Building Java Programs

Chapter 5
Lecture 5-2: Random Numbers

reading: 5.1, 5.6

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Methods that are tests

- Some methods return logical values (`true` or `false`).
  - A call to such a method is used as a **<test>** in a loop or `if`.

```
Scanner console = new Scanner(System.in);
System.out.print("Type your full name: ");
String name = console.nextLine();

if (name.startsWith("Dr.")) {
    System.out.println("Will you marry me?");
} else if (name.endsWith("Esq.")) {
    System.out.println("And I am Ted 'Theodore' Logan!");
}
```

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String test methods

Method	Description
equals(**<str>**)	whether two strings contain the same characters
equalsIgnoreCase(**<str>**)	whether two strings contain the same characters, ignoring upper vs. lower case
startsWith(**<str>**)	whether one contains other's characters at start
endsWith(**<str>**)	whether one contains other's characters at end
contains(**<str>**)	whether the given string is found within this one

```
String name = console.nextLine();
if (name.contains("Prof")) {
    System.out.println("When are your office hours?");
} else if (name.equalsIgnoreCase("buTteRs")) {
    System.out.println("You're grounded, young man!");
}
```

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Strings question

- Prompt the user for two words and report whether they:
  - *"rhyme"*   (end with the same last two letters)
  - *alliterate*   (begin with the same letter)

  - Example output: (run #1)
    ```
    Type two words: car STAR
    They rhyme!
    ```

    (run #2)
    ```
    Type two words: bare bear
    They alliterate!
    ```

    (run #3)
    ```
    Type two words: sell shell
    They alliterate!
    They rhyme!
    ```

    (run #4)
    ```
    Type two words: extra strawberry
    ```

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Strings answer

```java
// Determines whether two words rhyme and/or alliterate.
import java.util.*;

public class Rhyme {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);
        System.out.print("Type two words: ");
        String word1 = console.next().toLowerCase();
        String word2 = console.next().toLowerCase();

        // check whether they end with the same two letters
        if (word2.length() >= 2 &&
            word1.endsWith(word2.substring(word2.length() - 2))) {
            System.out.println("They rhyme!");
        }

        // check whether they alliterate
        if (word1.startsWith(word2.substring(0, 1))) {
            System.out.println("They alliterate!");
        }
    }
}
```

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Random numbers

reading: 5.1

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:

  `<name>``.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 47 inclusive?
    ```
    int random1 = rand.nextInt(47) + 1;
    ```

  - A random number between 23 and 30 inclusive?
    ```
    int random2 = rand.nextInt(8) + 23;
    ```

  - A random even number between 4 and 12 inclusive?
    ```
    int random3 = rand.nextInt(5) * 2 + 4;
    ```

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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 {   // r == 2
        System.out.println("Scissors");
    }
    ```

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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!
```

Random answer

```java
// 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 program that plays an adding game.
  - Ask user to solve random adding problems with 2-5 numbers.
  - The user gets 1 point for a correct answer, 0 for incorrect.
  - The program stops after 3 incorrect answers.

```
4 + 10 + 3 + 10 = 27
9 + 2 = 11
8 + 6 + 7 + 9 = 25
Wrong! The answer was 30
5 + 9 = 13
Wrong! The answer was 14
4 + 9 + 9 = 22
3 + 1 + 7 + 2 = 13
4 + 2 + 10 + 9 + 7 = 42
Wrong! The answer was 32
You earned 4 total points.
```

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Random answer

```java
// Asks the user to do adding problems and scores them.
import java.util.*;

public class AddingGame {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);
        Random rand = new Random();

        // play until user gets 3 wrong
        int points = 0;
        int wrong = 0;
        while (wrong < 3) {
            int result = play(console, rand);   // play one game
            if (result == 0) {
                wrong++;
            } else {
                points++;
            }
        }

        System.out.println("You earned " + points + " total points.");
    }
```

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Random answer 2

```
    ...
    // Builds one addition problem and presents it to the user.
    // Returns 1 point if you get it right, 0 if wrong.
    public static int play(Scanner console, Random rand) {
        // print the operands being added, and sum them
        int operands = rand.nextInt(4) + 2;
        int sum = rand.nextInt(10) + 1;
        System.out.print(sum);

        for (int i = 2; i <= operands; i++) {
            int n = rand.nextInt(10) + 1;
            sum += n;
            System.out.print(" + " + n);
        }
        System.out.print(" = ");

        // read user's guess and report whether it was correct
        int guess = console.nextInt();
        if (guess == sum) {
            return 1;
        } else {
            System.out.println("Wrong! The answer was " + total);
            return 0;
        }
    }
}
```

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