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Java™ 101: Basic Syntax and Structure

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*i want stress-free IT.
i want control.
i want an **i**.*

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Outline

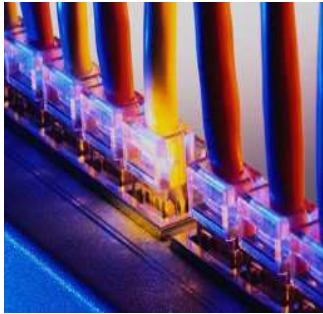
- Introduction
- Why Java™?
- Object-Oriented Overview
- Java Keywords and Definitions
- Elementary Java Structure
- Java Syntax and Control Flow
- Compiling and executing Java Code
- Tips for Approaching Java Code
- Tools for Java Development



Introduction

- Goals
 - Introduce basic Java syntax elements
 - Compare control flow constructs with those in RPG
 - Develop skills for reading and understanding Java source code
- Expand skills in writing Java code
 - Get you understanding Java code syntax
 - Help you find different ways of looking at code
- How to get there
 - Look at Java code
 - Help you understand it

Why “Java”? It’s simple.



- Most popular language
- Distributed
- Secure
- Robust
- Multithreaded
- Write once, run anywhere
- Internationalization (I18N)

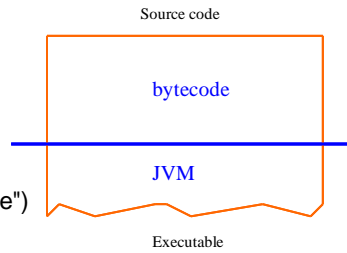
OO in 5 Minutes or Less

- **Class**
 - A pattern, template, or model for an **object**
 - Existence is independent of any single VM
 - Stored ‘externally’ in files in the filesystem
 - Classes can define “inner” classes since Java2
 - Invariant (constant) *class* data shareable
- **Object**
 - Defn: combination of **data** and **methods**
 - An **instance** of a class
 - Existence *depends* on a VM to “hold” the object
- **Data**
 - The **fields** of an object (attributes, characteristics)
- **Methods**
 - The **functions** of an object (procedures, subroutines)



Java Definitions

- **Classfile**
 - A file in the hierarchical file system
 - Contains Java "object code" (a.k.a "bytecode")
 - Result of compiling Java **source code**
- **Jar File**
 - **J**ava **A**Rchive; a **collection** (zipfile) of classfiles and other resources
- **Virtual Machine for Java (VM)**
 - Software that loads and executes **bytecode**
- **Classpath**
 - Locations searched by the VM for classes and other resources
- **Package**
 - Collection of related classes
 - Provides access **protection** and name space management

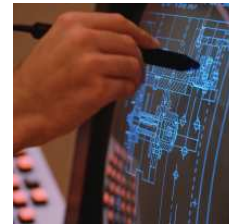


Java Keywords

| | | | | |
|----------|----------|------------|-----------|--------------|
| abstract | continue | for | new | switch |
| assert | default | goto | package | synchronized |
| boolean | do | if | private | this |
| break | double | implements | protected | throw |
| byte | else | import | public | throws |
| case | enum | instanceof | return | transient |
| catch | extends | int | short | try |
| char | final | interface | static | void |
| class | finally | long | strictfp | volatile |
| const | float | native | super | while |

A few minutes on Java and “code reuse”

- Writing code, such as Java, blends two orientations:
 - Coding **FROM reuse** (using code that others provide)
 - Coding **FOR reuse** (writing code to provide to others)
- **FROM reuse**
 - Everybody codes "from reuse" in Java
 - ...every time you use a java.lang.String, for instance
 - Typically, “applications” are *strictly FROM reuse*
- **FOR reuse**
 - Designing classes to be used by others (i.e. API)
 - Up-front design work fundamentally important
 - Migration paths, versioning, encapsulation
 - Definitely “advanced” Java programming
- **We will stick to “FROM reuse” initially**



