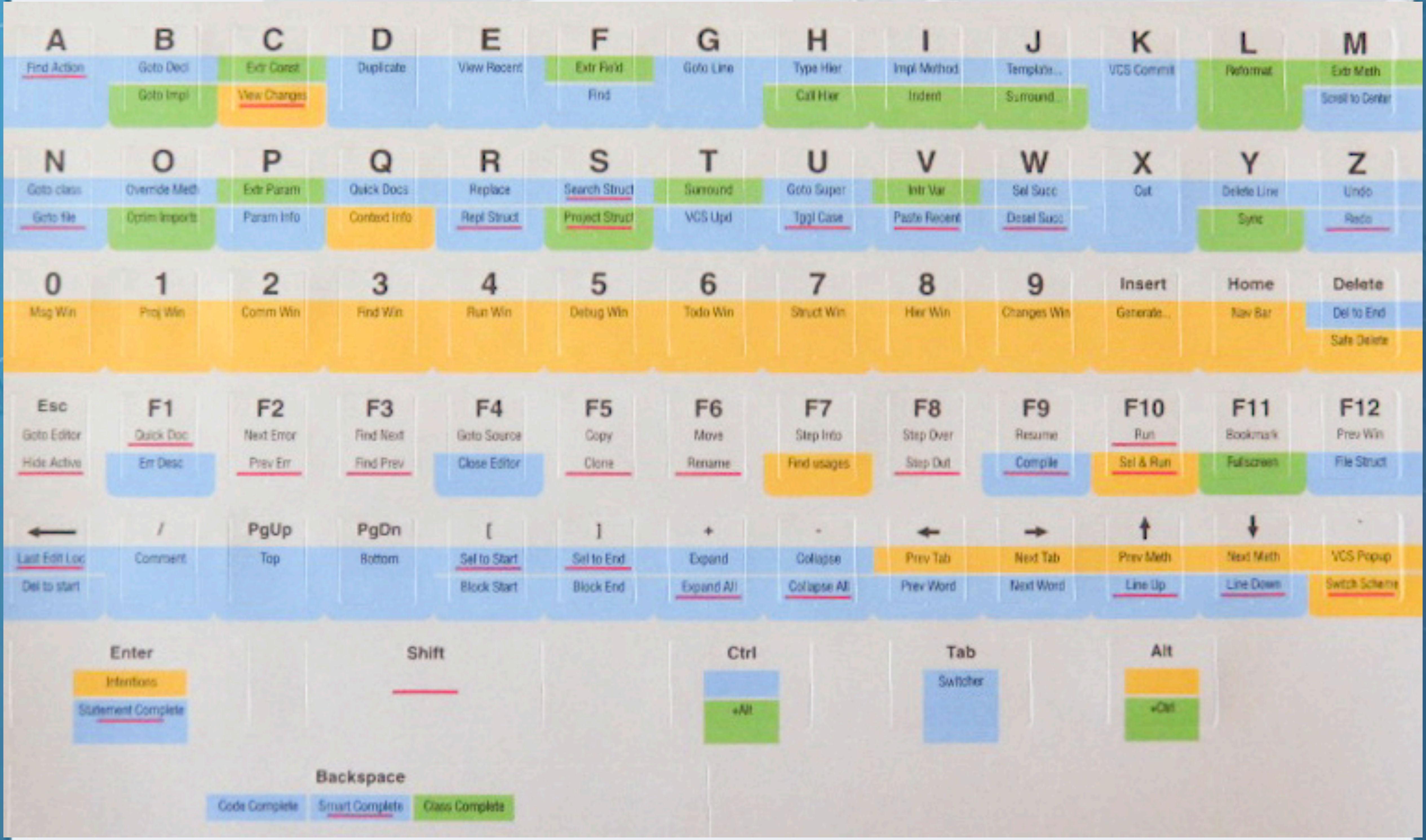
Keyboard Stickers



A	B	C	D	E	F	G	H	I	J	K	L	M
Find Action	Goto Decl	Extr Const	Duplicate	View Recent	Extr Field	Goto Line	Type Hier	Impl Method	Template...	VCS Commit	Reformat	Extr Meth
	Goto Impl	View Changes			Find		Call Hier	Indent	Surround...			Scroll to Center

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Goto class	Override Meth	Extr Param	Quick Docs	Replace	Search Struct	Surround	Goto Super	Intr Var	Sel Succ	Cut	Delete Line	Undo
Goto file	Optim Imports	Param Info	Context Info	Repl Struct	Project Struct	VCS Upd	Tggl Case	Paste Recent	Desel Succ		Sync	Redo

0	1	2	3	4	5	6	7	8	9	Insert	Home	Delete
Msg Win	Proj Win	Comm Win	Find Win	Run Win	Debug Win	Todo Win	Struct Win	Hier Win	Changes Win	Generate...	Nav Bar	Del to End
												Safe Delete

