Introduction to Java — PL/SQL Developers Take Heart!

Paper #460

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quovera

IOUG FORUM COLLABORATE08 Technology and Applications Forum for the Oracle Community

Quote

> A language that doesn't affect the way you think about programming is not worth knowing.
>
> —Dennis M. Ritchie

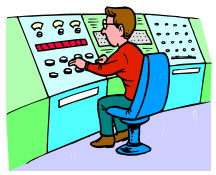
Survey

- Years with PL/SQL?
  - Less than 2, 2-4, 4+
- Years with Java?
  - None
  - 2, 2-4, 4-13, 13+
- Other languages?
  - C
  - C++
  - Smalltalk
  - COBOL, Basic, JCL, Perl …

Agenda

- Java Basics
- Object Orientation
- Anatomy 101
- Datatypes and Variables
- Control Statements

Slides and white paper are available on the IOUG and Quovera websites.



Java Advantages

- Platform independent (the promise of portability)
- The core of J2EE
  - Lots of deployment options
- Modern language
  - Object oriented (the promise of reuse)
  - Supports multi-tasking
- Looks like C++
  - No pointers
  - Manages memory for you (C-- ?)
- A well-developed user community
  - Open-source support
- Emerging language
  - Currently hot; It has Oracle's attention

Java Drawbacks

- Emerging language
  - Currently hot
  - No mass acceptance
    - Microsoft is still in the game (.NET languages)
  - Technologies are changing rapidly
- Not a "normal" skill for an Oracle developer
- It requires a 3GL tool
  - Some IDEs help create code
- Arguably more complex than PL/SQL
  - Database access is not a natural thing
  - Needs object-oriented thinking

Developing the Code

1. Create or modify source code file
   - Standard ASCII text – can use Notepad or vi
   - Use .java extension (HiThere.java)
2. Compile the source code file
   - `javac.exe HiThere.java`
   - Creates <classname>.class (HiThere.class)
3. Test the class file in a runtime (interpreter) session
   - Also called *Java Virtual Machine* (JVM)
   - `java.exe HiThere`
4. Repeat 1-3 until victory is declared
5. Deploy the file
   - Package with required libraries

Called "bytecode" or "bytecodes"

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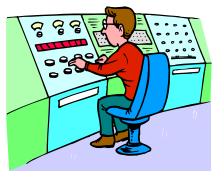


Project Timeline

Deliver yesterday,
code today,
think tomorrow.

—*Anonymous*

OO Basics

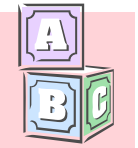
- Basic building block is the Class
  - The fundamental building block
  - A pattern, template, archetype, or blueprint from which objects are built
    - Like for a car – 1988 Honda Accord LXI
  - A "concept" not anything "real"
  - Also called an *abstract data type*
- Objects
  - "Real" things – in code, anyway
    - Like PL/SQL variables
  - The "instantiation" of a class
    - 1988 Honda Accord LXI (VIN 785789359019)
  - Kind of like a variable built from a data type

Big Three OO Concepts

- Inheritance
  - Parent-child relationship
  - Child has data and behavior of the parent
  - Classes inherit by "subclassing" a parent class
- Encapsulation
  - Data is hidden from the outside
  - Use an approved interface to get to data (setCity, getAddress, etc.)
- Polymorphism
  - Similar to overloading in PL/SQL
  - Caller doesn't know which method will be called

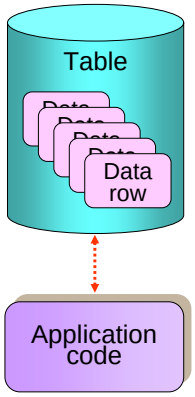
OO (Java) vs PL/SQL?

