Productive Coder

Dr Heinz M. Kabutz

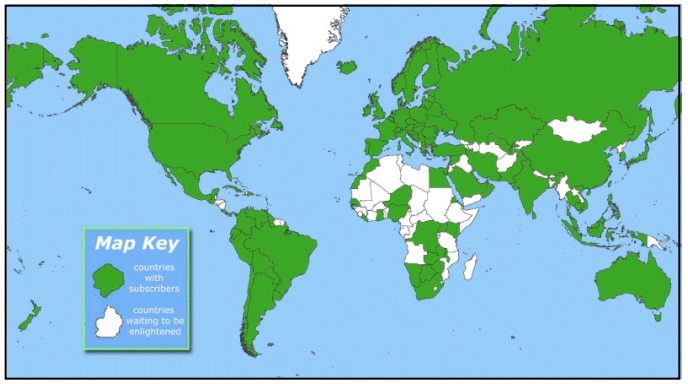
The Java Specialists' Newsletter

http://javaspecialists.co.za

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***
    - **20 000 readers in 111 countries**
  - **Taught Java to hundreds of developers**
    - **Java Patterns Course**
    - **Java 5 Delta Course**
    - **http://javaspecialists.co.za/courses**
  - **Java Champion**
  - **Java programmer since 1997**
    - **Worked on large Java systems**
      - **500 000 – 1 000 000 LOC**

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Java Training Courses and Java Performance

Specialists in Object Orientation

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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?

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"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

Courselinks

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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**

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

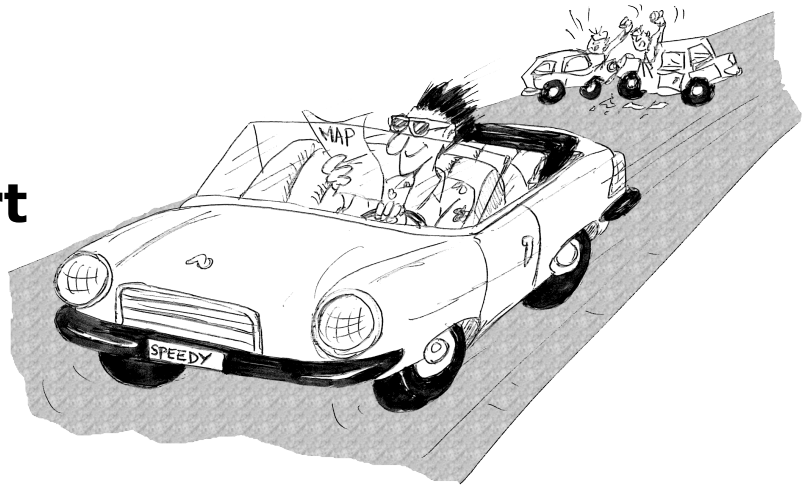
- **IntelliJ my favourite**
  - **Eclipse narrowing gap**
- **Short demo of how to create three classes:**
  - **Flower, RarityStatus, FynbosFan**

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.co.za/archive/newsletter.do?issue=049
- **Find fields that are not private**
  - **Doclet that runs through your code and finds non-private fields**
    http://javaspecialists.co.za/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.co.za/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:**

```
/**
 * 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://javaspecialists.co.za/archive/newsletter.do?issue=046

"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.co.za/archive/newsletter.do?issue=077

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**

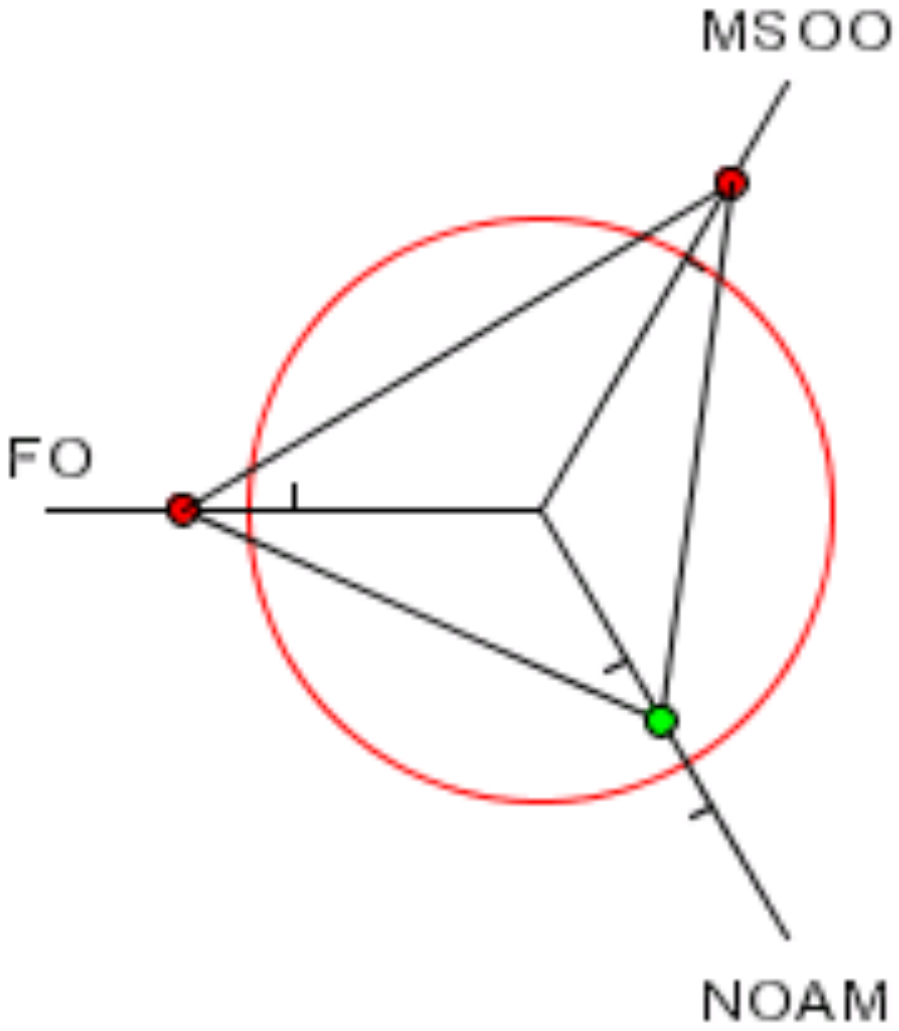
Better Metrics

- **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**

Non-private Fields

- **Search with Doclet**
  - http://javaspecialists.co.za/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
```

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://javaspecialists.co.za/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**

```
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"?

- **Sun Microsystems 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
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.co.za/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.co.za/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.co.za/archive/newsletter.do?issue=089
  - **Nice, but does not solve the "poor coding" of empty catch blocks**

Global Exception Handling

```
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**

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**

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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