Random Numbers

zyBook Chap 5.12

When to use random numbers?

- Games
  - Typing games
  - Shuffle cards, roll dice…
  - Flashcards
- Statistical sampling
- Cryptography

Pseudo-random

- **Pseudo-random**:
  - Numbers that, although they are derived from predictable and well-defined algorithms, mimic the properties of numbers chosen at random

- The pseudo-random number generator generates a number based on a **seed**, which is the **current time**, which is different for each program run

Random Number in Java

1. **Math.random()** method

2. **Random** object
   - `import java.util.Random;`

Math.random()

- Returns a random number between **[0.0, 1.0)**
- Can use multiplication to extend the range
- Example:

```
double random = Math.random();        // [0.0, 1.0)
double random = 2.0 * Math.random(); // [0.0, 2.0)
```

Random Objects

- Must `import java.util.Random`
- Construct it with the keyword new

```
Random rand = new Random();
```

Return	Method	Description	Example
int	**nextInt()**	**Random int between -2^{31} and $(2^{31} - 1)$**	**int x = rand.nextInt();**
int	**nextInt(max)**	**Random int between [0, (max – 1)]**	**int y = rand.nextInt(10);**
double	nextDouble()	Random real # between [0.0, 1.0)	double z = rand.nextDouble();
boolean	nextBoolean()	Random logical value of true or false	boolean b = rand.nextBoolean();

Q: What is the range of the result of integers a, b, c, and d?
Be specific with inclusive vs. exclusive.

```
Random rand = new Random();
int a = rand.nextInt(50);
int b = rand.nextInt(5)+10;
int c = rand.nextInt(10)+5;
int d = rand.nextInt(50)-25;
```

[0, 49]

[10, 14]

[5, 14]

[-25, 24]

nextInt(max)
Returns a random int between **[0, (max - 1)]**

Q: What's wrong with the following code?

```
import java.util.Random;

public class RandomSingleValue {
    public static void main (String[] args) {

        Random r = new Random();

        System.out.println("My random value is: " + (r.nextInt(101)));
        System.out.println("My random value plus 1: " + (r.nextInt(101) + 1));
        System.out.println("My random value times 5: " + (r.nextInt(101) * 5));
    }
}
```

```
$ java RandomSingleValue
My random value is: 65
My random value plus 1: 2
My random value times 5: 275

$ java RandomSingleValue
My random value is: 4
My random value plus 1: 97
My random value times 5: 375

$ java RandomSingleValue
My random value is: 31
My random value plus 1: 32
My random value times 5: 165
```

The `nextInt(101)` method generates a random integer between [0, 100] every time it's called.

Corrected

```
$ java RandomSingleValue
My random value is: 78
My random value plus 1: 79
My random value times 5: 390

$ java RandomSingleValue
My random value is: 60
My random value plus 1: 61
My random value times 5: 300

$ java RandomSingleValue
My random value is: 2
My random value plus 1: 3
My random value times 5: 10
```

```java
import java.util.Random;

public class RandomSingleValue {

    public static void main (String[] args) {

        Random r = new Random();
        int val = r.nextInt(101);

        System.out.println("My random value is: " + val);
        System.out.println("My random value plus 1: " + (val + 1));
        System.out.println("My random value times 5: " + (val * 5));
    }
}
```

Generate only one random integer between [0, 100]