Caveats

- We only have 1¼ hours total – just time for the "high points"
 - The complete Java language "specification" (JLS) is available here:
 - http://java.sun.com/docs/books/jls/third_edition/html/j3TOC.html
 - This specification includes a complete "grammar" for Java
 - Formal specification of keywords and their valid relationships
- We will focus mainly on traditional Java classes
 - Class, method and field declaration syntax
 - Method bodies and control flows
 - No fancy stuff (inner classes, abstract classes)
- For further study, see The Java Tutorial
 - A very valuable source of do-it-yourself instructional materials
 - <http://java.sun.com/docs/books/tutorial/index.html>

Gross anatomy of a Java source file

- **Comments**
 - Comment delimiters modeled on C++
 - Can go anywhere – use liberally
 - Special “javadoc” comments
 - Self-documenting code – tied to what follows
 - Absolutely VITAL when coding “FOR reuse”
- **Package statement**
 - Provides “namespace” for declared types
 - Must be **first non-commentary statement**
 - Implies **directory structure** for source code
- **Import statements**
 - Provides a way to include groups of classes
 - Declares the “domain of reuse”
 - NOTE: `java.lang.*` – no import required
- **Type(s)**
 - Typically one class (or interface) per file
 - Always the same name as the file
 - Enumerated types (new in JDK 1.5)

```

/* File: com/ibm/examples/HiThere.java
 * Provided as-is, a simple Java example.
 * Usage: java com.ibm.examples.HiThere
 */
package com.ibm.examples;

/* Import to get java.sql.Timestamp */
import java.sql.*;

/** Very simple example application,
 * with just one method.
 */
public class HiThere {

    /* Every application has a "main" */
    public static void main(String[] args) {
        long now = System.currentTimeMillis();
        Timestamp ts = new Timestamp(now);
        System.out.println("Time is: " + ts);
    } // end of main()

} // end of HiThere

```

It's all there -- between the curly braces

- Remember:
 - Java classes define the methods and fields of an object
- Class declaration is itself delimited by curly braces { }
- Java's C/C++ heritage shows through
 - Not the last time we'll see their importance
- Classes:
 - May declare fields and methods (explicitly within the braces)
 - Will inherit any fields and methods of their superclasses
- It is easy to tell a method() apart from a field:
 - Method declarations ALWAYS have parentheses (empty or not)
 - Field declarations do NOT need parentheses (there are no parameters!)
 - Note that some methods do NOT have a body!
 - (i.e. `abstract` and `native` do not specify a method body)

Fields and methods

```
class ExampleClass extends SomeSuperClass
{
    SomeType dealyBobber;           // Field or method?
    static SomeType thingamaJig;    // Field or method?

    SomeType doHickey()             // Field or method?

    static SomeType whatzItz(int i) // Field or method?

} // End of ExampleClass
```

Fields and methods

```
class ExampleClass extends SomeSuperClass
{
    SomeType dealyBobber;           // Field or method?
    static SomeType thingamaJig;    // Field or method?

    SomeType doHickey()             // Field or method?
    {
        return this.instanceField;
    }
    static SomeType whatzItz(int i) // Field or method?
    {
        return staticField;
    }

} // End of ExampleClass
```

Static vs. instance fields and methods

- What does 'static' mean?
 - While a class is a "template" for an object, it's also an object itself!
 - Static methods and fields are scoped with the class, not with any instance
- Example: keep a count of all cars in this VM (extra credit for finding the bug...)

```
class Car {
    static int numCars; // static field to hold count of cars
    String myMake;      // instance's make
    String myModel;     // instance's model
    int    myModelYear; // instance's year

    // special method, called a "constructor"
    public Car(String make, String model, int modelYear) {
        myMake = make; myModel=model; myModelYear = modelYear;
        // In the constructor, increment the static number of cars
        numCars++;
    } // end of constructor
    public setCarInfo(Car(String make, String model, int modelYear) {
        myMake = make; myModel=model; myModelYear = modelYear;
    } // end of setCarInfo
} // end of Car class
```

