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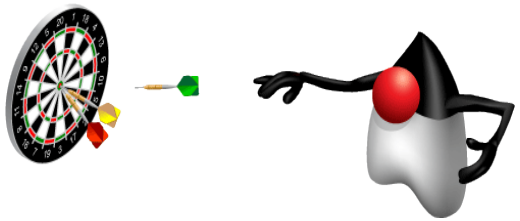
Java Foundations

4-5
The `Math` Class

Objectives

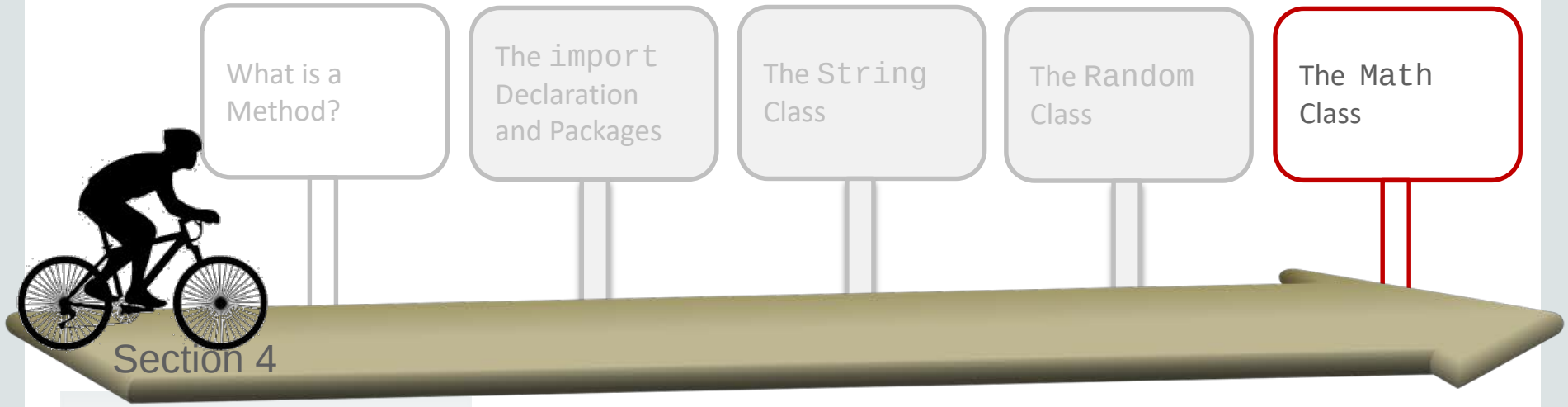
This lesson covers the following objective:

- Understand the methods of the `Math` class
- Use methods of the `Math` class to perform mathematical calculations
- Use fields of the `Math` Class



Topics

- Getting Started with `Math` Class
- Using methods of `Math` Class
- Using fields of `Math` Class



Performing Mathematical Calculations

- While developing programs, you may need more advanced mathematical calculations than what the basic Java math operators provide.
- For example:
  - Finding the maximum or minimum of two values
  - Rounding values
  - Logarithmic functions
  - Square root
  - Trigonometric functions
- The Java `Math` class contains methods for performing mathematical calculations.

