Java Programming Basics

COMP 401, Fall 2018

Lecture 2

Program Organization and Execution

- All code in Java is organized into classes and interfaces
  - One public class or interface per file.
    - Not strictly true, but accept this as true for now.
    - Also, don't worry about what an interface is for now.
  - Must match file name.
  - Classes can be organized into "packages".
    - Again, more on that later.
- Java compiler (javac) produces "byte code".
- Java interpreter (java) executes program
  - Need to specify a specific class name as the "main class".
  - Interpreter starts execution with the method "main"
    - Must be defined with the declaration:

```
public static void main(String[] args)
```

Writing AverageHeightApp In Eclipse

- Demonstrates
  - Starting Eclipse Workspace
  - Creating new project
  - Creating a new package
  - Creating new class
- More about using Eclipse in future recitations.

AverageHeightApp

```
public class AverageHeightApp {

  public static void main(String[] args) {
    double[] heights = readHeightData();
    double sum_of_heights = 0.0;

    for (int i=0; i<heights.length; i++) {
      sum_of_heights += heights[i];
    }

    double avg_height = sum_of_heights / heights.length;

    System.out.println("The average height is: " +
                       avg_height + " inches");
  }


  static double[] readHeightData() {
    double[] height_data = {66.0, 72.0, 69.5, 68.2, 75.0, 64.5, 63.0};

    return height_data;
  }

}
```

Comments

- Single line comments:

```
// This is a comment.
```

- Multiple line comments:

```
/*
All of these lines.
Are commented.
*/
```

A Word About Values

Primitive Value Types

- Integers
- Real numbers
- Booleans
- Character

Reference Types

- An Object
  - String
  - Array
  - An object typed by a class or interface.
  - Classes themselves

Values types are defined entirely by their value.

Reference types are structures in memory.

- Address in memory uniquely identifies them.
  - The "value" of a variable that holds a reference type is this address.

Value Types

- Integers
  - `byte, short, int, long`
  - Difference is in size (1, 2, 4, or 8 bytes)
  - No “unsigned” version
  - Decimal (*255*), hexidecimal (*0xff*), and binary (*0b11111111*) literal formats
- Real Numbers
  - `float, double`
  - Difference is in precision.
- Characters
  - `char`
  - Characters in Java are 16-bit Unicode values
  - Literals use single-quote: *‘c’*
  - Unicode escape sequence: ‘\u####’ where # is hex digit.
    - Example: ‘\u00F1’ for ñ
- Logical
  - `boolean`
  - Literals are *true* and *false*

Packages, classes, and methods, oh my!

- A package is a collection of classes.
  - Defined by a “package” statement at the beginning of a source code file.
    - Example:

      ```
      package lec02.ex01;
      ```

    - All classes defined in the file belong to that package.
- A class is a collection of functions (for now).
  - Defined by “class” keyword followed by a block of code delimited by curly braces.
  - Example:

```
public class ClassName
{
     /* Class definition. */
}
```

- A method is just another name for a function or procedure and is a named sequence of Java statements.
  - Defined within a class.
  - Can be “called”, or “invoked” with parameters
  - Syntax: a method header or signature followed by a block of code delimited by curly braces.

Method Declaration

- Almost everything you need to know about a method is in its declaration
  - 5 parts to a method declaration
    - Access modifier
      - `public`, `private`, `protected`
      - If unspecified, then "package" access.
    - Method type
      - `static` or default (i.e., not specified)
      - The keyword static indicates that this is a "class method".
      - If the keyword static is not present, then this is an "instance method".
    - Return type
      - The type of value returned by the method as a result.
      - If there is no result, then this is indicated by the keyword `void`.
    - Method name
      - Must start with a letter, $, or _
      - Can contain letters, numbers, $, or _ (no spaces or other punctuation)
    - Parameter list
      - In parenthesis, comma-separated list of typed parameter names.
        - » If the method has no parameters, then just: ()
      - Each parameter variable name is preceded by a type declaration.