Static vs. instance fields and methods

- A CarDealer application to utilize the Car class

```
public class CarDealer {
    public static void main(String[] args){
        Car a1("Chevy", "Cavalier", 2001);
        Car b3("Dodge", "Dynasty", 1996);
        Car a2("Nissan", "Ultima", 2006);

        b3.setCarInfo("Hammer", "H3", 2004);
        int num = Car.numCars; //notice the class name qualifier
    } // end of main method
} // end of CarDealer class
```

Class Declaration Syntax

- [modifier*] class <ClassName> [extends <AnotherClass>]
[implements <InterfaceName*>]
- Class **modifiers**:
 - **public**: can be accessed from outside the package;
 - **abstract**: can not instantiate; usually has one or more abstract method; and
 - **final**: can not be subclassed.
- Examples:
 - class File
 - final class Student extends Person
 - public abstract class Farm implements Land, House, Animal

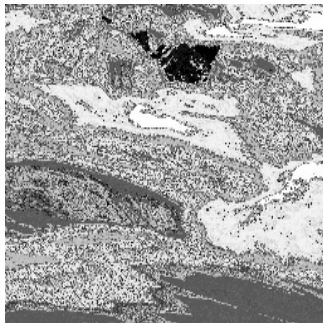
Field Declaration Syntax

- [modifier*] <TypeName> <fieldName> [= initializerValue];
- Field **modifiers**:
 - **public**: accessible wherever the class name is accessible
 - **protected**: accessible to subclasses and all classes in the same package
 - **private**: only accessible to the class it declares it
 - **static**: field is associated with the class not the object. One copy for the class and shared among all objects.
 - **final**: Once set, value can not be changed (immutable)
- **TypeName**: one of the 8 primitive data types or any non-abstract class
- Examples:
 - boolean isSenior;
 - static final int WHITE=1;//declared in the Color class and access Color.WHITE;
 - public String name = file.getName());

Method Declaration Syntax

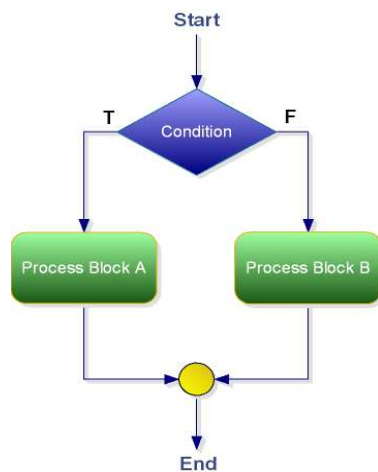
- [modifier*] <returnType> <methodName>([<args>])
[throws <ExceptionName*>]
- Field **modifiers**:
 - All those of the field (with final meaning can not be overridden) plus
 - **abstract**: no code, part of abstract class, subclass must implement or re-declare as abstract
 - **synchronized**: for locking/unlocking by threads; and
 - **native**: field is associated with the class not the object
 - **final**: Once set, value can not be changed (immutable)
- **returnType**: one of the 8 primitive data types or any non-abstract class
- **Examples**:
 - public static void main(String [] args)
 - private final long calculateArea()
 - public String getName()

Control Flow Constructs



- **Conditional**
 - Branches and loops
- **Exceptional**
 - try, catch, throw
- **Unconditional**
 - Method calls

Conditional Control Flow: if/else



- **if/else**

- executes block if expression evaluates to “true”

Conditional Control Flow: if/else

Java Syntax

```

if (nameLength > 8) {
    truncate = true;
} else {
    truncate = false;
}
  
```

```

ticketPrice = 10;
If(age > 65){
    ticketPrice -= 2;
}
  
```

RPG Syntax

```

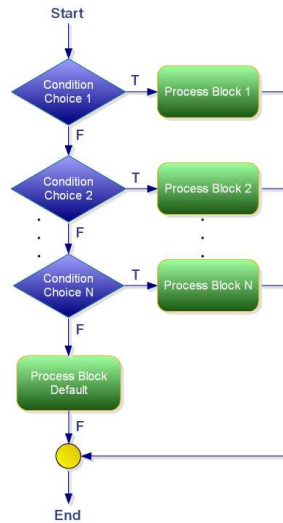
if nameLength > 8;
    truncate = *ON;
else;
    truncate = *OFF;
endif;
  
