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.

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

Method name	Description
nextInt()	returns a random integer
nextInt(**max**)	returns a random integer in the range [0, *max*) in other words, 0 to *max*-1 inclusive
nextDouble()	returns a random real number in the range [0.0, 1.0)

  - Example:

```
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*

```
int n = rand.nextInt(20) + 1;   // 1-20 inclusive
```

- To get a number in arbitrary range [*min*, *max*] inclusive:

```
nextInt(size of range) + min
```

  - where (**size of range**) is (**max - min + 1**)

- Example: A random integer between 4 and 10 inclusive:

```
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:

```
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:

```
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.

Random answer

```
// Rolls two dice until a sum of 7 is reached.
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
```

Random answer

```
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;
        }
    }
}
```