Method Declaration Examples

```
public static void main(String[] args)

int foo (int a, MyType b, double c)

protected static void bar()

static String toUpperCase(String s)

static private Secret my_secret()
```

Until we know a little more…

- All of the methods in my examples today are going to be *public class* methods.
  - This means their declarations will include the words:
    - public
    - static

Inside a method

- The body of a method is a sequence of *statements.*
- A statement ends in a semi-colon
  - Types of statements:
    - Declarations of local variables
    - Assignment
    - Conditional
    - Loop
    - Method call
    - Return statement
- Statement blocks
  - Zero or more statements enclosed within a method delimited by curly braces { }
  - Allowed anywhere a single statement is allowed.
    - And vice versa

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Local variable declaration

- Syntax:
```
type name;
type name1, name2, name3;
type name = value;
```
- A local variable is valid within the block of statements where the declaration occurs.
  - This is known as the *scope* of the variable.
  - The declaration must occur before the variable is used.
- Parameter names are local variables that are in scope for the entire method body.

Variable Names

- Variable names *should* start with a letter and can contain letters, digits, $, or _
  - Cannot start with digit
  - Cannot contain whitespace or punctuation other than $ or _
    - In general, use of punctuation in variable names is discouraged.
  - Case sensitive
  - Cannot be a keyword (e.g. for, while, if, …)
- Legal:
  - foo, bar, a_variable, var123
- Legal but not considered good:
  - var_with_$, _badness
- Illegal:
  - 1var, while, break, this has whitespace

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Assignment

- Syntax:

```
variable = expression;
```

- Note: single equals for assignment.
- Left hand side must be some sort of variable name that can be assigned.
- Expression must produce a value that matches the type of the variable.

Expressions

- A sequence of symbols that can be evaluated to produce a value.
  - Can be used wherever a value is expected.
- Types of expressions:
  - Literal values: 123, ‘c’, “a string”, true
  - Named value: a_variable
  - Value retrieved from an array: my_array[3]
  - Class/object fields: Math.PI
  - Value as a result of a method call: foo()
  - Compound expression of operators: 4+3*2

Operators

- Arithmetic: +, -, /, *, %
- Relational: ==, !=, >, >=, <, <=
- Boolean: &&, ||, !
- Ternary: ?:
  - *boolean_expression ? value_if_true : value_if_false*
- Bitwise: ~, <<, >>, >>>, &, |, ^
- Be aware of precedence
  - Can be controlled by explicitly grouping with ()
- Be aware of context
  - Some operators do different things depending on the types of the values they are applied to.

Assignment and Unary Operators

- Most numeric operators have an “assignment” form.
  - Easy syntax for applying the operator to a variable and assigning the result back to the same variable.
  - Examples:
    - a += 3 // Equivalent to a = a + 3
    - b *= 4 // Equivalent to b = b * 4
- Unary operators ++ and --
  - Used with integer typed variables to increment and decrement.
  - Usually used as a statement unto itself:
    - a++;   // Equivalent to a = a + 1;
    - b--;   // Equivalent to b = b – 1;

Creating an Eclipse Project From A GitHub Repository

- Open eclipse “Git Repository” panel
  - Window -> Show View -> Other… -> Git -> Git Repositories
- Click on “Clone a Git Repository” icon
- Provide github clone URL
  - Should fill in form with correct values.
  - May need to provide github account name/password.
  - Go through dialog boxes until “Finish”
    - Will provide a default location for the repository on your machine.
    - Either note this location or specify a different specific location.
- Create new Eclipse Java Project
  - Uncheck “Use default location”
  - Choose location of repository directory from step above.

lec02.ex2.Example2

- Variable declarations for value types
- Integer math vs. Real math
- Ternary operator
- Operator precedence
- Boolean operator shortcut

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Conditional Execution: if-else if-else

```
if (expression) {
  // Block of statements
} else if (expression) {
  // Block of statements
} else {
  // Block of statements
}
```

if example

```
if (score > 90) {
  System.out.println(“You got an A!”);
} else if (score > 80) {
  System.out.println(“You got a B.”);
} else if (score > 70) {
  System.out.println(“You got a C?”);
} else if (score > 60) {
  System.out.println(“You got a D :-(“);
} else {
  System.out.println(“You failed”);
}
```

Conditional Execution: switch

```
switch (expression) {
case value:
  statements
  break;
case value:
  statements
  break;
...
default:
  statements
}
```

- Works with basic value data types
- Works with String as of Java 7
- Execution starts at first matching case value
  - or default if provided and no case matches
- Continues until a break statement or end of switch.