```

```

ticketPrice = 10;
if age > 65;
    ticketPrice = ticketPrice - 2;
  
```

Conditional Control Flow: switch

- **switch**
 - An easy-to-read collection of if statements
 - Use the **break** keyword to transfer control to just after the switch statement
 - Argument to **switch()** must be scalar value (i.e. integer or character)



Conditional Control Flow: switch

Java Syntax

```

switch (status) {
  case 1:
    System.out.println ("Error.");
    break;
  case 2:
    System.out.println ("End of File.");
    break;
  default:
    System.out.println ("Success!");
    break;
}

```

RPG Syntax

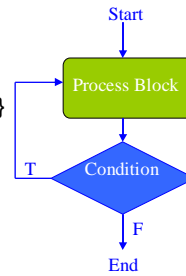
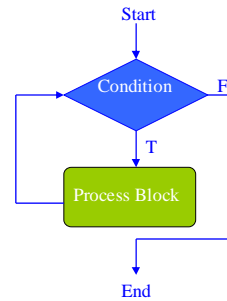
```

select;
  when status = 1;
    dsply 'Error.';
  when status = 2;
    dsply 'End of File.';
  other;
    dsply 'Success!';
endsl;

```

Conditional Control Flow: Loops

- **while**
 - `while (condition) { statements }`
- **do ... while**
 - `do { statements } while (condition) ;`
- **for**
 - `for (init; condition; incr) { statements }`



Conditional Control Flow: Loops

Java Syntax

```

while(!eof(file)) {
    processRecord();
}

do {
    processRecord();
} while(x > array.length);

for(i = start; i < end;
    i += inc) {
    processRecord();
}
  
```

RPG Syntax

```

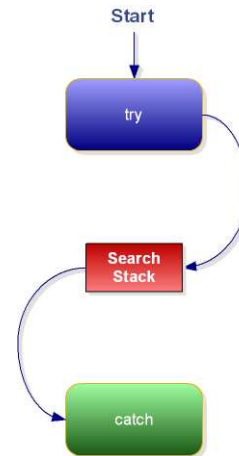
dow not %eof(file);
    processRecord();
enddo;

dou x > %elem(Array);
    processRecord();
enddo;

for i = start by inc
    to %elem(array);
    processRecord();
endfor;
  
```

Exceptional Control Flow

- **try/catch**
 - Errors are propagated up the stack
 - Always list catch blocks from most specific to most general
 - The **finally** statement is always executed
 - Must re-throw exception using the **throw** keyword if not handled



Exceptional Control Flow

Java Syntax

```

try {
    // code that might 'throw'
} catch(FileException e1) {
    // handle file error
} catch(Exception e2) {
    // handle all other errors
} finally {
    // ALWAYS do...
}
  
```

RPG Syntax

```

MONITOR
    // code that might 'throw'
ON-ERROR *FILE
    // handle file error
ON-ERROR
    // handle all other errors
ENDMOD
  
```

Unconditional Control Flow: Method Calls

```
import javax.swing.*;

class MyWhy {
    public static void main( String[] args ) {
        String question = "Why \"i\"?";
        String answer = showDialog("Question!", question);
        System.out.println( question + " " + answer );
        System.exit(0);
    }

    static String showDialog(String title, String message) {
        String out = JOptionPane.showInputDialog(
            new JFrame(),
            message,
            title,
            JOptionPane.PLAIN_MESSAGE);
        return out;
    }
} // end of MyWhy
```



Be Cautious as You Program in Java

- A Java code file must contain one and only one (outer) class with possible inner classes.
- The file name must match exactly the name of the (outer) class it declares.
- Java is very strictly case sensitive.



Compiling and Executing Java Code

- A JDK must be installed for source compilation.
- From a command line, the Sun compiler command is
 - javac myApp.java
- This command produces a classfile named myApp.class.

