CS1004: Intro to CS in Java, Spring 2005

Lecture #15: Java conditionals/loops

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Administrivia

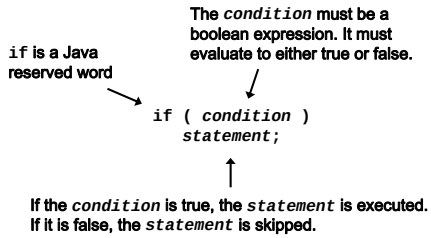
- Homework due now
- Midterm on Thursday
  - We'll stop the lecture at about noon and I'll take questions at that point

Conditional Statements

- A *conditional statement* lets us choose which statement will be executed next
- The Java conditional statements are the:
  - if statement
  - if-else statement
  - ? operator (well, not quite a statement)
  - switch statement
- Less "clumsy" than the assembly equivalents

The if Statement

- The *if statement* has the following syntax:



Boolean Expressions

- Java's *equality operators* or *relational operators* all return boolean results:

==	equal to
!=	not equal to
<	less than
>	greater than
<=	less than or equal to
>=	greater than or equal to

- Remember, equality operator (==) vs. assignment operator (=)
- Lower precedence than math operators

The if Statement

- An example of an if statement:

```
if (sum > MAX)
   delta = sum - MAX;
System.out.println ("The sum is " + sum);
```

- First the condition is evaluated -- the value of `sum` is either greater than the value of `MAX`, or it is not
- If the condition is true, the assignment statement is executed -- if it isn't, it is skipped.
- Either way, the call to `println` is executed next

Indentation

- The statement controlled by the `if` statement is indented to indicate that relationship
- The use of a consistent indentation style makes a program easier to read and understand
- Although it makes no difference to the compiler, proper indentation is crucial when the code needs to be *maintained*
- Emacs will do this automatically for you; just hit TAB once

Logical Operators

- Boolean expressions can also use the following *logical operators*:

`!`	Logical NOT
`&&`	Logical AND
`||`	Logical OR

- Exactly like circuit/assembly equivalents
- Process boolean operands, and produce boolean results

Logical Operators (II)

- Expressions that use logical operators can form complex conditions

```
if (total < MAX+5 && !found)
   System.out.println ("Processing…");
```

- All logical operators have lower precedence than the relational operators (and math operators)
  - Personally, I would use parentheses
- Logical NOT has higher precedence than logical AND and logical OR

Short-Circuited Operators

- The processing of logical AND and logical OR is "short-circuited"
- If the left operand is sufficient to determine the result, the right operand is not evaluated

```
if (count != 0 && total/count > MAX)
   System.out.println ("Testing...");
```

- This type of processing must be used carefully

if-else

- An *else clause* can be added to an `if` statement to make an *if-else statement*

```
if ( condition )
   statement1;
else
   statement2;
```

- If the *`condition`* is true, *`statement1`* is executed; if the condition is false, *`statement2`* is executed
- One or the other will be executed, but not both

Indentation Revisited

- Remember that indentation is for the human reader, and is ignored by the computer
- Emacs will help you avoid this confusion

```
if (total > MAX)
   System.out.println ("Error!!");
   errorCount++;
```

Despite what is implied by the indentation, the increment will occur whether the condition is true or not

Block Statements

- Several statements can be grouped together into a *block statement* delimited by braces
- A block statement can be used wherever a statement is called for in the Java syntax rules
- Bracing can be spaced in different ways (book uses *open* bracing, I use *closed* bracing)

```
if (total > MAX)
{
   System.out.println ("Error!!");
   errorCount++;
}
```

Block Statements (II)

- In an `if-else` statement, the `if` portion, or the `else` portion, or both, could be block statements

```
if (total > MAX)
{
   System.out.println ("Error!!");
   errorCount++;
}
else
{
   System.out.println ("Total: " + total);
   current = total*2;
}
```

When in doubt, brace!

