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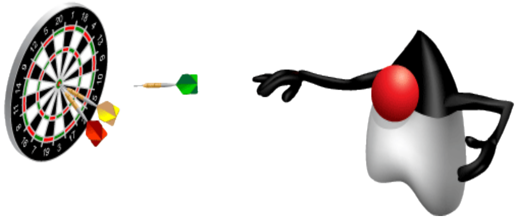
Java Foundations

4-4
The Random Class

Objectives

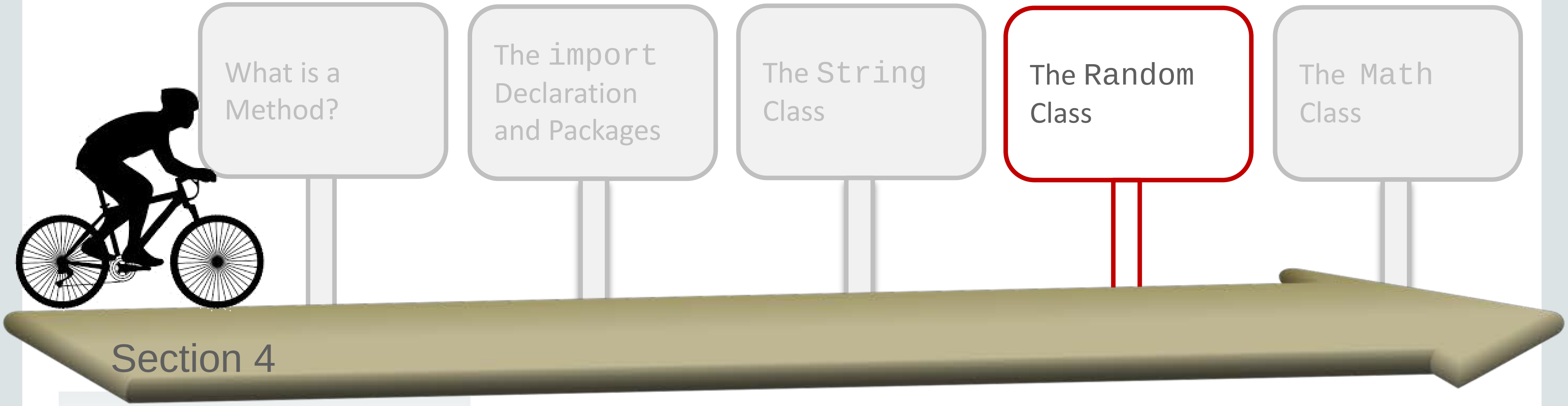
This lesson covers the following objectives:

- 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



Topics

- Purpose of Random Numbers in Java
- Using Methods from the Random Class
- Obtaining Random Numbers in a Range of Numbers
- Purpose of the Random Number Seed



What is a Method?