- A JRE (JVM) must be installed for execution of the bytecode in the myApp.class
- The Sun execution command is
 - Java myApp

Tips for Approaching Java Code

- Check packaging
 - Jar or classes
 - Does it include the source?
- API or Application
 - If it is an API, evaluate the interface
 - If it is an Application, look for main and run it
- Look at documentation
 - Is there a javadoc? (Should be for API!)



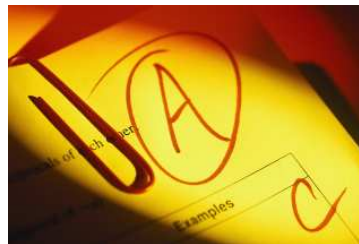
Tools for Java Development

- Development Environments and Editors
 - Eclipse
 - WebSphere Studio Application Developer
 - jEdit
- Modeling
 - Unified Modeling Language (UML)
 - Rational Rose XDE
- Decompilers
 - DJ Java Decompiler
 - jShrink



Summary

- Scratching the surface...
 - Why Java?
 - Terminology
 - Java Structure and Syntax
 - Development Tools and Tips
- Java Resources
 - Sun's Java Website (java.sun.com)
 - IBM developerWorks
 - IBM Toolbox for Java



Example Application "Mydu.java" (pg. 1)

```
// file: Mydu.java
import java.io.*;
import java.util.*;
```

Usage: Mydu [-a | -s] [-k | -b] [filename ...]

```
public class Mydu {

    private int showDivisor = 1;           // handles '-b' (blocks) or '-k' (kbytes) flags
    private char showChar = 'd';          // handles '-a' (all) or '-s' (summary) flags
    private boolean verbose = false;      // if true, extra output is generated
    private boolean help = false;         // if true, just writes message and dies
    private int depth = 0;                 // recursion depth for indented output
    private ArrayList<String> cmdArgs;    // holder for filenames passed on command line

    public static void main(String[] args) {
        Mydu me = new Mydu(args);
        me.info("Begin processing...");
        me.perform();
        me.info("Processing complete.");
    }

    // constructor (<init>)
    public Mydu(String[] args) { cmdArgs = parseArgsRemoveFlags(args); }

    private void report(long len, String rptName) {
        System.out.printf("%10d %s\n", ((len + (showDivisor-1)) / showDivisor), rptName);
    }
}
```

Example Application "Mydu.java" (pg. 2)

```
public void perform() {
    for (String s : cmdArgs) {
        info("...processing command line arg '" + s + "'");
        File f = new File(s);
        if (f.exists()) {
            if (f.isDirectory()) {
                long thisLen = recurse(f);
                if (showChar == 's') report(thisLen, s);
            } else {
                report(f.length(), s);
            }
        } else {
            warn("Cannot find '" + s + "' not a file or directory");
        }
    }
}

private void warn(String s) { System.err.println("WARNING:" + s); }
private void info(String s) { if (verbose) System.err.println("INFO:" + s); }
private void info_indent(int indent, String msg) {
    if (verbose) {
        if (indent <= 0) indent = 1; // Internal error, actually
        System.err.printf("%" + indent + "s%s\n", "", msg);
    }
}
}
```

Example Application "Mydu.java" (pg. 3)

```

private long recurse(File inDir) {
    long accumulator = inDir.length();
    try {
        info_indent(++depth, "> ENTER:" + inDir);
        String outerName = inDir.getCanonicalPath();
        // run the directory listing of 'inDir', recursing into subdirs
        for (String wrkName : inDir.list()) {
            File subDir = new File(outerName + File.separator + wrkName);
            String loopName = subDir.getCanonicalPath();
            if (subDir.isDirectory()) { // BUG: if subDir a self-symlink
                accumulator += recurse(subDir);
            } else {
                accumulator += subDir.length();
                if (showChar == 'a') report(subDir.length(), loopName);
            }
        }
        if (showChar != 's') { report(accumulator, outerName); }
        info_indent(depth--, "< LEAVE:" + inDir);
    } catch(IOException ioe) {
        throw new RuntimeException("Error in recurse", ioe);
    } finally {
        return accumulator;
    }
} // end of recurse