Switch Example

```
switch (c) {
  case 'a':
  case 'e':
  case 'i':
  case 'o':
  case 'u':
   System.out.println("Vowel");
   break;
  default:
   System.out.println("Consonant");
}
```

lec02.ex3.Example3

- if and switch demo
- Variables scoped within block
- Style hint:
  - Don't use == to compare a boolean expression against true or false as literals
- Testing real numbers with epsilon bounds

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Loops: while

```
while (expression) {
  block
}

do {
  block
} while (expression);
```

while example

```
int sum = 0;
int n = 1;
while (n < 11) {
  sum += n;
  n++;
}
System.out.println(“The sum of 1 to 10 is: “ + sum);
```

Loops: for

```
for (init; test; update) {
  statement block
}
```

for example

```
int sum = 0;
for(int n=1; n<11; n++) {
  sum += n;
}
System.out.println(“The sum of 1 to 10 is: “ + sum);
```

- Note that variable *n* is declared as part of init expression in for loop.
  - This is a common programming idiom when the variable is only needed for the loop.
  - Scope of variable is limited to the loop block.

Loop odds and ends

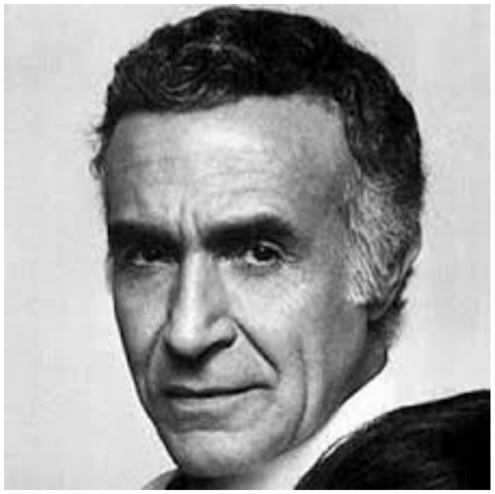
- To skip to next iteration of loop body use “continue” statement.
- To break out of the loop body use “break” statement.

Example 4

- while and for
- while and for equivalence
- scope of for loop variable
- break / continue

Quienes Mas Macho?

```
// Antonio Banderas
int sum = 0;
for (int i=0; i<100; i++) {
    sum += nextRandomNumber();
    if (sum >= 100) {
        break;
    }
}
```



```
// Ricardo Montalban
int sum = 0;
while (sum < 100) {
    sum += nextRandomNumber();
}
```

Quienes Mas Fuerte?

```
// Angelina Jolie
int i;
for (i=1; i<100; i++) {
   if (items[i] < items[i-1]) {
      break;
   }
}
```

```
// Charlize Theron
int i = 1;
while (items[i] > items[i-1]) {
   i++;
   if (i == 100) {
      break;
   }
}
```

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Calling Methods

- Calling a class method defined in the same class:
  `methodName(`*`parameters`*`);`

- Calling a class method defined in a different class (same package):
  `ClassName.methodName(`*`parameters`*`);`

- Calling a class method defined in a different package:
  `PackageName.ClassName.methodName(`*`parameters`*`)`

- In the above "*parameters*" is a comma separated list of values.
  – Must match in number and type according to method's signature.

- A method call that returns a value (i.e., not a "void" method) can be part of an expression.

```
int max_times_min = max(a, b, c) * min(a, b, c);
```

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Return

- Syntax:

```
return expression;
```

- Ends execution of a method and returns the value of the expression as the result of the method.
  - Must match type declared in method signature.
  - If method return type is “void”, then simply:

```
return;
```

lec02.ex5.Example5

- Calling methods
- Compound expressions as part of method call to provide parameter value.
- Returning from middle of method
  - Generally, try to avoid.
- Unreachable code error
- Calling method in same/different class, same/different package
  - lec02.ex5.Example5Other

Import Directive

- Maps class names from other packages into current name space.
  - Convenient if going to use one or more class names repeatedly.
- Map all class names from a package:

`import` *`package`*`.*;`

- Map a specific class name from a package:

`import` *`package`*`.`*`ClassName`*`;`

Example5OtherRevisited

- import
- Math revisited
  - Classes in java.lang package are automatically imported.