- PL/SQL does not have inheritance
  - Cannot subclass a procedure or package
  - You can call prebuilt code, of course
- OO objects vs PL/SQL variables
  - Behavior is loosely bound in PL/SQL
  - Behavior is integrated into OO objects
- Different paradigms

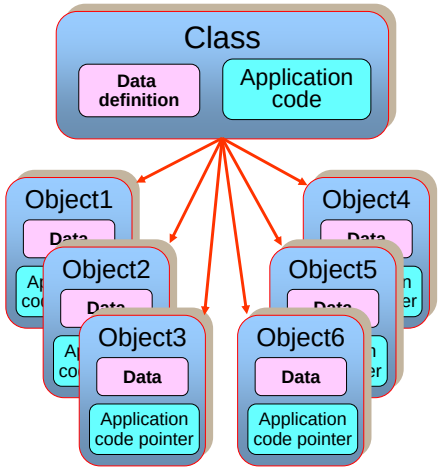


Data & Code Paradigms

Structured, Relational, Procedural

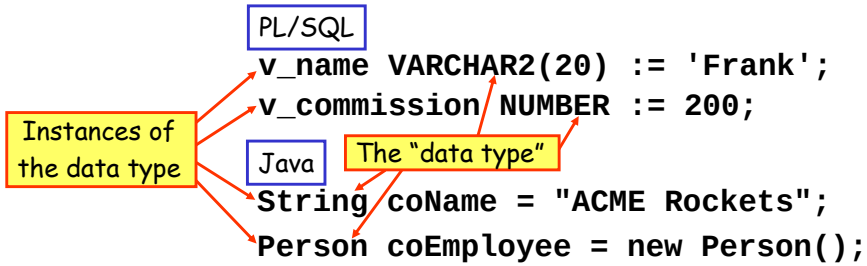


Object-Oriented



Another Way to Think About Objects

- It is like an abstract data type
  - Each "thing" created from the data type has the same characteristics as the data type



  - The difference is that Java (OO) has methods for the declared instance

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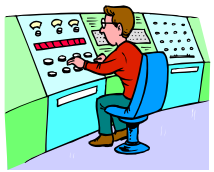


Flon's Law

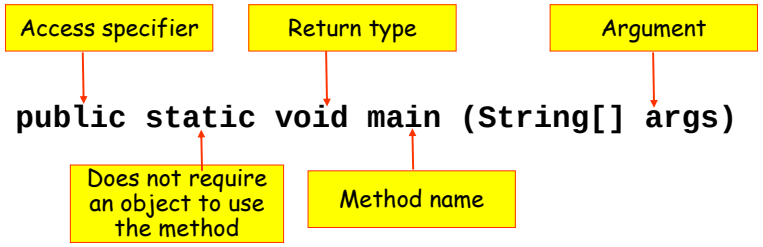
There is not now, and never will be, a language in which it is the least bit difficult to write bad programs.

Basic Java Terms

- Class
  - Fundamental building block
  - All code is contained in classes
  - Source code (.java) is compiled (.class)
- Object
  - An *instance* of a class
- Method
  - Unit of code contained in a class
  - Like PL/SQL procedures and functions
- Constructor
  - Code unit used to instantiate an object

About Methods

- Method signature:



- Return type can be something or nothing (void)
- Overloading allowed
  - More than one method with the same name and different arguments
- Access specifier declares which classes can see this class
  - E.g., “private” is not visible to other classes

Access Specifiers

- *Specifiers* (or *modifiers*) word change class visibility and functionality
  - Serve like grants to execute PL/SQL code
  - **`public`** - accessible from anywhere
  - **`protected`** **–** not accessible from a class that is not a subclass in a different package
  - <no specifier> (the default) – accessible to classes in the same package
  - **`private`** - cannot be seen outside its class, even from objects created from that class

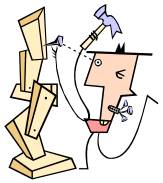
Access Specifier Effects

Specifier / Available to	public	protected	(no specifier)	private
Same class	Yes	Yes	Yes	Yes
Same package subclass	Yes	Yes	Yes	No
Same package non-subclass	Yes	Yes	Yes	No
Different package subclass	Yes	Yes	No	No
Different package non-subclass	Yes	No	No	No

