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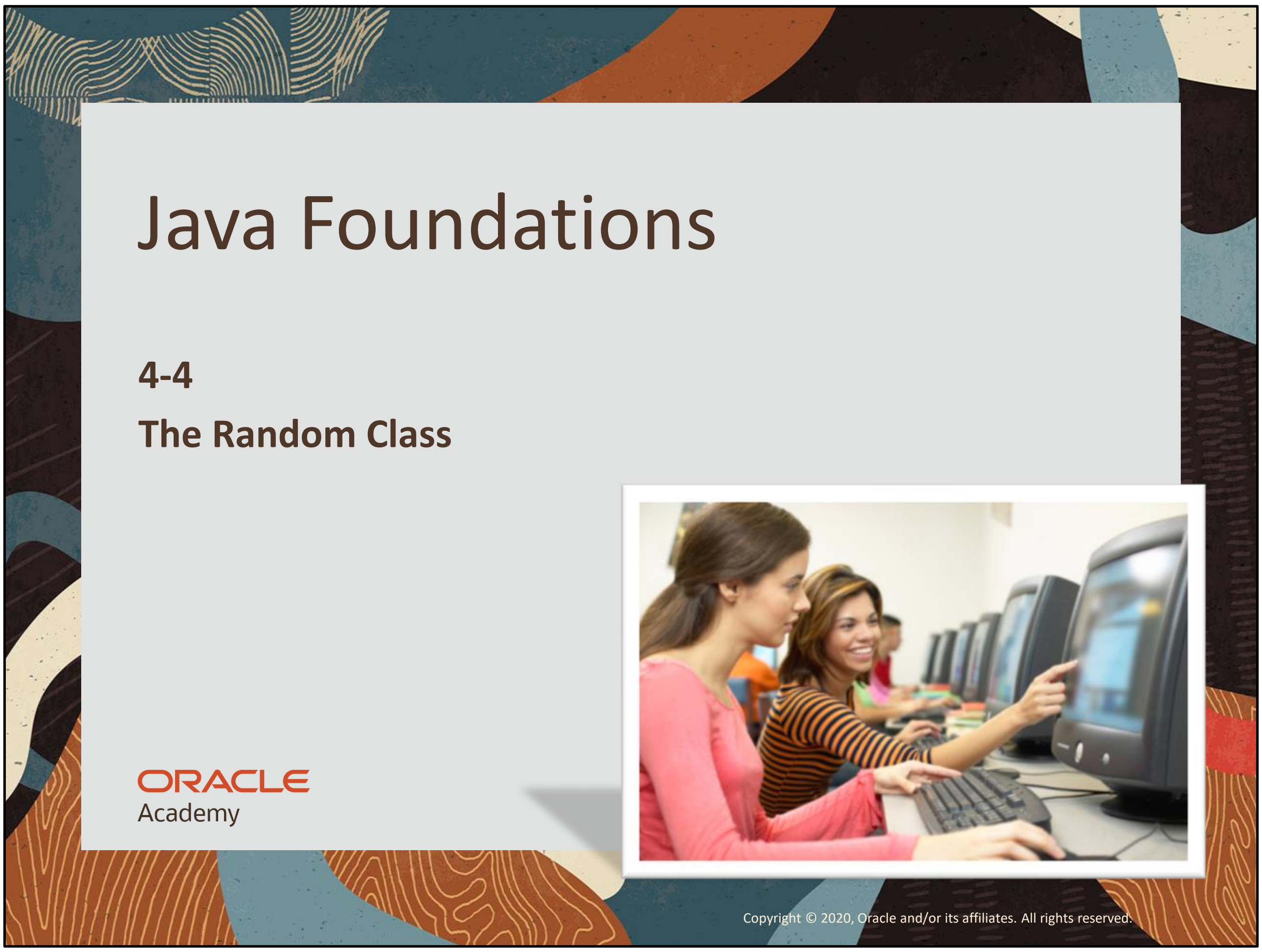

# Java Foundations

## 4-4
## The Random Class

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## Objectives

- This lesson covers the following objectives:
  - Describe the purpose and uses of random numbers in Java programming
  - Identify methods of the Random class that obtain random numbers
  - Obtain random numbers in a range of numbers
  - Understand the purpose of the random number seed

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## Purpose of Random Number Generation in Java

- A software application often needs to perform a task based on some randomly obtained value
- A number of applications need generation of random numbers
- Let's look at some applications that use random number generation

## Applications Based on Random Number Generation

- A card game application needs to shuffle a deck of cards randomly and then randomly distribute the cards to the players

- A lottery application requires a randomly generated number that's based on an algorithm
  - The person wins if his number matches the randomly generated number

## Generating Random Numbers in Java

- So far in the previous lessons, you saw that Java comes with a variety of classes that support almost all basic application development features
- For example:
  - String provides the capability for manipulating strings
  - Scanner provides capability for obtaining input from the console
- Another important class in Java is the Random class that's used to obtain random numbers