- It's *okay* to use braces even when you have one statement
- I'll almost always use braces, and will only occasionally omit them

Else if

- We can have more than two conditions:

```
if(age < 20) {
  System.out.println("You're young!");
} else if(age > 20 && age < 40) {
  System.out.println("You're not so young!");
} else if(age > 40 && age < 60) {
  System.out.println("You're a bit older!");
} else {
  System.out.println("You're still a student?");
}
```

- Starts with the top clause and works down from there
- Last else is only run if *none of the others matched*
- *Major* bug(s) in this code; what is it?

Nested if Statements

- The statement executed as a result of an `if` statement or `else` clause could be another `if` statement
- These are called *nested if statements*
- An `else` clause is matched to the last unmatched `if` (no matter what the indentation implies)
- Braces can be used to specify the `if` statement to which an `else` clause belongs
- *Not* the same thing as else if

Let's put it all together…

- Modify our `DieRoller` class to ask the user to guess the value of the die

The Conditional Operator

- Java has a *conditional operator* that uses a boolean condition to determine which of two expressions is evaluated
- Its syntax is:

```
condition ? expression1 : expression2
```

- If the `condition` is true, `expression1` is evaluated; if it is false, `expression2` is evaluated
- The value of the entire conditional operator is the value of the selected expression
- Sometimes called an "immediate if"

The Conditional Operator (II)

- The conditional operator is similar to an `if-else` statement, except that it is an expression that returns a value
- For example:

```
larger = ((num1 > num2) ? num1 : num2);
```

- If `num1` is greater than `num2`, then `num1` is assigned to `larger`; otherwise, `num2` is assigned to `larger`
- The conditional operator is *ternary* because it requires three operands
- **Use parentheses** to avoid confusion

The Conditional Operator (III)

- Another example:

```
System.out.println ("Your change is " + count +
   ((count == 1) ? "Dime" : "Dimes"));
```

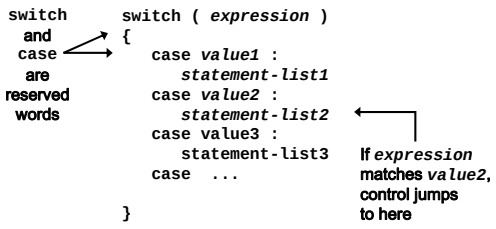
- If `count` equals 1, then `"Dime"` is printed
- If `count` is anything other than 1, then `"Dimes"` is printed

The switch Statement

- The *switch statement* provides another way to decide which statement to execute next
- The `switch` statement evaluates an expression, then attempts to match the result to one of several possible *cases*
- Each case contains a value and a list of statements
- The flow of control transfers to statement associated with the first case value that matches

The switch Statement (II)

- The general syntax of a `switch` statement is:



switch and break

- Often a *break statement* is used as the last statement in each case's statement list
  - A `break` statement causes control to transfer to the end of the `switch` statement
  - If a `break` statement is not used, the flow of control *will continue into the next case*
- Biggest common bug with switch, and a reason why I use it sparingly

switch Example

- An example of a switch statement:

```
switch (option)
{
   case 'A':
      aCount++;
      break;
   case 'B':
      bCount++;
      break;
   case 'C':
      cCount++;
      break;
}
```

switch and default case

- A `switch` statement can have an optional *default case*
- The default case has no associated value and simply uses the reserved word `default`
- If the default case is present, control will transfer to it if no other case value matches
- If there is no default case, and no other value matches, control falls through to the statement after the switch

What can you switch on?

- The expression of a `switch` statement must result in an *integral type*, meaning an integer (`byte`, `short`, `int`, `long`) or a `char`
- It cannot be a `boolean` value or a floating point value (`float` or `double`)
- The implicit boolean condition in a `switch` statement is equality (==, not .equals())
- Common for things like menu systems ("Enter one of the above 5 options")

Comparing Data

- When comparing data using boolean expressions, it's important to understand the nuances of certain data types
- We've talked about these, but now let's formalize it