About Constructors

- They look a bit like methods
- No return type (not even void)
  - For example, **`Box(int quantity)`**
- Responsible for instantiating the class
  - Creating the object
  - Usually initializes variables
- Called using new operator:
  - **`Box usefulBox = new Box();`**
- There is a default (non-declared) constructor for every class
  - This is used if you do not write a constructor
  - Constructors with parameters will override this one, however

Constructor



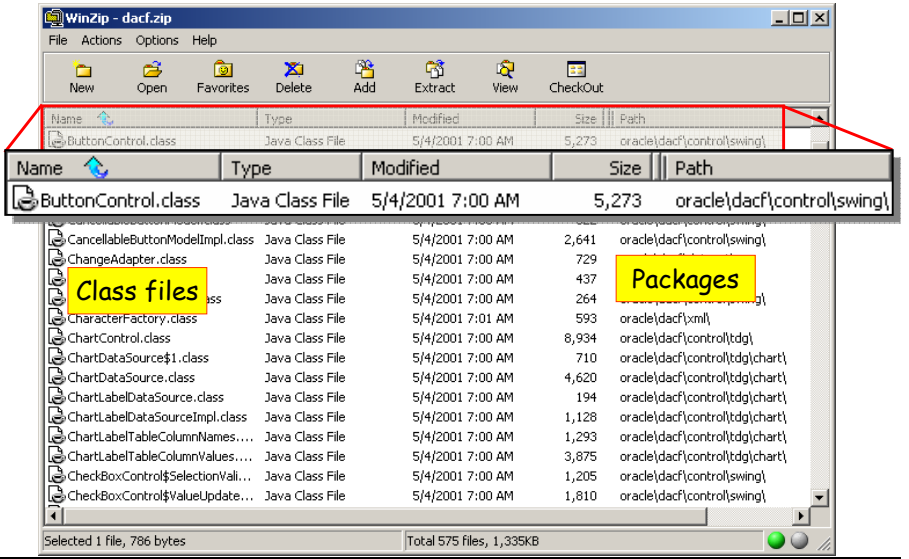
About Java Classes

- One “public” class per file
  - Public classes are available everywhere
- All code is contained in classes
  - File name is the public class name
    - Spelled exactly the same
    - Upper/lower case exactly the same
- Each public class stored in its own source file
  - Has exactly same name as class
  - Uses .java extension
  - Compiled into a .class file
- Used to create objects, run code, or serve as superclasses

Using Java Classes

- To create an object, declare an instance
  - For example,
    `String empName = new String();`
  - This creates an object, empName
- Class files are collected into packages
  - Directories in the file system or in a zip file
- Java Archive (JAR) contains multiple class files
  - Can use .jar or .zip extension
  - “Libraries” made of one or more JARs

Sample Archive Contents



CLASSPATH

- JVM needs to be told where the classes are
  - Your classes
  - Library classes
- Set the environment variable (shell variable) CLASSPATH
  - The list includes directories or archive files (JAR or Zip), for example:

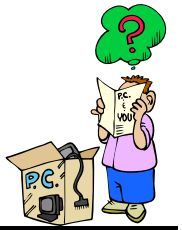
```
SET CLASSPATH=.;C:\JDev10\jdk\jre\lib\rt.jar
```

Current directory

Naming Conventions

- Java is a case-sensitive language
  - Keywords are in lower case
    - **`for, while, if, switch,`** etc.
    - Case compliance is enforced for keywords
- There are conventions for other names
  - Normally, no underscores used
    - For example, EmpLastName not EMP_LAST_NAME
  - Package names are all lower case
  - Class names are mixed case
    - **`EmployeeDataAccess`**
  - Method and variable names are init-lower
    - **`numberOfEmps, getCity()`**, **`setCity()`**
  - Constants use all uppercase and underscores
    - MAX_LOAD, MIN_HEIGHT

Note: Java names can have any number of characters.