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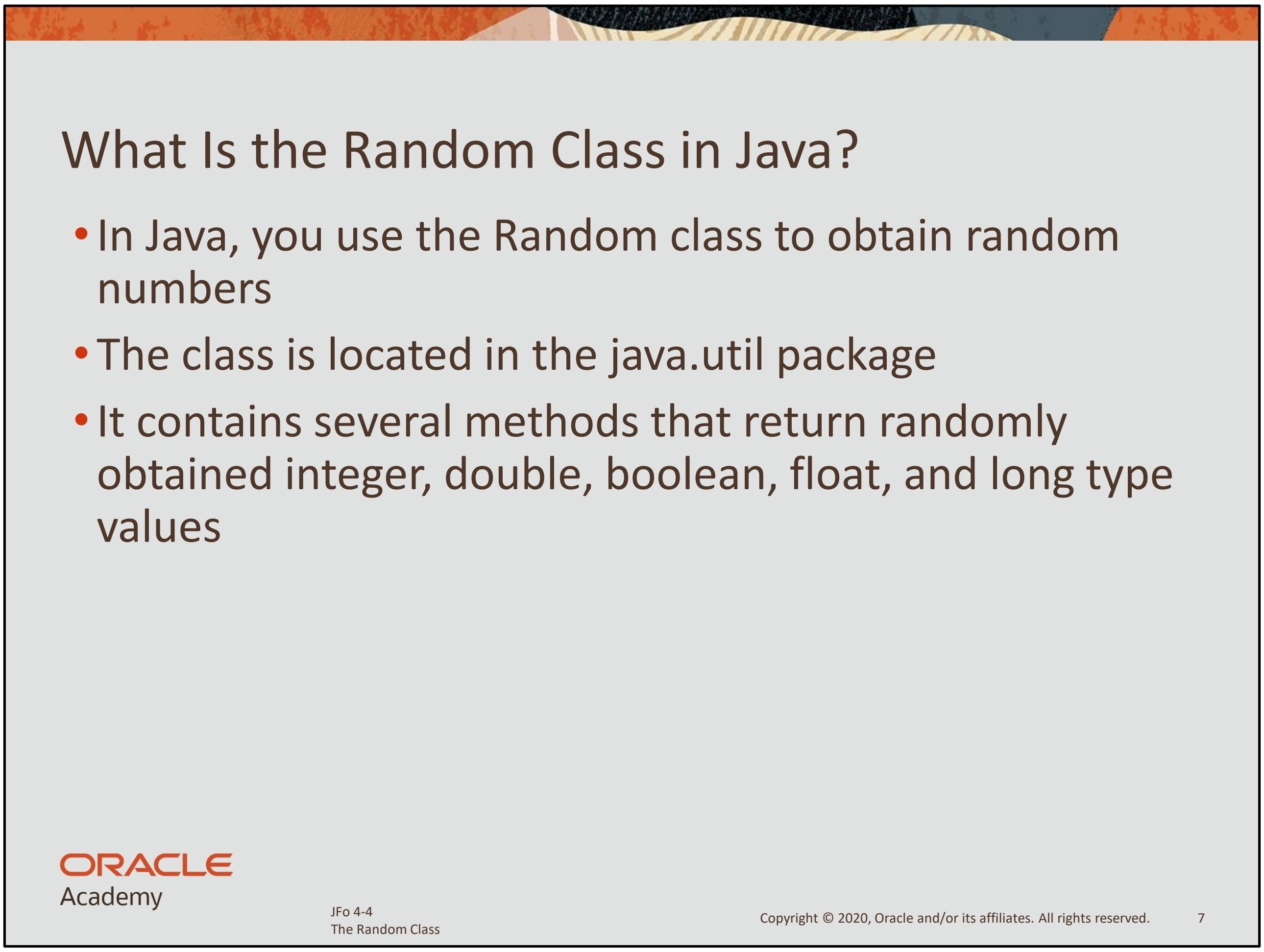

## What Is the Random Class in Java?

- In Java, you use the Random class to obtain random numbers
- The class is located in the java.util package
- It contains several methods that return randomly obtained integer, double, boolean, float, and long type values

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## How Do You Use the Random Class in a Java Program

- Import the Random class from the java.util package
- Create an instance of the Random class, like this:

```
import java.util.Random;

public class RandomIntNums {
    public static void main(String[] args) {
        Random rndNumber = new Random();
   }//end method main
}//end class RandomIntNums
```

import statement to import the Random class from the java.util package

Creates an instance of Random class, rndNumber

## Methods Provided by the Random Class

- You can obtain random values by invoking the following methods provided in the Random class:

| Method | Produces |
|---|---|
| `boolean` nextBoolean(); | A true or false value |
| `int` nextInt() | An integral value between Integer.MIN_VALUE and Integer.MAX_VALUE |
| `long` nextLong() | A long integral value between Long.MIN_VALUE and Long.MAX_VALUE |
| `float` nextFloat() | A decimal number between 0.0 (included) and 1.0 (excluded) |
| `double` nextDouble() | A decimal number between 0.0 (included) and 1.0 (excluded) |