The `import` Declaration and Packages

The `String` Class

The `Random` Class

The `Math` Class

Section 4

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

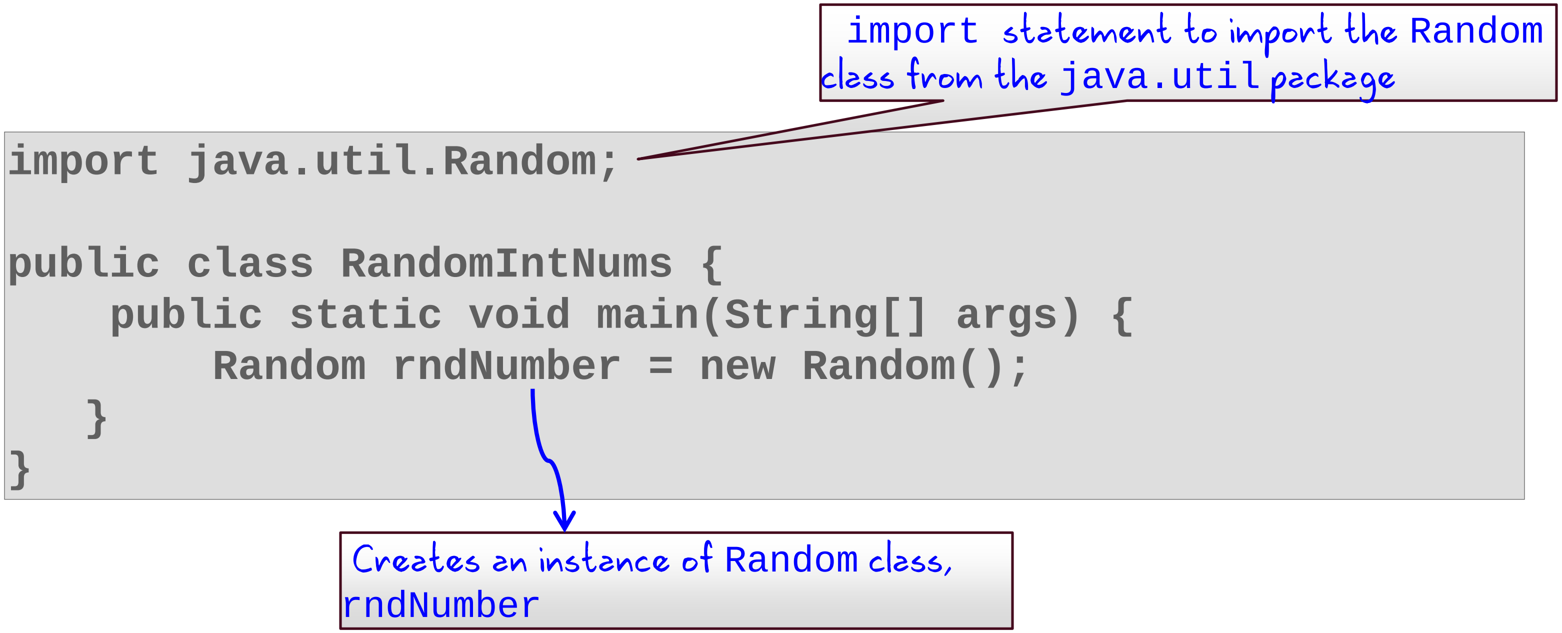
- So far in the previous lessons, you saw that Java comes with a variety of classes that support almost all basic application development features.
- For example:
  - String provides the capability for manipulating strings.
  - Scanner provides capability for obtaining input from the console.
- Another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

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.

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();
   }
}
```

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

Creates an instance of Random class, rndNumber

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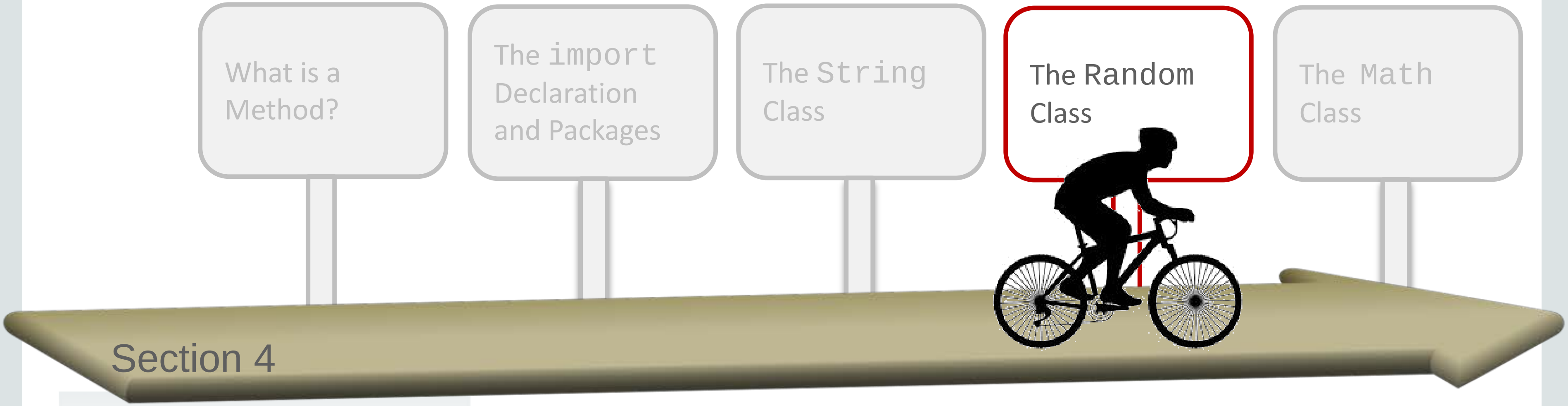

Methods Provided by the Random Class

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);
    }
}
```

- Output:

```
Random Number: 1660093261
```

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.

```
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());
   }
}
```

