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Java Foundations

4-5

The Math Class

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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

Performing Mathematical Calculations

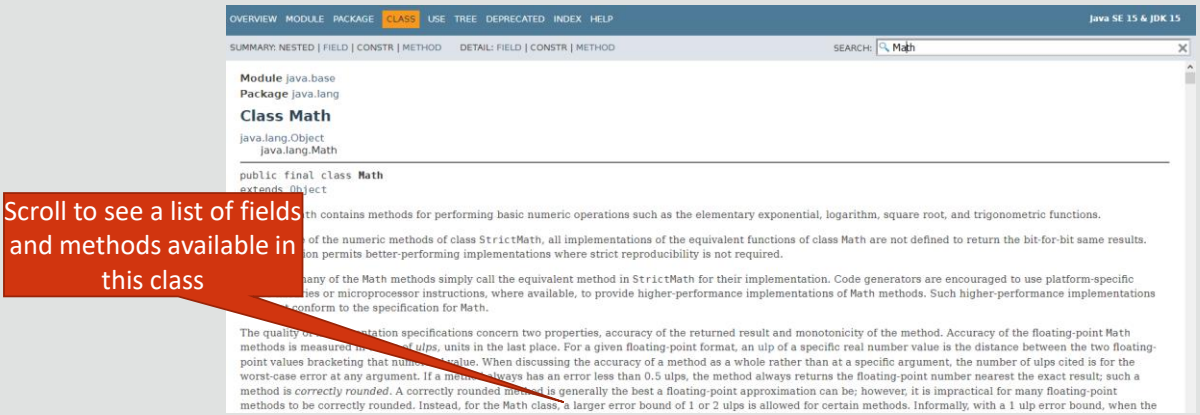
- While developing programs, you may need more advanced mathematical calculations than what the basic Java math operators provide
- For example:
  - Finding the maximum or minimum of two values
  - Rounding values
  - Logarithmic functions
  - Square root
  - Trigonometric functions
- The Java Math class 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:
  - https://docs.oracle.com/en/java/javase/17/docs/api/java.base/module-summary.html



Exercise 1

- Examine the Math class documentation
- See if you can find a value for PI and a method for computing the square root of a number

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);
}//end method main
```

- 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
}//end method main
```

  - Store the value:

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

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
}//end method main
```

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?

Answer:
What expression would replace negative ages with 0?
Math.max(age, 0)
What expression would limit the maximum age to 40?
Math.min(age, 40)

Fields in the Math Class

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

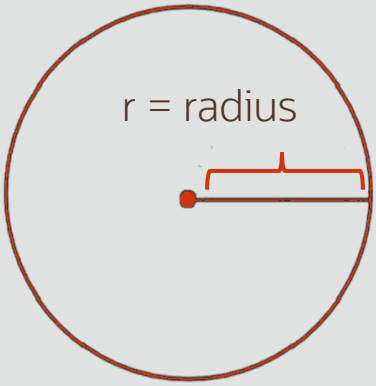
Field	Description
Math.**E**	2.7182818...
Math.**PI**	3.1415926...

PI Field

- The Math class contains a constant, PI
- It contains a double value:
  - 3.14159265358979323846
- 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);
    }//end method main
}//end class AreaOfCircle
```


Output:
Enter the radius: 7.5
The area of circle is: 176.71458676442586

Exercise 4

- A person's body mass index (BMI) is computed like this: $BMI = \frac{weight}{height^2} \times 703$
- Create a new project and add the `ComputeBMI.java` file to the project
- 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:
  - Understand the methods of the Math class
  - Use methods of the Math class to perform mathematical calculations
  - Use fields of the Math Class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