## How Do You Obtain a Random Number?

- You can obtain a random number of integer type by using the nextInt method
- For example:

```
import java.util.Random;
public class RandomNum {
    public static void main(String[] args) {
        Random rndNum = new Random();
        int randomNum = rndNum.nextInt();
        System.out.println("Random Number: " + randomNum);
   }//end method main
}//end class RandomNum
```

- Output:

```
Random Number: 1660093261
```

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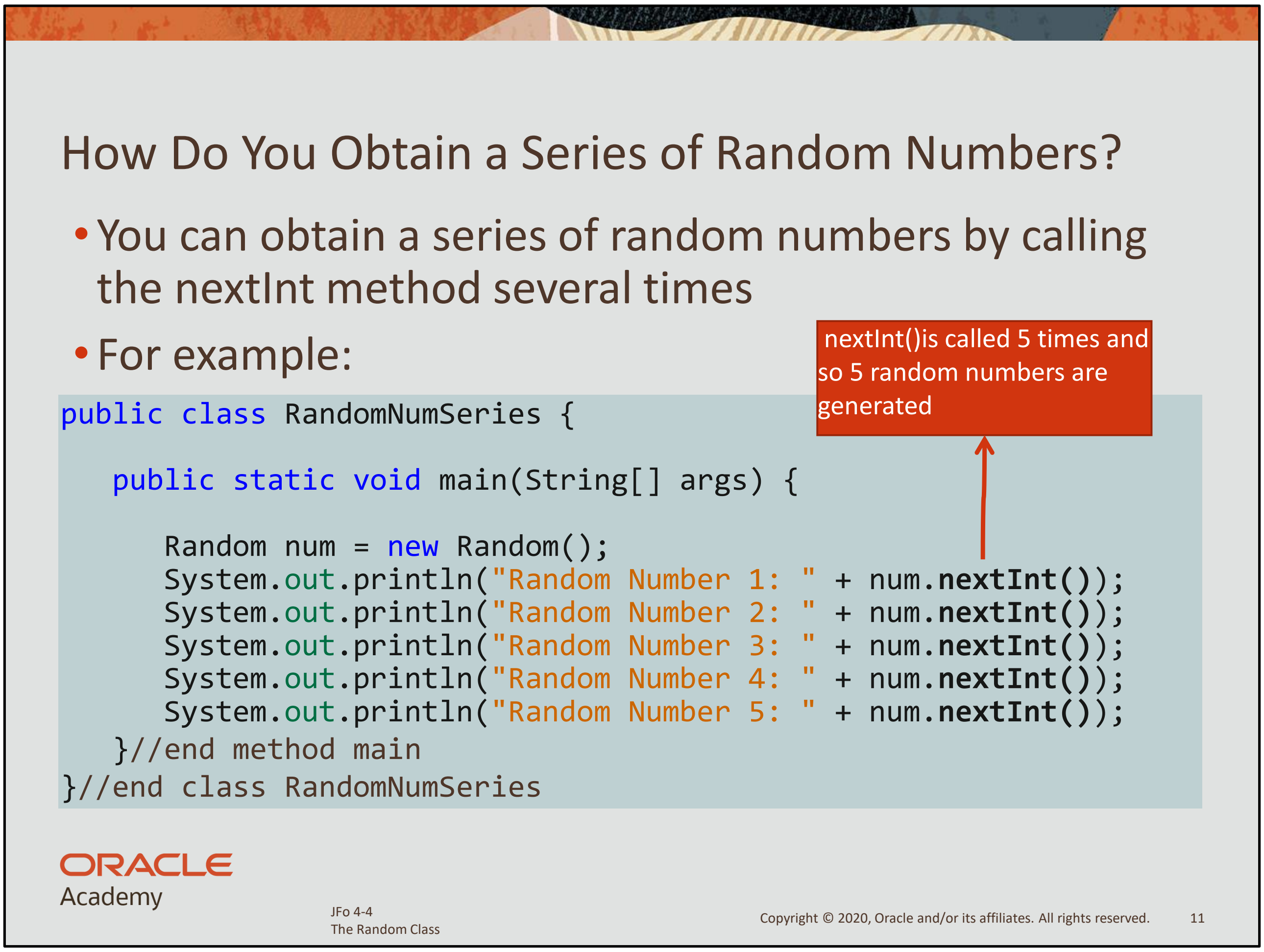

## How Do You Obtain a Series of Random Numbers?

- You can obtain a series of random numbers by calling the nextInt method several times
- For example:

nextInt()is called 5 times and so 5 random numbers are generated

```java
public class RandomNumSeries {

   public static void main(String[] args) {

      Random num = new Random();
      System.out.println("Random Number 1: " + num.nextInt());
      System.out.println("Random Number 2: " + num.nextInt());
      System.out.println("Random Number 3: " + num.nextInt());
      System.out.println("Random Number 4: " + num.nextInt());
      System.out.println("Random Number 5: " + num.nextInt());
   }//end method main
}//end class RandomNumSeries
```