Blocks and Comments

- Executable program blocks - { } symbols
  - Collection of declarations, specifiers, and methods
  - Code blocks can be nested
- Comments:
  - Single line

```
// This is a single-line comment.
int count;  // it can end a line
```

  - Multiline

```
/* This is a multiline comment in
  Java, the same as in SQL. */
/* It can be one line */
```

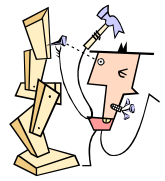
  - Javadoc

```
/** This will be written to an
    HTML document. */
```

Simple Class Example

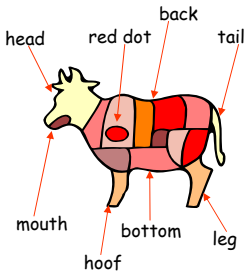
```
public class HiThere {
   public static void main (String[] args) {
     System.out.println("What's Happening?");
   }
}
```

- First line declares the class
  - Specifier **`public`** – available everywhere
    - Other specifiers: private, default, protected
  - { } represent the start and end of the code block
- Second line declares a method – the *method signature*
  - JVM looks for method **`main()`** when application starts
  - **`void`** declares a return type of nothing
  - Remainder used to pass parameters to **`main()`** method
- Third line calls external method to show message in console – command line window



Anatomy of a Class

- Package that the class belongs to
- Import statements for libraries used
- Class declaration
- Variable declaration
- Methods and constructors
  - Constructor
    - Same name as class
    - Creates the object and initializes the data
  - **`main()`**
  - **`set()`** and **`get()`**
    - Called "accessors" or "getters and setters"
  - Application-specific methods



Don't Give Me Static

- **`static`** keyword signifies a *class member*
  - Variables and methods
  - No need to create an object to use the class member
  - For example, you can run main() without instantiating Rectangle
- Static variables on the class level are like global variables
  - Only one copy exists regardless of the number of objects created from the class
- Static methods
  - Can only call other static methods
  - Can only access static data (variables)
  - Cannot refer to **`this`** or **`super`**
- The opposite of static is no keyword
  - For example, **`public void main()`**

"Null" and "Void"

- Return type "void" means the method does not return anything
- The "null statement" is used as a placeholder (just a semicolon)
  - For example after a loop statement that requires something (same as PL/SQL NULL statement)
- The keyword null means "nothing"
  - Not like SQL NULL
  - You can compare null with something
    - For example: **`(null == null)`** is **`true`**

Example Class

```
package shapes;

public class Rectangle {
  private int height;
  private int width;

  public Rectangle() {
     height = 1;
     width = 1;
  }

  public int getHeight() {
    return height;
  }

  public void setHeight(int newHeight) {
     height = newHeight;
  }

  public int getWidth() {
    return width;
  }

  public void setWidth(int newWidth) {
     width = newWidth;
  }
}
```

Package statement

Class declaration

Constructor

Variable declarations (attributes, fields)

Code block symbol

Example Subclass

Package assignment

Class imports

Subclass keyword

Variables and methods are called "members" of the class.

set() and get() methods

```
package shapes;
import java.util.*;

public class Box extends Rectangle {
  private int depth;
  private int height;

  public Box() {
    height = 4;
    super.setWidth(3);
    this.depth = 2;
  }

  public int getDepth() {
    return depth;
  }
  public void setDepth(int newDepth) {
    depth = newDepth;
  }

  public int boxVolume() {
    return height * getWidth() * getDepth();
  }
}
```


Using Box

main() method

Object instantiation. Calls Box() which calls Rectangle()

