Virtual Lecture Notes: The Random Class

Java's Random class creates lists of pseudorandom numbers and then provides methods to take a number from the list, in sequential order. For example, if the following list of 20 random numbers between 0 and 99 were generated, we would use them one at a time starting from the beginning of the list.

26 57 22 10 15 34 33 88 9 46 13 37 16 0 21 98 58 26 3 50

The following program generated these numbers.

```
< 1>     import java.util.Random;
< 2>     public class RandomNumbers
< 3>     {
< 4>         public static void main(String[] args)
< 5>         {
< 6>             int randNum = 0;
< 7>             Random randNumList = new Random();
< 8>
< 9>             for(int n = 1; n <= 25; n++)
<10>             {
<11>                 randNum = randNumList.nextInt(100);
<12>                 System.out.println(randNum + " ");
<13>             }
<14>         }
<15>     }
```

Enter this program into BlueJ and observe the output. After running the program, study the following line-by-line explanation.

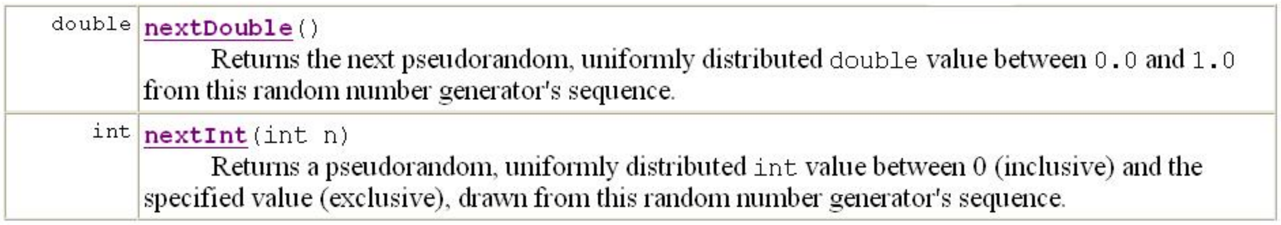
Lines

< 1> imports the **`Random`** class from the java.util library.
< 2> declares a class named **`RandomNumbers`**.
< 3> opening curly brace marking the beginning of the class (matches up with Line <15>).
< 4> declares the **`main()`** method where program execution begins.
< 5> opening curly brace to start the **`main()`** method (matches up with line <14>).
< 6> declares and initializes the **`randNum`** variable.
< 7> Constructs a new object of the **`Random`** class called **`randNumList`**. This object holds the list of random numbers generated.
< 8> white space to improve program readability.
< 9> beginning of the **`for`** loop, which will count from 1 to 25.
<10> opening curly brace of the **`for`** loop (matches up with line <13>).
<11> the **`nextInt()`** method of the **`Random`** class selects the next number from 0 to 99 from the **`randNumList`** object and assigns it to the **`randNum`** variable.
<12> prints the value of the **`randNum`** variable.
<13> closing curly brace marking the end of the **`for`** loop (matches up with line <10>.
<14> closing curly brace marking the end of the **`main()`** method (matches up with line <5>).
<15> closing curly brace marking the end of the class (matches up with line <3>).

Hand-tracing code in this manner is the best way to fully understand a program's purpose and design. It makes you think!

Background

The **`Random`** class can pick random decimals and integers with the **`nextDouble()`** and **`nextInt()`** methods, respectively. Carefully study the following Method Summary excerpts from the **`Random`** class API.



`double`	`nextDouble()` Returns the next pseudorandom, uniformly distributed `double` value between `0.0` and `1.0` from this random number generator's sequence.
`int`	`nextInt(int n)` Returns a pseudorandom, uniformly distributed `int` value between 0 (inclusive) and the specified value (exclusive), drawn from this random number generator's sequence.

In this course you will only need these two **`Random`** class methods. Do the method names look familiar? So far you have used them to accept integer and decimal values input from the keyboard and a file. Java frequently re-uses method names that do similar things in different classes. These two methods perform a similar task in all three classes; they retrieve the next available value.

These use of these two methods is straightforward.

- The **`nextInt()`** method takes a parameter that indicates the maximum value of the integers in the list, **minus one** since the upper end of the range is not inclusive. Consequently, **`nextInt(53)`** would return random numbers in the range of 0–52.
- The **`nextDouble()`** method returns decimals values from 0.0 inclusive to 1.0 exclusive. Like the **`random()`** method of the **`Math`** class, decimal numbers returned will never equal 1.0.

Scaling is required for higher ranges of decimals numbers. For example, if you want random decimals between 0.0 and 1,000.0, you would simply multiply by the scaling factor as shown below.

```
double doubleValue = randNumList.nextDouble() * 1000;
```

The context of a specific program will determine whether you use the **`nextDouble()`** and **`nextInt()`** methods of the **`Math`** class or the **`Random`** class.

The real key to generating random numbers with the **`Random`** class is the following statement in the program above.

```
Random randNumList = new Random();
```

You use a similar statement anytime you need to create a **`Scanner`** object to accept input from the keyboard. Objects will be covered in depth in an upcoming module, but in the meantime, simply realize that this statement assigns a list of pseudorandom numbers to an object called **`randNumList`**. When the **`nextInt()`** or **`nextDouble()`** methods are invoked, the next available number is retrieved from the list.

Modifications

As always, you will learn more about these methods from experimenting. Make the following modifications to the RandomNumbers class.

- Modify the program to pick 100 random numbers instead of 25.
- Change the program to choose random integers between 0 and 4319.
- Modify the range of integers picked with your own values.
- How can the random integers be converted to negative numbers?
- How could you pick random integers between -50 and 50?

- Change the program to pick 50 random numbers between 0.0 and 1.0.
- Modify the program to pick random numbers between 0.0 and 433.0
- How could you pick random numbers between 100.0 and 200.0?
- What happens if you put a decimal number in the parentheses of the **`nextDouble()`** method?
- What happens if you delete **`randNumList`** on line <11>?
- Can you simulate rolling a six-sided die (singular of dice) 10 times?

Continue to experiment with the nextInt() and nextDouble() methods until you are satisfied that you understand their basic features.