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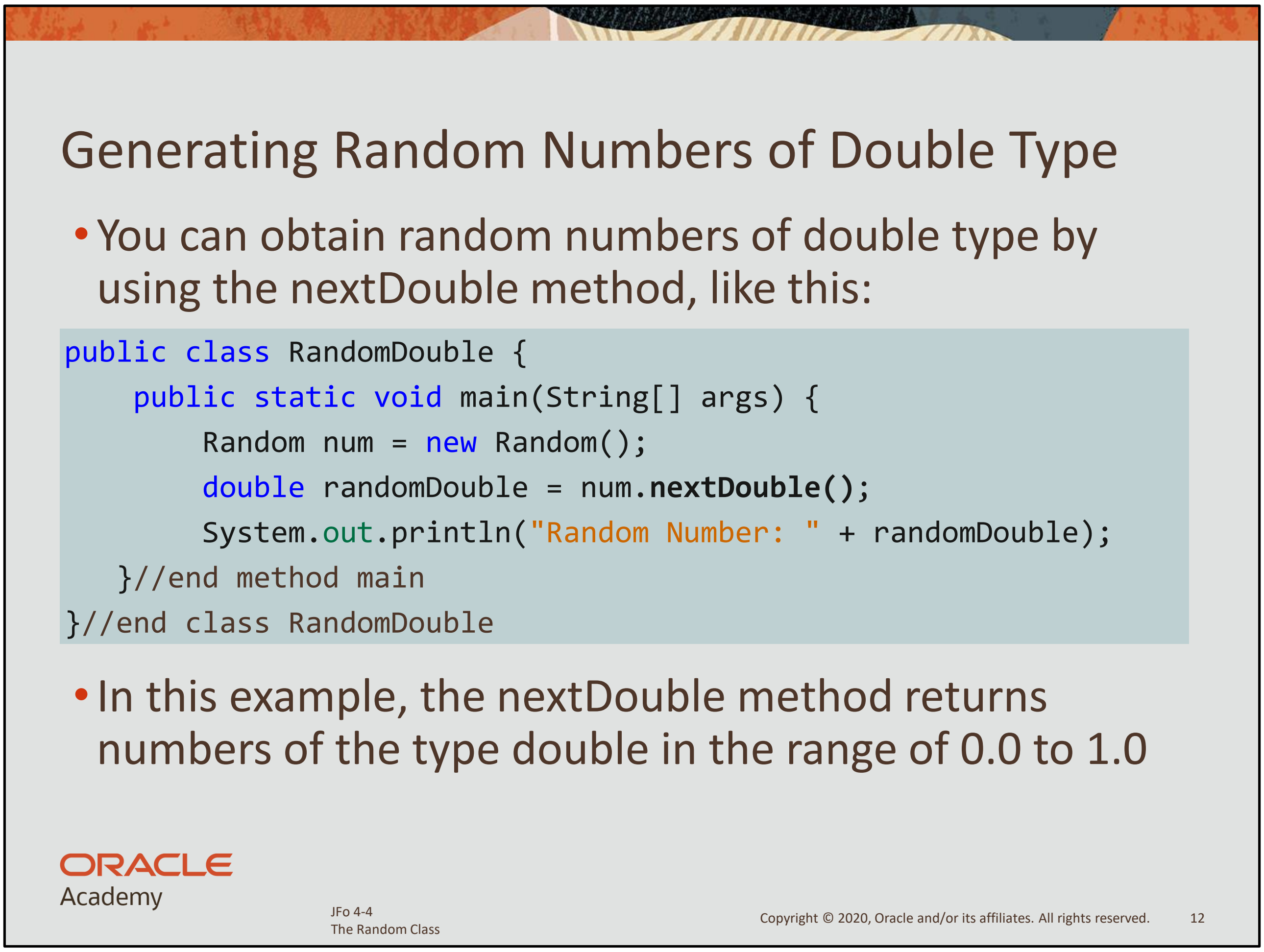
Output:
```
Random Number 1: 1882639820
Random Number 2: -1976069676
Random Number 3: 1981623857
Random Number 4: 583773510
Random Number 5: 1679041043
```

Note: You can write this example with a looping statement like for or while. Those statements are covered later in the course.



## Generating Random Numbers of Double Type

- You can obtain random numbers of double type by using the nextDouble method, like this:

```java
public class RandomDouble {
    public static void main(String[] args) {
        Random num = new Random();
        double randomDouble = num.nextDouble();
        System.out.println("Random Number: " + randomDouble);
   }//end method main
}//end class RandomDouble
```

- In this example, the nextDouble method returns numbers of the type double in the range of 0.0 to 1.0

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Output:
Random Number: 0.4031547854609302

## Exercise 1

- Import and open the RandomEx project
- Examine FlipCoin.java:
  - Execute the following program and observe the random number that chance generated
  - If chance < 0.5, record the result as “heads”; else record the result as “tails”
  - Repeat this many times