Call to method in external package

```
public class TestBox {
  public static void main(String[] args) {
    Box usefulBox = new Box();
    // getHeight() is from Rectangle
    // getDepth() is from Box
    // height in Box is not accessible
    System.out.println(
      "The height is " + usefulBox.getHeight());
    System.out.println(
      "The depth is " + usefulBox.getDepth());
    usefulBox.setWidth(5);
    System.out.println(
      "The volume is " + usefulBox.boxVolume());
  }
}
```

Output

```
The height is 1
The depth is 2
The volume is 40
```


Some Java Operators

Function	PL/SQL	Java
Concatenation	`||`	`+`
Modulus (remainder)	`MOD()`	`%`
Assignment	`:=`	`=`
Increment	`i := i + 1`	`i++`
Addition assignment	`i := i + 5`	`i += 5`
Equal to	`=`	`==`
Not equal to	`!=`	`!=`
Logical AND	`AND`	`&&`
Logical OR	`OR`	`||`
Ternary if-then-else	`DECODE()`	`? :`
Bitwise unary not	[nothing]	`~`
Percolate	`BREW()`	☺

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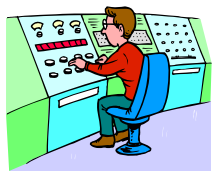

Variable Declarations

- You can declare multiple variables on one line

```
int i, j, k;   <-- declaration
int i = 1;     <-- initialization
```

- You can initialize at the same time

```
int i = 2, j, k = 10;
```

- Variable and object declarations can take place anywhere
  - Java supports objects created on the fly
- Two datatype categories
  - Primitive: single value, no methods, no class
  - Reference: based on classes, technically a variable created from a class is an object

Primitive Types - Number

- Whole number
  - **byte** (-128 to 127)
  - **short** (-32,768 to 32,767)
  - **int** (-2,147,483,648 to 2,147,483,647)
  - **long** (-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807)
- Decimal place
  - **float** (3.4e-038 to 3.4e+038)
  - **double** (1.7e-308 to 1.7e+308)
    - More precise than float, but takes double the space (64 bytes)

9.2 quintillion in North America
9.2 trillion in Europe and the UK

Primitive Types – Character and Logical

- Character
  - **char** (integer of 16 bytes, 0 to 65,536)
  - Single character or symbol
  - Handles Unicode (an international character set)
- Logical
  - **boolean (true** or **false)**
  - Two values only (no null logical value)
  - **true** is not a number like –1
  - No quotes around the symbol
  - For example:

```
boolean isTrue = true;
isTrue = (2 < 1);
```

The only character primitive datatype.

char Examples

Java

```
// decimal equivalent of letter 'a'
   char myFirstChar = 97;
// using a character
   char mySecondChar = 'a';
// octal equivalent of letter 'a'
   char myThirdChar = '\141';
// Unicode (Hex) value for 'a'
   char myFourthChar = '\u0061' ;
```

PL/SQL

```
v_string_char CHAR(66) := 'Data type CHAR is a fixed' ||
    ' length, multi-character string in PL/SQL';
```

Typing Based on a Class

- Use the new operator:

```
String testString;
testString = new String();
```

declaration

instantiation

OR

```
String somestring = new String();
```

Use StringBuffer() if you will change the data

- Most any class can be used to create an object
  - Exceptions: abstract classes, classes with private constructors
  - Data and behavior of the class are available to the object
- *Wrapper classes* implement primitives
  - These have methods (primitives do not)

String Class Examples

Java

The String class defines a multi-character variable:

```
String myString;
myString = "Any size string here";

// You can also combine declaration and assignment
String myString = "Whatever here";
```

Java uses double quotes for strings

PL/SQL

```
v_varchar VARCHAR2(100);
v_varchar := 'Up to 100 characters';
-- declare and assign
v_varchar VARCHAR(100) := 'Data type VARCHAR is a
   variable length string in PL/SQL';
```


Constants

- Use keyword **`final`**
  - Like **`CONSTANT`** in PL/SQL
  - Final variables must be initialized in same statement
  - For example,

```
static final double PI = 3.141592;
```