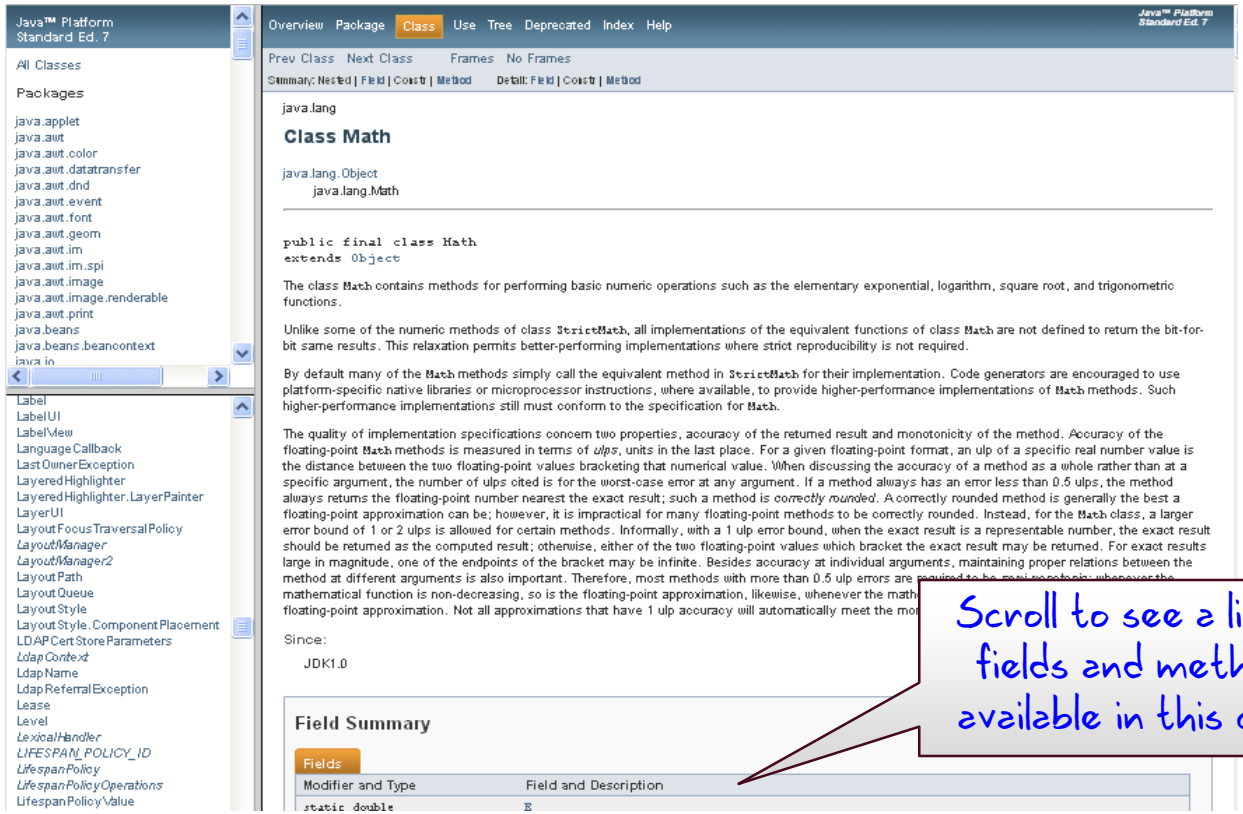
The `Math` Class

- Is one of the many classes included in the Java class libraries.
- Contains methods that perform various mathematical functions.
- Is part of the `java.lang` package.

Documentation for the Math Class

You can access the documentation from here:

http://docs.oracle.com/javase/8/docs/api/index.html



Exercise 1

- Examine the `Math` class documentation:
  - Standard Edition for Java SE 8: http://docs.oracle.com/javase/8/docs/api/
  - See if you can find a value for PI and a method for computing the square root of a number.

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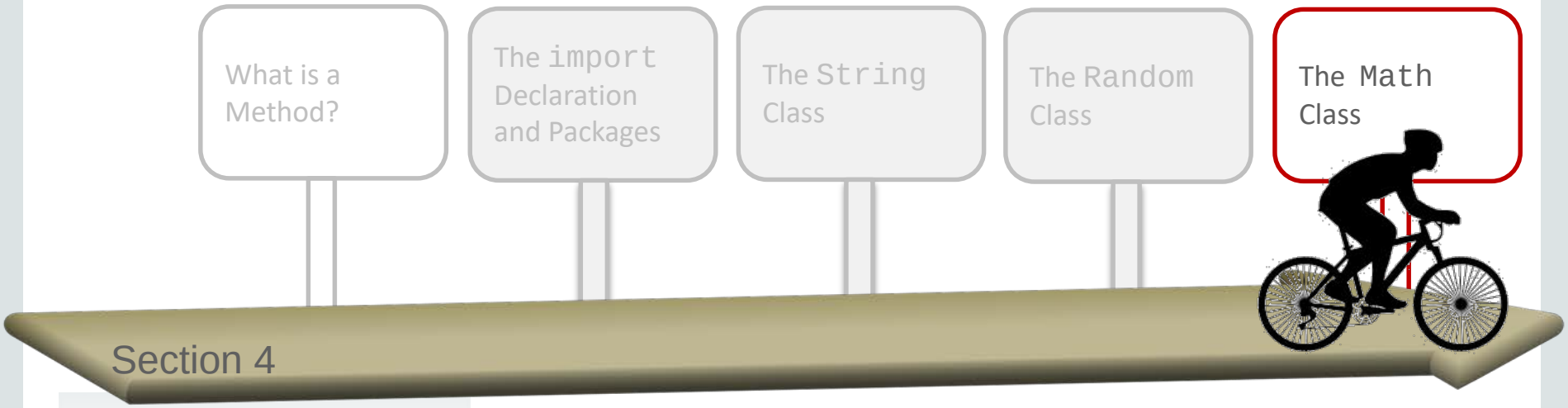

Some of the Methods Available in `Math` Class

Method Name	Description
`abs(`*`value`*`)`	absolute value
`ceil(`*`value`*`)`	rounds up
`cos(`*`value`*`)`	cosine, in radians
`floor(`*`value`*`)`	rounds down
`log(`*`value`*`)`	logarithm base *e*
`log10(`*`value`*`)`	logarithm base 10
`max(`*`value1, value2`*`)`	larger of two values
`min(`*`value1, value2`*`)`	smaller of two values
`pow(`*`base, exponent`*`)`	*base* to the *exponent* power
`random()`	random double between 0 and 1
`round(`*`value`*`)`	nearest whole number
`sin(`*`value`*`)`	sine, in radians
`sqrt(`*`value`*`)`	square root

What's Different About the Math Class?