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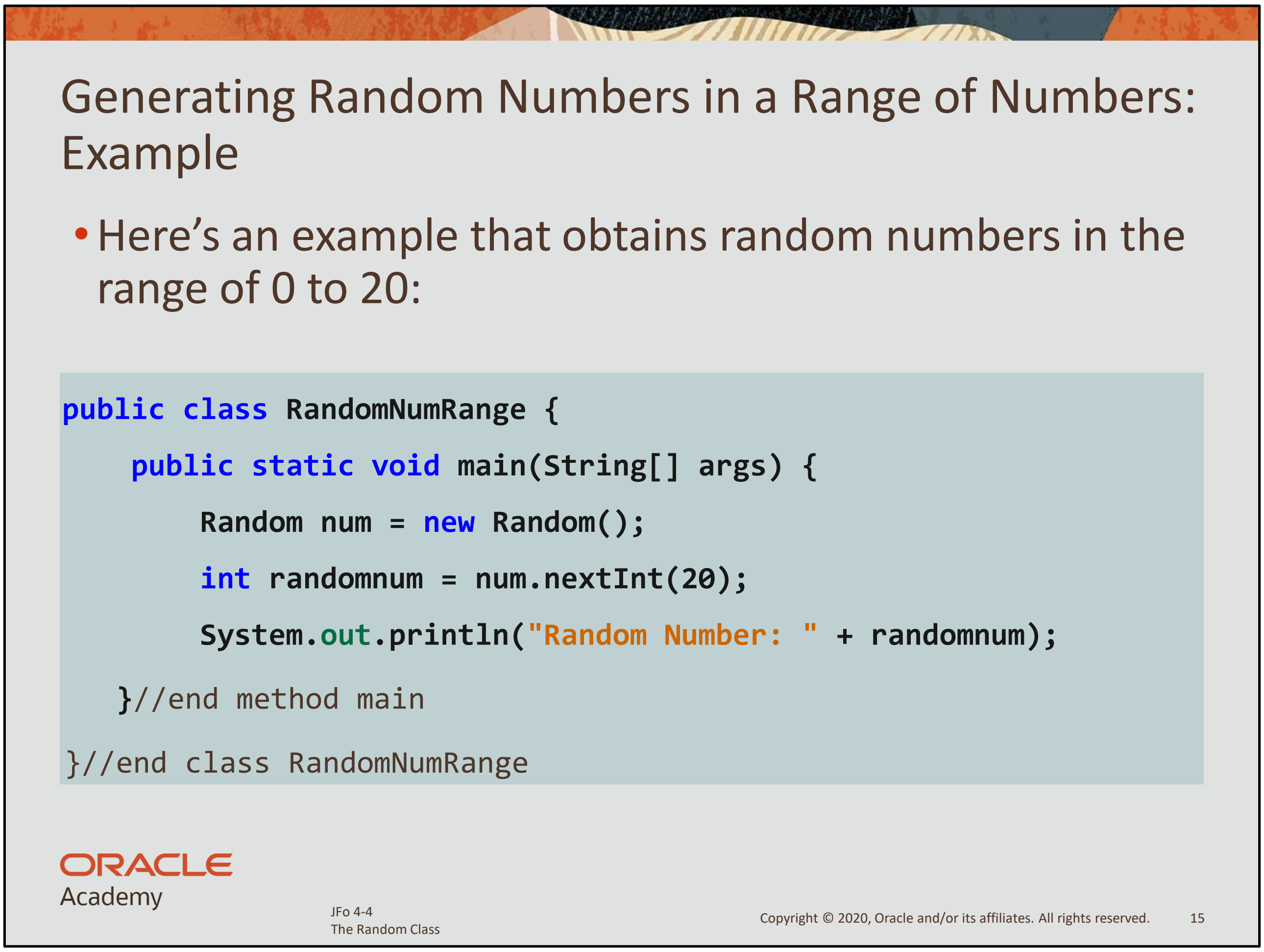
## Generating Random Numbers in a Range of Numbers

- So far, you have generated a random number within the range of an integer data type
- Sometimes, you may want to restrict the range of numbers that can be generated
- To implement this, you can use another version of the nextInt method:
  - nextInt(int maxValue);
    - The argument determines the highest integer that can be obtained by the nextInt() method
    - You can obtain random positive numbers from 0 (included) to a maximum (excluded) of your choice



## Generating Random Numbers in a Range of Numbers: Example

- Here's an example that obtains random numbers in the range of 0 to 20:

```
public class RandomNumRange {
    public static void main(String[] args) {
        Random num = new Random();
        int randomnum = num.nextInt(20);
        System.out.println("Random Number: " + randomnum);
   }//end method main
}//end class RandomNumRange
```

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In this example, the nextInt method returns an integer type value between 0 (inclusive) and 20 (exclusive). The randomly obtained returned number is then printed on the console screen.