Comparing Float Values

- You should rarely use the equality operator (`==`) when comparing two floating point values (`float` or `double`)
- Two floating point values are equal only if their underlying binary representations match exactly
- Computations often result in slight differences that may be irrelevant
- In many situations, you might consider two floating point numbers to be "close enough" even if they aren't exactly equal

Comparing Float Values (II)

- To determine the equality of two floats, you may want to use the following technique:

```
if (Math.abs(f1 - f2) < TOLERANCE)
   System.out.println ("Essentially equal");
```

  - If the difference between the two floating point values is less than the tolerance, they are considered to be equal
  - The tolerance could be set to any appropriate level, such as 0.000001

Comparing Characters

- As we've discussed, Java character data is based on the Unicode character set
- Unicode establishes a particular numeric value for each character, and therefore an ordering
- We can use relational operators on character data based on this ordering
- For example, the character `'+'` is less than the character `'J'` because it comes before it in the Unicode character set
- Appendix C provides an overview of Unicode

Comparing Characters (II)

- In Unicode, the digit characters (0-9) are contiguous and in order
- Likewise, the uppercase letters (A-Z) and lowercase letters (a-z) are contiguous and in order

Characters	Unicode Values
0 – 9	48 through 57
A – Z	65 through 90
a – z	97 through 122

String equality

- Remember that in Java a character string is an object
- The `equals` method can be called with strings to determine if two strings contain exactly the same characters in the same order
- The `equals` method returns a boolean result

```
if (name1.equals(name2))
   System.out.println ("Same name");
```

String inequalities

- We cannot use the relational operators to compare strings
- The `String` class contains a method called `compareTo` to determine if one string comes before another
- A call to `name1.compareTo(name2)`
  - returns zero if `name1` and `name2` are equal (contain the same characters)
  - returns a negative value if `name1` is less than `name2`
  - returns a positive value if `name1` is greater than `name2`

compareTo example

```
if (name1.compareTo(name2) < 0)
   System.out.println (name1 + "comes first");
else
   if (name1.compareTo(name2) == 0)
      System.out.println ("Same name");
   else
      System.out.println (name2 + "comes first");
```

- Because comparing characters and strings is based on a character set, it is called a *lexicographic ordering*

Lexicographic Ordering

- Lexicographic ordering is not strictly alphabetical when uppercase and lowercase characters are mixed
- For example, the string `"Great"` comes before the string `"fantastic"` because all of the uppercase letters come before all of the lowercase letters in Unicode
- Also, short strings come before longer strings with the same prefix (lexicographically)
- Therefore `"book"` comes before `"bookcase"`

Comparing Objects

- The == operator *can* be applied to objects, as we mentioned before
- The `equals` method is also defined for all objects, but unless we redefine it when we write a class, it has the same semantics as the == operator
- It has been redefined in the `String` class to compare the characters in the two strings
- When you write a class, you can redefine the `equals` method to return true under whatever conditions are appropriate

Midterm exam

- Three parts
  - True/False (4-5 questions)
  - Short answer (3-4 questions)
  - Long answer (one question)
- Covers lectures 1-14, S/G ch. 1, 4 and 5, and L/L ch. 1-4
  - Except stuff at the very end of lecture 14 (if statements)

Sample T/F question

- In this section, assert whether the proposition is true or false, and provide a one-sentence justification as to why. (If you feel an assertion is ambiguous, review the course materials: it will have been well-defined somewhere.)
- *You run a Java program on CUNIX by typing* `java Foo.java` *at the $ prompt and hitting Enter.*

Sample short-answer question

- *State two advantages and two disadvantages of using applets as opposed to applications.*
- Some short-answer questions may be more structured than others:
- *You're given the following piece of code. Explain what it does.*

Sample long-answer question

- (L/L exercise 4.1) *Write a method called randomInRange that accepts two integer parameters representing a range. The method should return a random integer in the specified range (inclusive). Assume that the first parameter is greater than the second.*
- Well, this one is only 1 line of code, so it might be a bit longer
- By the way, I *will* ask theory questions: these are just examples

Next time

- Exam. ☹
- After break, finish chapter 5 of L/L
  - Loops