- The methods of the Math class are static methods.
- Static methods can be invoked through the class name.
- That means you don't have to create an object of the Math class to call the methods.
- For example, to invoke the methods of the Random class, you have to create an object of the Random class like this:

```
Random rndNum = new Random();
int randomNum = rndNum.nextInt();
```

How Do You Call the Methods of the `Math` Class?

You can call methods of the `Math` class without creating an instance of the `Math` class, like this:

- Syntax:
  - `Math.methodName(parameters)`
- Example:
  - `Math.sqrt(121.0);`

Call methods by prefacing them with `Math` dot operator.

Calling a Method and Observing Its Result

- Let's see an example of calling a method and observing its result:

```
public static void main(String[] args) {

    Math.sqrt(121.0);
}
```

- Observe the output:
  - No output is displayed.
  - Simply calling these methods produces no visible result.

How Do the Methods of the `Math` Class Work?

- The `Math` methods don't print the results to the console.
- Each method returns a numerical result.
- The returning value is more flexible than printing.
- You can store, print, or combine it with a larger expression.

Storing and Printing the Results

- To see the result, you must print it or store it in a variable. For example:
- Print the result:

```
public static void main(String[] args) {
     System.out.println("Square root: "+ Math.sqrt(121.0)); //11.0
}
```

- Store the value:

```
public static void main(String[] args) {
     double sqroot= Math.sqrt(121.0);
     System.out.println("Square root: "+sqroot); //11.0
}
```

Combining the Results

You can combine the results and use it in a larger expression, like this:

```
public static void main(String[] args) {
    double result = Math.min(3, 7) + Math.abs(-50);
    System.out.println("Result is " + result); //53
}
```

Exercise 2

- On paper, evaluate the following Java statements and record the results:
  - `Math.abs(-1.23)`
  - `Math.pow(3, 2)`
  - `Math.sqrt(121.0) - Math.sqrt(256.0)`
  - `Math.abs(Math.min(-3, -5))`

Exercise 3

- Consider an integer variable named `age`.
- Use `Math.max` and `Math.min` methods to answer the following questions:
  - What expression would replace negative ages with 0?
  - What expression would limit the maximum age to 40?

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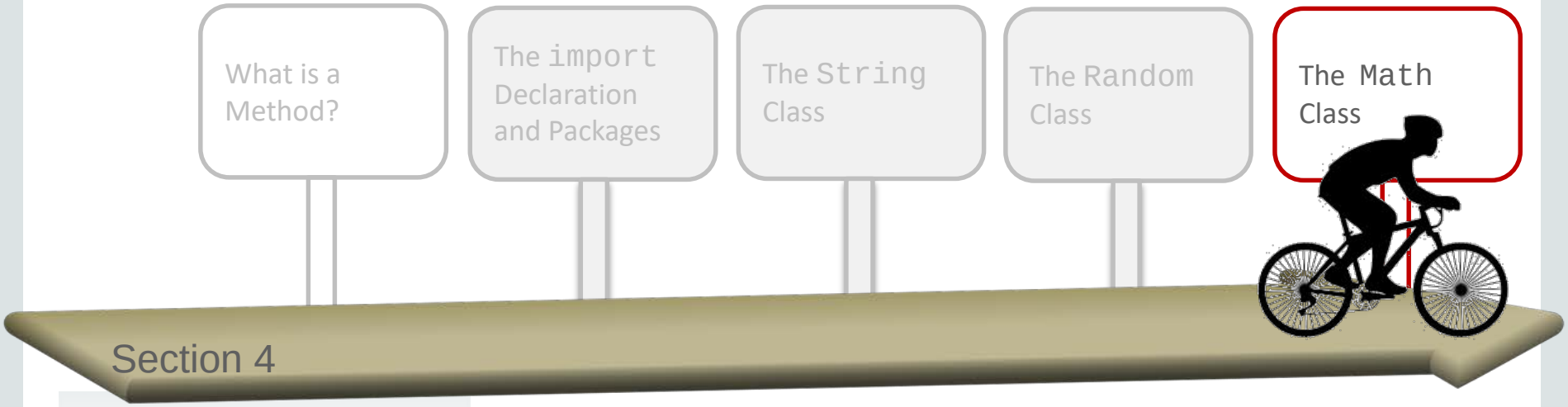
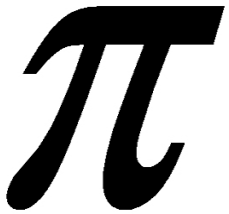