Output after first execution:
Random Number: 13

Output after second execution:
Random Number: 19

## Generating a Range Starting from 1

- To specify a range that starts with 1, add 1 to the result of the nextInt()method
- For example, to pick a number between 1 and 40 inclusively, add 1 to the result:

```
Random rand = new Random();
int randomnum = rand.nextInt(40) + 1;
```

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## Generating a Range Starting from a Higher Number Than 1

- If the range starts from a higher number than 1:
  - Subtract the starting number from the upper-limit number and then add 1
  - Add the starting number to the result of the nextInt() method
- For example, to pick a number from 5 to 35, inclusively:
  - The upper limit number will be 35-5+1=31 and 5 needs to be added to the result:

```java
Random rand = new Random();
int randomnum = rand.nextInt(31) + 5;
```

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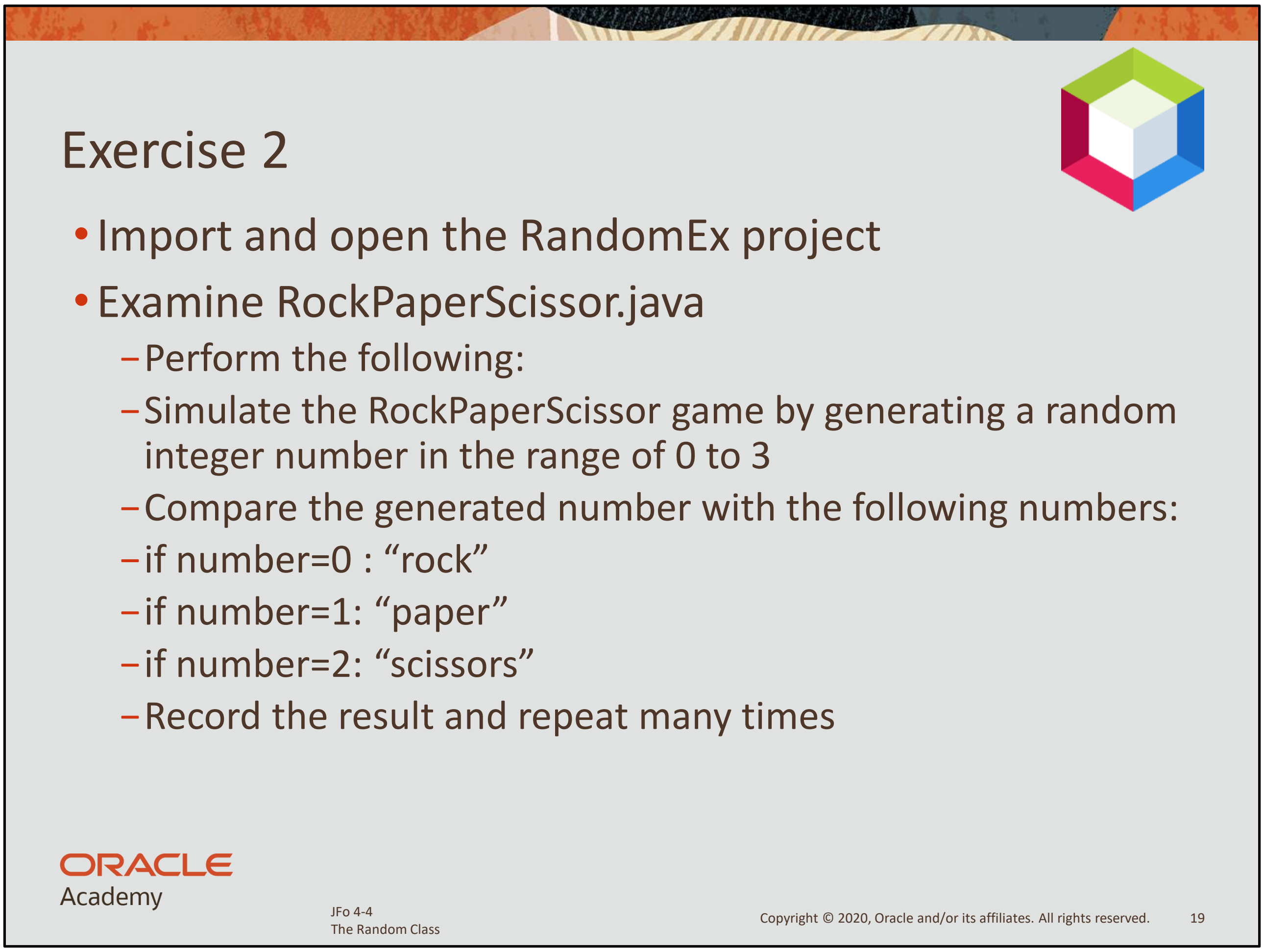
## Program for Lottery Application

```
public class Lottery {

   public static void main(String[] args) {

      Scanner numberScanner = new Scanner(System.in);
      System.out.print("Enter a number between 1 and 10: ");
      int userNum = numberScanner.nextInt();
      Random rnd = new Random();
      int winningNum = rnd.nextInt(10) + 1;
      System.out.println("Your Number: " + userNumber);
      System.out.println("The winning number is: " + winningNum);
   }//end method main

}//end class RandomNumRange
```

The example is a lottery program that lets the user input a series of integers and compares that number to a winning value. A random number is obtained in the range between 1 to 10 and is compared with the number entered by the user.
Output:

```
Give me a number between 1 and 10: 9
Your Number: 9
The winning number is: 1
```