```

Example Application "Mydu.java" (pg. 4)

```

private ArrayList<String> parseArgsRemoveFlags(String[] args) {
    ArrayList<String> rtnVal = new ArrayList<String>();
    for (String a : args) {
        if (a.equals("-h")) {
            System.err.println("Usage: mydu [-k|-b] [-s|-a] [<name>...");
            System.exit(1);
        } else if (a.equals("-k")) { showDivisor = 1024;
        } else if (a.equals("-b")) { showDivisor = 512;
        } else if (a.equals("-a")) { showChar = 'a';
        } else if (a.equals("-s")) { showChar = 's';
        } else if (a.equals("-v")) { verbose = true;
        } else {
            rtnVal.add(a);
        }
    }
    if (rtnVal.isEmpty()) rtnVal.add(".");
    return rtnVal;
} // end of class Mydu

```

References

- All things Java: <http://java.sun.com>
- developerWorks: <http://www-130.ibm.com/developerworks/>
- IBM Toolbox for Java: <http://www-1.ibm.com/servers/eserver/series/toolbox/>
- eclipse: <http://www.eclipse.org>
- WebSphere: <http://www-306.ibm.com/software/websphere/>
- jEdit: <http://www.jedit.org>
- UML: <http://www.uml.org>
- Rational: <http://www-306.ibm.com/software/rational/>
- DJ Java Decompiler: <http://members.fortunecity.com/neshkov/dj.html>
- Jshrink: <http://www.e-t.com/jshrink.html>
- The Java Tutorials: <http://java.sun.com/docs/books/tutorial/index.html>

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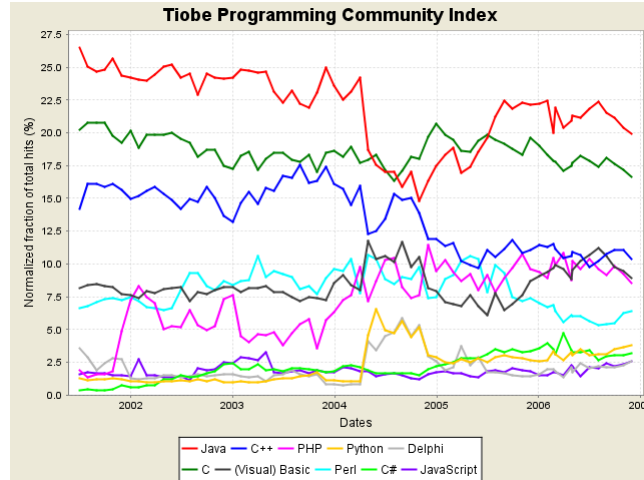
Backup Slides

Programming Languages Popularity

| Position Dec 2006 | Position Dec 2005 | Delta in Position | Programming Language | Ratings Dec 2006 | Delta Dec 2005 | Status |
|-------------------------|-------------------------|-------------------|----------------------|------------------------|----------------------|--------|
| 1 | 1 | = | Java | 19.907% | -2.36% | A |
| 2 | 2 | = | C | 16.616% | -1.75% | A |
| 3 | 3 | = | C++ | 10.409% | -0.39% | A |
| 4 | 5 | ↑ | (Visual) Basic | 8.912% | +1.33% | A |
| 5 | 4 | ↓ | PHP | 8.537% | -2.24% | A |
| 6 | 6 | = | Perl | 6.396% | -0.74% | A |
| 7 | 8 | ↑ | Python | 3.762% | +1.00% | A |
| 8 | 7 | ↓ | C# | 3.171% | -0.11% | A |
| 9 | 10 | ↑ | Delphi | 2.569% | +1.11% | A |
| 10 | 9 | ↓ | JavaScript | 2.562% | +0.68% | A |

Source: TIOBE Programming Index for Dec 2006 - <http://www.tiobe.com/>

Programming Languages Popularity



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javadoc

```
java/lang/Object.java
/**
 * Class <code>Object</code>
 * Every class has <code>Obj
 * . . . .
```

javadoc