Esc	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Goto Editor	Quick Doc	Next Error	Find Next	Goto Source	Copy	Move	Step Info	Step Over	Resume	Run	Bookmark	Prev Win
Hide Active	Err Desc	Prev Err	Find Prev	Close Editor	Clone	Rename	Find usages	Step Out	Compile	Sel & Run	Fullscreen	File Struct

←	/	PgUp	PgDn	[	]	+	-	←	→	↑	↓	`
Last Edit Loc	Comment	Top	Bottom	Sel to Start	Sel to End	Expand	Collapse	Prev Tab	Next Tab	Prev Meth	Next Meth	VCS Popup
Del to start				Block Start	Block End	Expand All	Collapse All	Prev Word	Next Word	Line Up	Line Down	Switch Scheme

Enter	Shift	Ctrl	Tab	Alt
Intentions			Switcher	
Statement Complete		+Alt		+Ctrl

Backspace		
Code Complete	Smart Complete	Class Complete

Know Your IDE

- **Currently using IntelliJ 7.0.5 and 10.5**
  - **Eclipse and Netbeans also excellent nowadays**
- **Short demo of how to create three classes:**
  - **Flower, RarityStatus, FynbosFan**

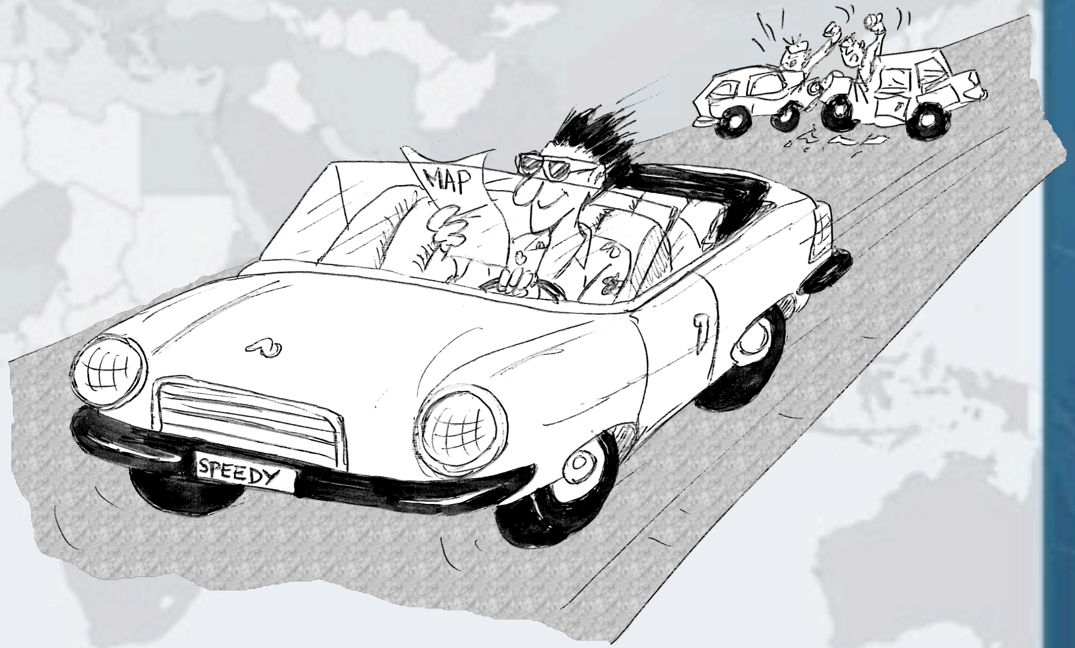
Orothamnus zeyheri (Marsh Rose)

Which IDE ? – Does Not Matter!

- **Whatever your choice, it’s your choice**
- **Spend 10 hours getting to know keyboard shortcuts**

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
- News: Design Patterns Course self-paced learning TBA

“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://www.javaspecialists.eu/archive/Issue049.html
- Find fields that are not private
  - Doclet that runs through your code and finds non-private fields
    http://www.javaspecialists.eu/archive/Issue035.html
- 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://www.javaspecialists.eu/archive/Issue039.html
  - 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:**

```
/**
  * 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**

```
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://www.javaspecialists.eu/archive/Issue046.html**

“Wonderfully Disgusting Hack”

- **JDK 1.4: java.awt.Toolkit**

```
static boolean enabledOnToolkit(long eventMask) {
// Wonderfully disgusting hack for Solaris 9
```

- **This made me think:**
  - **All software contains hacks.**
  - **I would prefer to know about them.**
  - **Only a real developer would write "hack" into his comments.**
  - **Rather use Java than black-box proprietary solution with hundreds of undocumented hacks**
- **“Wonderfully Disgusting Hack”**
  - **http://www.javaspecialists.eu/archive/Issue077.html**

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 someone.com 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**