## Exercise 2

- Import and open the RandomEx project
- Examine RockPaperScissor.java
  - Perform the following:
  - Simulate the RockPaperScissor game by generating a random integer number in the range of 0 to 3
  - Compare the generated number with the following numbers:
  - if number=0 : “rock”
  - if number=1: “paper”
  - if number=2: “scissors”
  - Record the result and repeat many times

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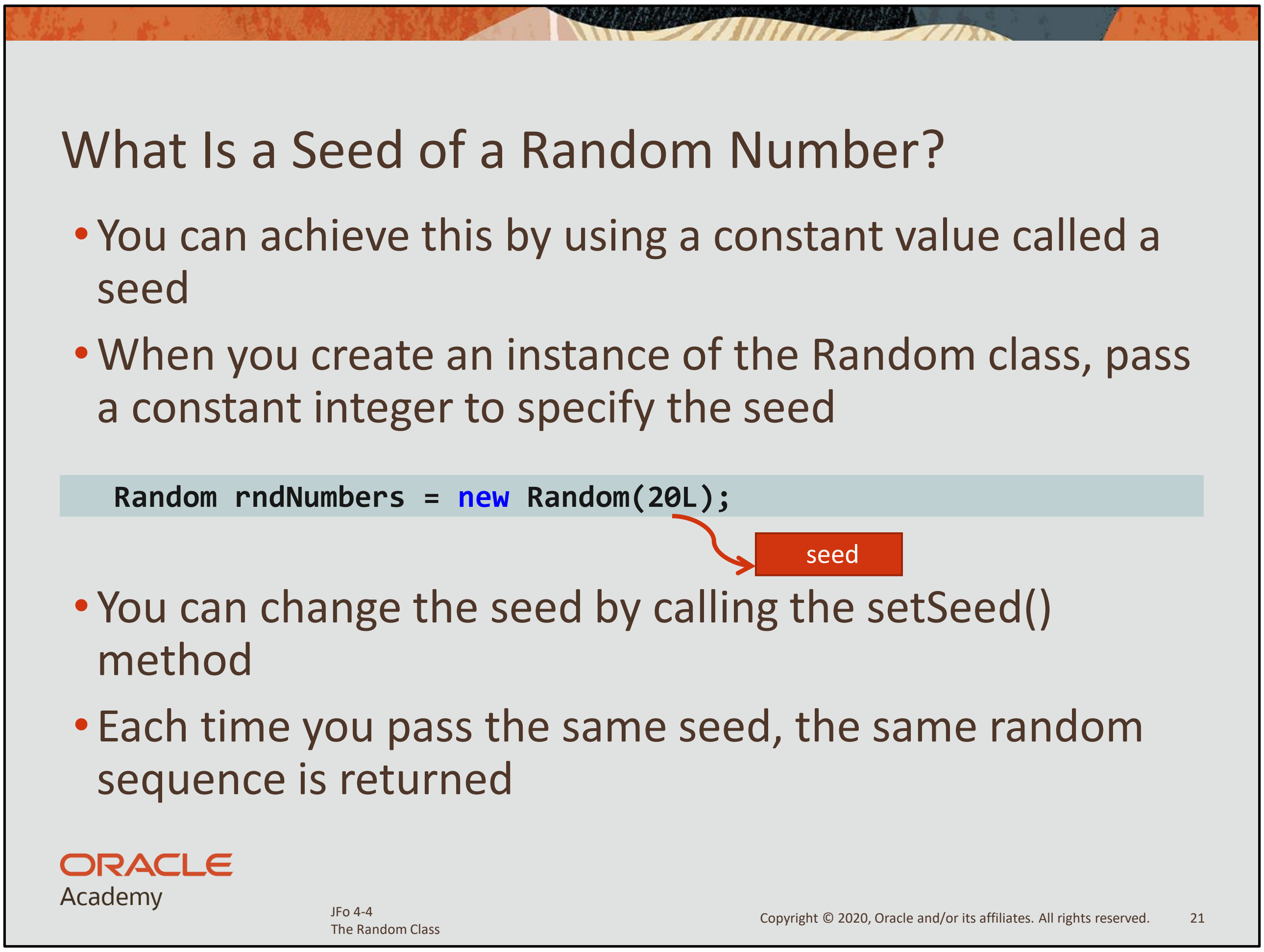
## Is the Same Random Number Generated Every Time?

- When you executed the previous examples multiple times, notice that the random number sequence is different each time
- Sometimes you may need to generate the same random number sequence every time



## What Is a Seed of a Random Number?

- You can achieve this by using a constant value called a seed
- When you create an instance of the Random class, pass a constant integer to specify the seed

```
 Random rndNumbers = new Random(20L);
```

seed

- You can change the seed by calling the setSeed() method
- Each time you pass the same seed, the same random sequence is returned