- Can use **`final`** for methods
  - Method cannot be overridden in a subclass
- Can use **`final`** for classes
  - Final **classes** cannot be inherited

Variable Scope

- Variables last within the curly brackets or structure that encloses them

```
for (int i = 0; i < 10; i++) {
```

i available only during "for" loop

- Like PL/SQL nested blocks
- Curly brackets for if..else, loops count
  - Unlike PL/SQL

masterVar available here

ifVar not available here

```
{
  int masterVar;
  if (true) {
    int ifVar;
  }
}
```

Variable Scope Examples

```
if (...) {
  int i = 17;
  ...
}
System.out.println("The value of i = " + i);
```

Error because i is declared in the if block.

```
public class VarTest {
  static int i = 2;

  public static void main(String[] args) {
    int i = 0;
    for (int i = 1; i <= 10; i++) {
      System.out.println(i);
    }
}
```

Member variable

Different variable - local to method

Error because i is already declared. This is OK

```
for (i = 1; i <= 10; i++)
```


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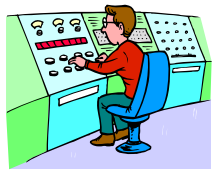
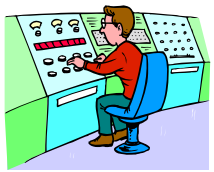


Standard Control Structures

- Sequence
  - Code executes in the order in which it is written
- Conditional branching
  - **`if else, switch`**
- Iteration
  - **`while, for, do while`**
- Jump statements
  - **`break`** – to exit a structure
  - **`continue`** – to start loop over
  - **`return`** – to go back to calling routine
  - No **`goto`**
- Exception handling
  - Enclose in **`try {} catch {}`** block
  - **`throws`** causes an explicit exception
  - Like PL/SQL BEGIN..EXCEPTION..END



Conditional Example

```
class ShowQuarter {
  public static void main (String[] args) {
    int taxMonth = 10;
    String taxQuarter;

    if (taxMonth == 1 || taxMonth == 2 || taxMonth == 3) {
      taxQuarter = "1st Quarter";
      }
    else if (taxMonth >= 4 && taxMonth <= 6) {
      taxQuarter = "2nd Quarter";
      }
    else if (taxMonth >= 7 && taxMonth <= 9) {
      taxQuarter = "3rd Quarter";
      }
    else if (taxMonth >= 10 && taxMonth <= 12){
      taxQuarter = "4th Quarter";
      }
    else {
      taxQuarter = "Not Valid";
      }
    System.out.println("Your current Tax Quarter is: " +
      taxQuarter );
  }
}
```

comparison equals

Logical OR

Logical AND

Loop Examples

```
class DemoFor {
  public static void main (String[] args) {
    int i;
    for (i = 1; i <= 10; i++) {
      System.out.println("Loop count is " + i);
    }
  }
}
```

println() handles mixing of data types

increment operator

Could be: `for (int i = 1; i <= 10; i++)`

```
class DemoWhile {
  public static void main (String[] args) {
    int i = 1;

    while (i <= 10) {
      System.out.println(
        "Loop count is " + i);
      i++;
    }
  }
}
```

```
Loop count is 1
Loop count is 2
Loop count is 3
Loop count is 4
Loop count is 5
Loop count is 6
Loop count is 7
Loop count is 8
Loop count is 9
Loop count is 10
```


Exception Handling

- Code block is surrounded by handler
  - Like PL/SQL (**`BEGIN EXCEPTION END`**)
- **`try`** – Used to start the block
- **`catch`** – Defines which exception you are waiting for
- **`finally`** – Code that executes after the try block (regardless of exceptions)
- **`throw`** – If you want to raise your own exception in the code
- **`throws`** – Declare which exception you will be throwing

Exception Handling Example

```
public class TestException extends Object {
  public static void main(String[] args) {
    int numerator = 5, denominator = 0, ratio;
    try {
      ratio = numerator / denominator;
      System.out.println("The ratio is " + ratio);
    }
    catch (SQLException sqlexcept) {
      // display SQL error message
      sqlexcept.printStackTrace();
    }
    catch (Exception except) {
      // display generic error message
      except.printStackTrace();
    }
    finally {
      System.out.println("After finally.");
    }
    System.out.println("The end.");
  }
}
```

Will throw a divide-by-zero error.