Generating Random Numbers of Double Type

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

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

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

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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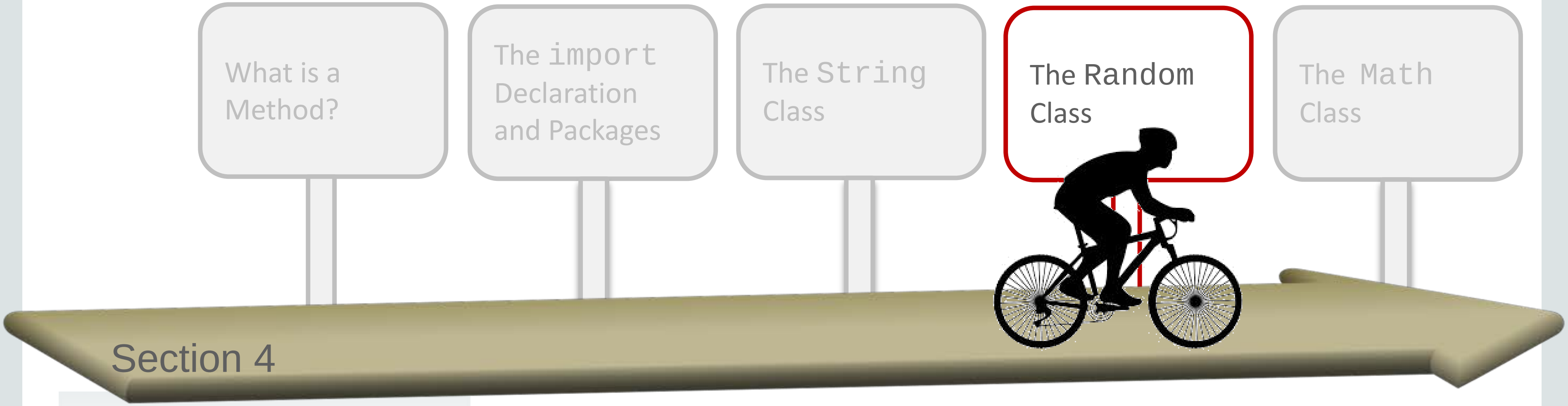

Generating Random Numbers in a Range of Numbers

- 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);

    }

}
```

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;
```

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:

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

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);
    }
}
```

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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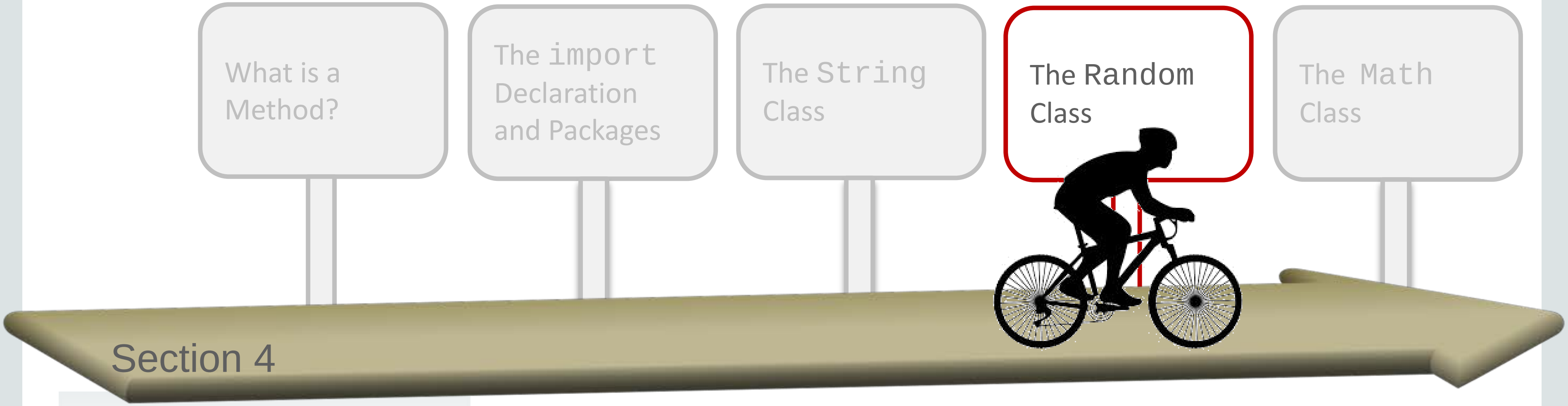

Is the Same Random Number Generated Every Time?

- 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.

Obtaining a Random Sequence by Using a Seed: Example

```
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));
}
```

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
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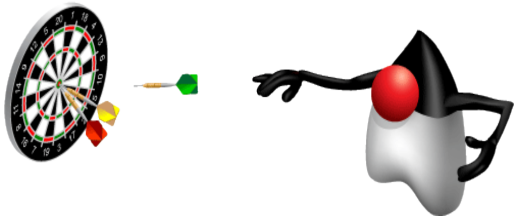
- Understand the purpose of the random number seed



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