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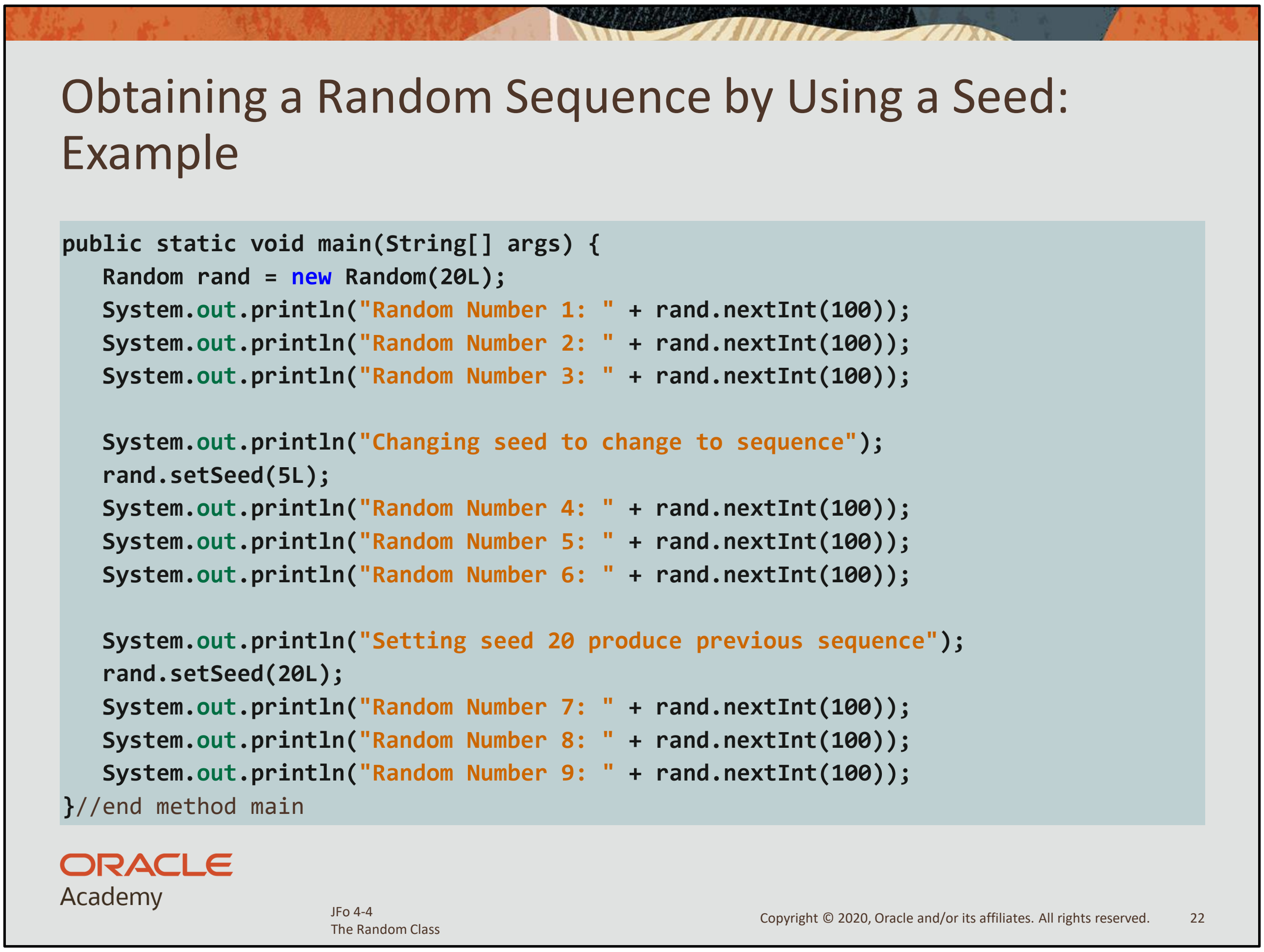
Note: Seed is a long number, represented as L



## Obtaining a Random Sequence by Using a Seed: Example

```java
public static void main(String[] args) {
   Random rand = new Random(20L);
   System.out.println("Random Number 1: " + rand.nextInt(100));
   System.out.println("Random Number 2: " + rand.nextInt(100));
   System.out.println("Random Number 3: " + rand.nextInt(100));

   System.out.println("Changing seed to change to sequence");
   rand.setSeed(5L);
   System.out.println("Random Number 4: " + rand.nextInt(100));
   System.out.println("Random Number 5: " + rand.nextInt(100));
   System.out.println("Random Number 6: " + rand.nextInt(100));

   System.out.println("Setting seed 20 produce previous sequence");
   rand.setSeed(20L);
   System.out.println("Random Number 7: " + rand.nextInt(100));
   System.out.println("Random Number 8: " + rand.nextInt(100));
   System.out.println("Random Number 9: " + rand.nextInt(100));
}//end method main
```

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Output:
```
Random Number 1: 53
Random Number 2: 36
Random Number 3: 1
Changing seed to change to sequence
Random Number 4: 87
Random Number 5: 92
Random Number 6: 74
Setting seed 40 to produce the previous sequence
Random Number 7: 53
Random Number 8: 36
Random Number 9: 1
```

## Summary

- In this lesson, you should have learned how to:
  - Describe the purpose and uses of random numbers in Java programming
  - Identify methods of the Random class that obtain random numbers
  - Obtain random numbers in a range of numbers
  - Understand the purpose of the random number seed

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