Building Java Programs

Chapter 5
Lecture 5-2: Random Numbers

reading: 5.1 - 5.2
self-check: #8 - 17
exercises: #3 - 6, 10, 12
videos: Ch. 5 #1-2
The Random class

- A Random object generates pseudo-random* numbers.
- Class Random is found in the java.util package.

```java
import java.util.*;
```

<table>
<thead>
<tr>
<th>Method name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>nextInt()</td>
<td>returns a random integer</td>
</tr>
<tr>
<td>nextInt(max)</td>
<td>returns a random integer in the range [0, max)</td>
</tr>
<tr>
<td></td>
<td>in other words, 0 to max-1 inclusive</td>
</tr>
<tr>
<td>nextDouble()</td>
<td>returns a random real number in the range [0.0, 1.0)</td>
</tr>
</tbody>
</table>

- Example:

```java
Random rand = new Random();
int randomNumber = rand.nextInt(10);  // 0–9
```
Generating random numbers

- Common usage: to get a random number from 1 to \( N \)
  ```java
  int n = rand.nextInt(20) + 1;  // 1–20 inclusive
  ```

- To get a number in arbitrary range \([min, max]\) inclusive:
  ```java
  nextInt(size of range) + min
  ```
  - where \((size of range)\) is \((max - min + 1)\)

- Example: A random integer between 4 and 10 inclusive:
  ```java
  int n = rand.nextInt(7) + 4;
  ```
Random questions

• Given the following declaration, how would you get:
  Random rand = new Random();

  • A random number between 1 and 100 inclusive?
    int random1 = rand.nextInt(100) + 1;

  • A random number between 50 and 100 inclusive?
    int random2 = rand.nextInt(51) + 50;

  • A random number between 4 and 17 inclusive?
    int random3 = rand.nextInt(14) + 4;
Random and other types

- `nextDouble` method returns a `double` between 0.0 - 1.0

- Example: Get a random GPA value between 1.5 and 4.0:
  ```java
  double randomGpa = rand.nextDouble() * 2.5 + 1.5;
  ```

- Any set of possible values can be mapped to integers
  - code to randomly play Rock-Paper-Scissors:
  ```java
  int r = rand.nextInt(3);
  if (r == 0) {
      System.out.println("Rock");
  } else if (r == 1) {
      System.out.println("Paper");
  } else {
      System.out.println("Scissors");
  }
  ```
Random question

- Write a program that simulates rolling of two 6-sided dice until their combined result comes up as 7.

  2 + 4 = 6  
  3 + 5 = 8  
  5 + 6 = 11  
  1 + 1 = 2  
  4 + 3 = 7  
  You won after 5 tries!

- Modify the program to play 3 dice games using a method.
import java.util.*; public class Dice {
    public static void main(String[] args) {
        Random rand = new Random();
        int tries = 0;

        int sum = 0;
        while (sum != 7) {
            // roll the dice once
            int roll1 = rand.nextInt(6) + 1;
            int roll2 = rand.nextInt(6) + 1;
            sum = roll1 + roll2;
            System.out.println(roll1 + " + " + roll2 + " = " + sum);
            tries++;
        }

        System.out.println("You won after " + tries + " tries!");
    }
}
Random question

- Write a multiplication tutor program.
  - Ask user to solve problems with random numbers from 1-20.
  - The program stops after an incorrect answer.

14 * 8 = 112  
Correct!
5 * 12 = 60  
Correct!
8 * 3 = 24  
Correct!
5 * 5 = 25  
Correct!
20 * 14 = 280  
Correct!
19 * 14 = 256  
Incorrect; the answer was 266

You solved 5 correctly
import java.util.*;

// Asks the user to do multiplication problems and scores them.
public class MultiplicationTutor {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);
        Random rand = new Random();

        // fencepost solution - pull first question outside of loop
        int correct = 0;
        int last = askQuestion(console, rand);
        int lastCorrect = 0;

        // loop until user gets one wrong
        while (last > 0) {
            lastCorrect = last;
            correct++;
            last = askQuestion(console, rand);
        }

        System.out.println("You solved " + correct + " correctly");
        if (correct > 0) {
            System.out.println("Last correct answer was " + lastCorrect);
        }
    }
}
Random answer 2

...  

// Asks the user one multiplication problem,  
// returning the answer if they get it right and 0 if not.  
public static int askQuestion(Scanner console, Random rand) {  
    // pick two random numbers between 1 and 20 inclusive  
    int num1 = rand.nextInt(20) + 1;  
    int num2 = rand.nextInt(20) + 1;  

    System.out.print(num1 + " * " + num2 + " = ");  
    int guess = console.nextInt();  
    if (guess == num1 * num2) {  
        System.out.println("Correct!");  
        return num1 * num2;  
    } else {  
        System.out.println("Incorrect; the correct answer was "+  
            (num1 * num2));  
        return 0;  
    }  
}