Fields in the `Math` Class

The `Math` class contains two constant fields: `PI` and `E`

Field	Description
`Math.E`	`2.7182818...`
`Math.PI`	`3.1415926...`

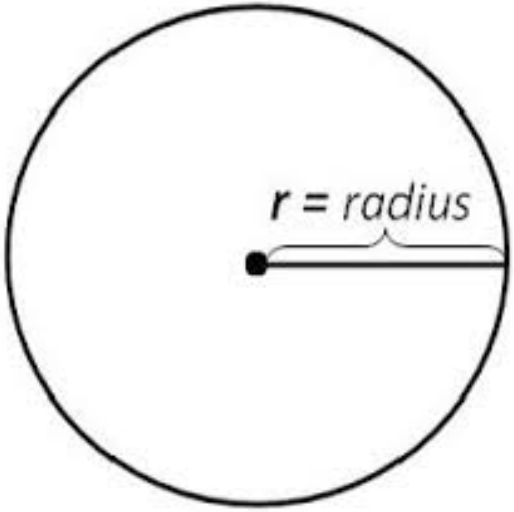
PI Field



- The `Math` class contains a constant, PI.
- It contains a double value: 3.141592653589793238 46.
- Remember, `Math` class methods are static methods and are accessed by using the `Math` class name.
- Similarly, `PI` is a static variable in the `Math` class, and it is accessed by using the `Math` class name.
- To use `PI` in a program, specify the class name (`Math`) and `PI`, separated by the dot operator:
  - `Math.PI`

Calculating the Area of a Circle

- Suppose that you have to write a Java program to compute the area of a circle.
- Here's the formula to compute the area of a circle:
  - Area = PI* radius* radius
  - Where PI is a constant (approximately 3.1416)



Computing the Area of a Circle

Using the `Math.PI` field for calculating the area yields a more accurate result than using a constant value for pi like 3.14.

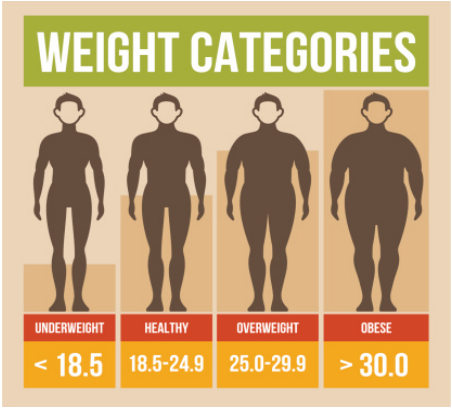
```
public class AreaOfCircle {
    public static void main(String args[]) {
        Scanner sc = new Scanner(System.in);
        System.out.print("Enter the radius: ");
        double radius = sc.nextDouble();
        double area = Math.PI * radius * radius;
        System.out.println("The area of circle is: " + area);

    }
}
```

Exercise 4

- A person's body mass index (BMI) is computed like this:

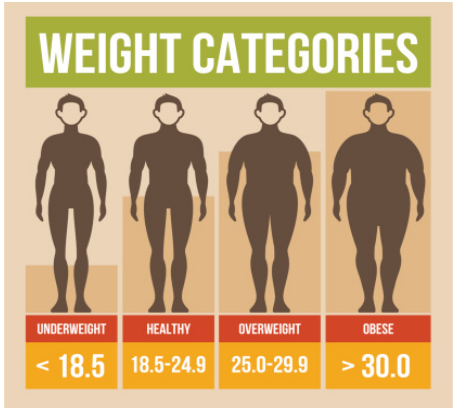
$$BMI = \frac{weight}{height^2} \times 703$$

- Import and open the `MathEx` project.
- Examine `ComputeBMI.java`.
- Write a program that computes the BMI and rounds off the BMI.



Exercise 4

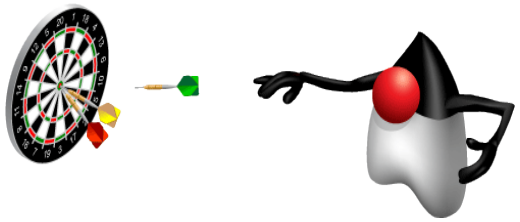
- Use the methods of the `Math` class and display the output as:
  - Enter the weight in pounds: 132.5
  - Enter the height in inches: 62.5
  - Your Body Mass Index is 24



Summary

In this lesson, you should have learned how to:

- Use methods of the `Math` class to perform mathematical calculations
- Use fields of the `Math` Class

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