Always run

Not run if an unhandled exception occurs

Some Gotchas

- Be careful of automatic rounding
  - E.g., the result of an int/int is an int:

```
int numA = 2, numB=3;
System.out.println("result=" + numB/numA);
```

`result=1`

- Be careful of order of precedence

```
System.out.println("result1=" + 4 + 5);
System.out.println("result2=" + (4 + 5));
```

```
result1=45
result2=9
```

- Use { } around all if statement clauses
  - Only one statement executes after **`if`**

```
if (anInteger == 0)
  anotherInteger = 5;
  someInteger = 10;
```

This always executes

Bibliography

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  - Martin Fowler, Addison-Wesley

Quote

Real programmers
can write assembly code
in any language.

—Larry Wall

Quiz Time

1. Is **`for`** and **`FOR`** the same in Java?
2. How do you define a procedure in Java?
3. What is a constructor?
4. What's wrong with the following Java?

```
string EmpName = 'SCOTT';
```

5. What does this mean?

```
public static void main()
```

Quiz Time

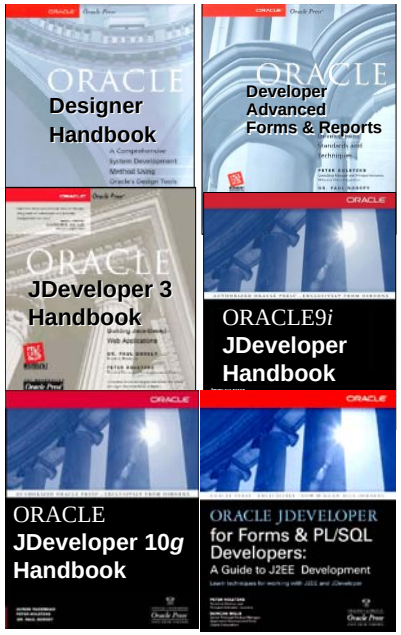
6. What does the symbol "Test" represent in the following?

```
public class Test
public Test()
public void test()
int test;
```

7. What is the main container for Java code?
8. What is a subclass?
9. What is a method?

Summary

- Java has the basic language elements
- Java is a case-sensitive language
- All Java code is inside classes
- Classes are grouped into packages
- Variables can be typed from primitive data types or from classes
- Recognized naming conventions
- Other than syntax, the big difference between Java and PL/SQL is OO



- Please fill out the evals – paper 460
- Books co-authored with Dr. Paul Dorsey, Avrom Roy-Faderman, & Duncan Mills
- Personal web site:
  `http://ourworld.compuserve.com/homepages/Peter_Koletzke`

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Quiz Answers

1. No. Java is case sensitive.
2. Java only has methods not procedures, but a method with a void return corresponds to a PL/SQL procedure.
3. It is a code unit used to create an object.
4. You need to use double quotes to delimit strings. Also, by convention, variables are initial lowercase. In addition, the standard string class is spelled “String”.
5. The method, main, is available to all callers (public). It returns nothing (void) and you do not need an object to call it (static). In addition, if this signature had a String array for an argument, you could call main() from the command line by running the class.

Quiz Answers

6. These are, a class, a constructor, a method, and a variable, respectively.
7. The class is the direct container for Java code.
8. A subclass is a class declared as a child of another class using the keyword “extends”.
9. A method is the main code unit in Java. Methods are contained in class files.