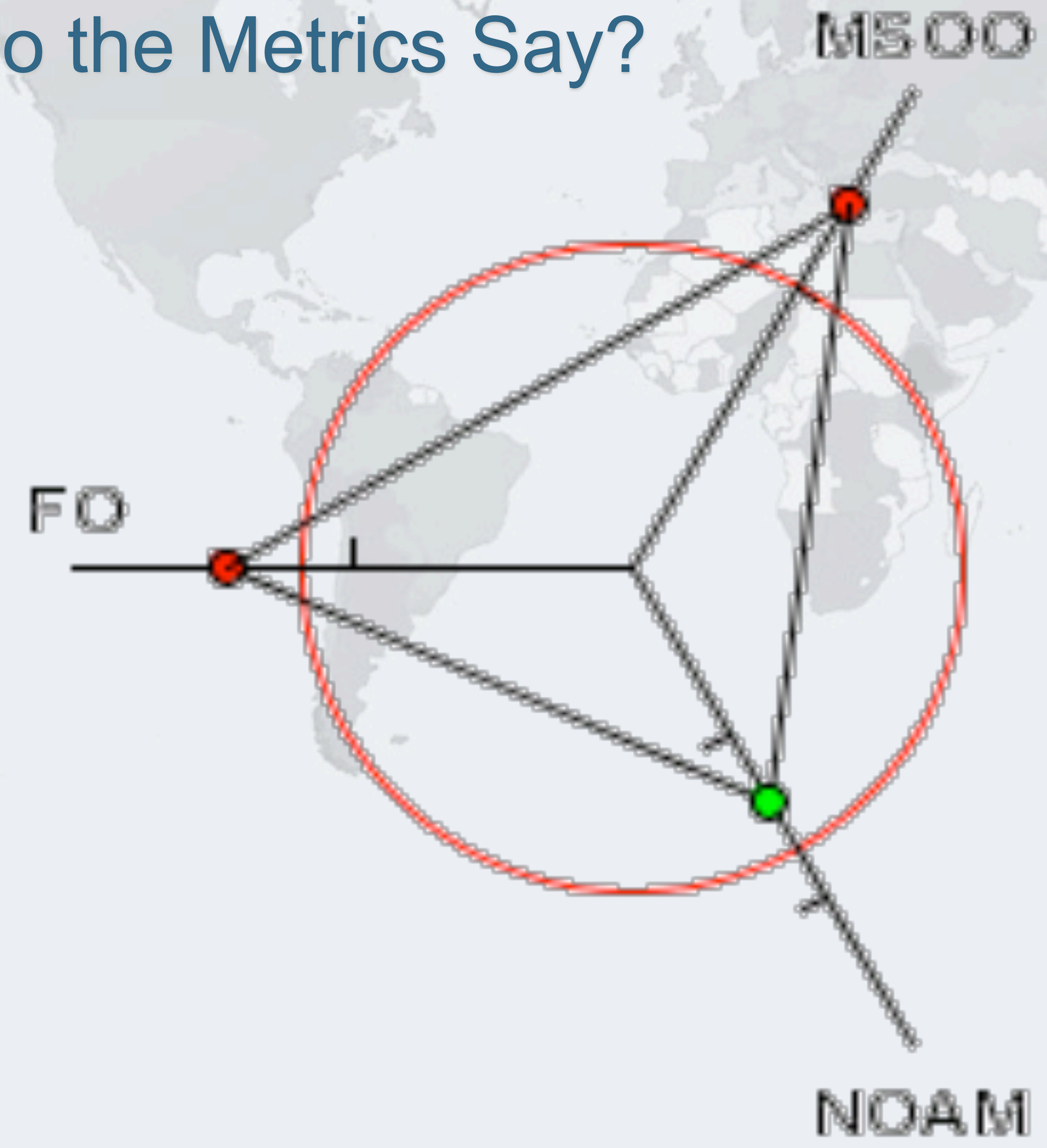
Better Metrics

- **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

Non-private Fields

- **Search with Doclet**
  - **http://www.javaspecialists.eu/archive/Issue035.html**
- **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

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://www.javaspecialists.eu/archive/Issue025.html**
- **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**

```
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**

```
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”?

- Java engineers ambivalent:
  - JDK 1.1:
    - Access control (private, etc.) not checked at runtime
    - Final fields cannot be rebound at runtime
  - JDK 1.2:
    - Access control checked at runtime, setAccessible(true) overrides
    - Final fields could be rebound at runtime with reflection
  - JDK 1.3 + 1.4:
    - Final fields cannot be rebound at runtime
  - JDK 1.5 + 1.6:
    - Final fields can be 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://www.javaspecialists.eu/archive/Issue096.html

Dead Code

- **Many times I have fixed bugs in dead code**
- **Dead code should be pruned**
  - **Make elements as private as possible**
  - **Make fields final**
  - **Search for dead code and delete**
  - **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://www.javaspecialists.eu/archive/Issue121.html**
- **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://www.javaspecialists.eu/archive/Issue089.html**
  - **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()
  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**

Productive Coder

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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++) { }**
- **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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