CS1004: Intro to CS in Java, Spring 2005

Lecture #7: Java expressions II, GUIs

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Administrivia

- HW#1 due now
- HW#2 out this afternoon
  - It will have three “mini” programming assignments

String concatenation, revisited

- Note that the + operator is used for both addition and concatenation
- If both operands are strings, or if one is a string and one is a number, it performs string concatenation
- If both operands are numeric, it adds them
- So what happens when you write "I am " + 10 + 10 + " years old"?
Increment and Decrement

- Also turns out that adding or subtracting one is extremely common, so much so there are special one-operand operators for these tasks.
- The increment operator (++) adds 1 to its operand.
- The decrement operator (--) subtracts 1 from its operand.
- The statement `count++;` is functionally equivalent to `count = count + 1;`.

Increment and Decrement

- The increment and decrement operators can be applied in postfix form:
  ```
  count++
  ```
- or prefix form:
  ```
  ++count
  ```
- When used as part of a larger expression, the two forms can have different effects.
- Because of their subtleties, the increment and decrement operators should be used with care.

Data Conversion

- Sometimes it is convenient to convert data from one type to another.
- For example, in a particular situation we may want to treat an integer as a floating point value.
- These conversions do not change the type of a variable or the value that's stored in it – they only convert a value as part of a computation.
Data Conversion (II)
- Conversions must be handled carefully to avoid losing information
- *Widening conversions* are safest because they tend to go from a small data type to a larger one (such as a short to an int)
- *Narrowing conversions* can lose information because they tend to go from a large data type to a smaller one (such as an int to a short)

Data Conversion (III)
- In Java, data conversions can occur in three ways:
  - assignment conversion
  - promotion
  - casting
- *Assignment conversion* occurs when a value of one type is assigned to a variable of another
  - If `money` is a float variable and `dollars` is an int variable, the following assignment converts the value in `dollars` to a float:
    `money = dollars`
  - Only widening conversions can happen via assignment; attempts to narrow trigger a compilation error
  - Note that the value or type of `dollars` did not change

Promotion
- *Promotion* happens automatically when operators in expressions convert their operands
- For example, if `sum` is a float and `count` is an int, the value of `count` is converted to a floating point value to perform the following calculation:
  `result = sum / count;`
- Also happens when you concatenate numbers with Strings
Casting

- Casting is explicit conversion
- Both widening and narrowing conversions can be accomplished by explicitly casting a value
- To cast, the type is put in parentheses in front of the value being converted
- 
  - Higher precedence than operators
  - For example, if total and count are integers, but we want a floating point result when dividing them, we can cast total:
    $$\text{result} = \frac{\text{float}(\text{total})}{\text{count}};$$
- When in doubt, cast!

Interactive Programs

- Programs generally need input on which to operate
- The Scanner class provides convenient methods for reading input values of various types
- A Scanner object can be set up to read input from various sources, including the user typing values on the keyboard
- Keyboard input is represented by the System.in object

Reading Input

- The following line creates a Scanner object that reads from the keyboard:
  Scanner scan = new Scanner(System.in);
- The new operator creates the Scanner object
  - We'll learn much more about new soon
- Once created, the Scanner object can be used to invoke various input methods, such as:
  String answer = scan.nextLine();
Reading Input

- The `Scanner` class is part of the `java.util` class library, and must be `imported` into a program to be used
  - `import java.util.Scanner;` at the top of your code
- The `nextLine` method reads all of the input until the end of the line is found
- The details of object creation and class libraries are discussed further in Chapter 3

Input Tokens

- What if you want to input multiple values into separate variables?
- Unless specified otherwise, `white space` is used to separate the elements (called `tokens`) of the input
- White space includes space characters, tabs, new line characters
- The `next` method of the `Scanner` class reads the next input token and returns it as a string
- Methods such as `nextInt` and `nextDouble` read data of particular types

Let's put it all together

- Simplest example: write a Fahrenheit-to-Celsius converter
- Steps?
  - Create two variables, one to hold the temperature in F and another to hold it in C
  - Get temperature input from user
  - Do the math and store the result in the second variable
  - Print out the result
- You tell me what to write
Introduction to Graphics

- Book reinforces some of the concepts through graphics examples at the end of each chapter.
- A picture is made up of pixels (picture elements), and each pixel is stored separately.
- The number of pixels used to represent a picture is called the picture resolution.
- The number of pixels that can be displayed by a monitor is called the monitor resolution.
- Each pixel can be identified using a two-dimensional coordinate system.

Coordinate Systems

- When we use a coordinate system with the origin in the top-left corner.

![Diagram of Coordinate System]

Representing Color

- A black and white picture could be stored using one bit per pixel (0 = white and 1 = black).
- A colored picture requires more information; there are several techniques for representing colors.
- For example, every color can be represented as a mixture of the three additive primary colors Red, Green, and Blue.
- Each color is represented by three numbers between 0 and 255 that collectively are called an RGB value.
The Color Class

- A color in a Java program is represented as an object created from the Color class.
- The Color class also contains several predefined colors, including the following:

<table>
<thead>
<tr>
<th>Object</th>
<th>RGB Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color.black</td>
<td>0, 0, 0</td>
</tr>
<tr>
<td>Color.blue</td>
<td>0, 0, 255</td>
</tr>
<tr>
<td>Color.cyan</td>
<td>0, 255, 255</td>
</tr>
<tr>
<td>Color.orange</td>
<td>255, 200, 0</td>
</tr>
<tr>
<td>Color.white</td>
<td>255, 255, 255</td>
</tr>
<tr>
<td>Color.yellow</td>
<td>255, 255, 0</td>
</tr>
</tbody>
</table>

Applets

- All the programs we've written so far are Java applications.
- A Java applet is a program that is intended to be transported over the Web and executed using a web browser.
- An applet also can be executed using the appletviewer tool in the JDK.
- An applet doesn't have a main method.
- Instead, there are several special methods that serve specific purposes.

Applets

- The paint method, for instance, is executed automatically and is used to draw the applet's contents.
- The paint method accepts a parameter that is an object of the Graphics class.
- A Graphics object defines a graphics context on which we can draw shapes and text.
- The Graphics class has several methods for drawing shapes.
Why applets?

- You can write programs your friends can access without installing the full JDK or having a CUNIX account.
  - Although they may need the Java plug-in (available from www.java.com)
  - If you install the JDK on your home computer, it installs this automatically
- Easy to set up graphical programs
  - You can create a graphical Java application, but it turns out to be more work
- Applets have limitations to prevent security problems
  - Won't be a problem for this homework

How to create an Applet

- Your class must extend the Applet class
  - This makes use of inheritance (Chapter 8)
  - You don’t need to know how this works in order to write applets
- Next, embed the applet into an HTML file using a tag that references the class file of the applet
- View the HTML file using a web browser or appletviewer
  - The web browser can automatically download the .class file like an image

Next time

- Finish applets
- Basic circuit design and computer architecture