Lecture 6: Methods

MIT-AITI Kenya 2005

In this lecture, you will learn…

- What a method is
- Why we use methods
- How to declare a method
- The four parts of a method
- How to invoke a method
- The purpose of the main method
- And see some example methods

The Concept of a Method

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- Methods are a way of capturing a sequence of computational steps into a reusable unit.
- Can you think of places where you might want to use methods?

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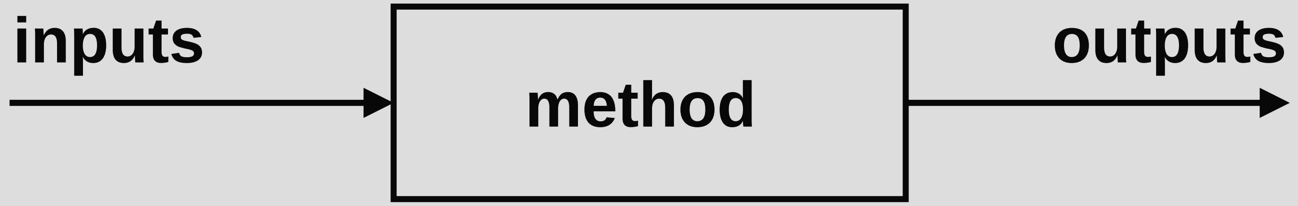
- Can you think of places where you might want to use methods?
  - evaluate the quadratic formula, print to the screen

The Concept of a Method (con't)

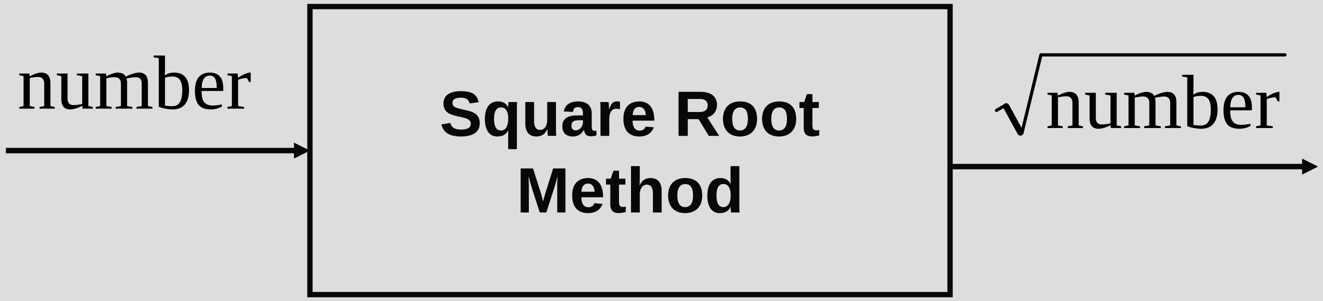
- Methods can accept inputs in the form of *arguments*
- They can then perform some operations with the arguments
- And can *return* a value that is the result of the computations, which is also known as the output



Square Root Method

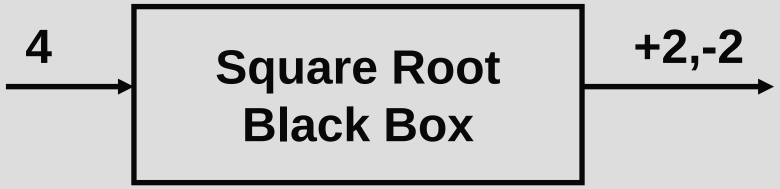
- Square root is a good example of a method.

- The square root method accepts a single number as an argument and returns the square root of that number.



Square Root Method (con’t)

- The computation of square roots involves many intermediate steps between input and output.
- When we use square root, we don’t care about these steps. All we need is to get the correct output.
- Hiding the internal workings of a method from a user but providing the correct answer is known as *abstraction*



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  - later be reused
- What is the name given to hiding the internal workings of a method?
  - Abstraction

Declaring Methods

- A method has 4 parts: the return type, the name, the arguments, and the body:

```
         type    name   arguments
       double sqrt(double num) {
body      // a set of operations that compute
          // the square root of a number
       }
```

- The type, name and arguments together is referred to as the *signature* of the method

The Return Type of a Method

- The return type of a method may be any data type.
- The type of a method designates the data type of the output it produces.
- Methods can also return nothing in which case they are declared void.

Return Statements

- The return statement is used in a method to output the result of the methods computation.
- It has the form:
  - `return expression_value;`
- The type of the expression_value must be the same as the type of the method:

```
double sqrt(double num) {
    double answer;
    // Compute the square root of num
    // and store in answer
    return answer;
}
```

Return Statements (con't)

- A method exits immediately after it executes the return statement
- Therefore, the return statement is usually the last statement in a method
- A method may have multiple return statements. Can you think of an example of such a case?

Multiple Returns

- An example using multiple returns:

```
int absoluteValue (int num){
   if (num < 0)
       return -num;
   else
       return num;
}
```

void **Methods**

- A method of type **`void`** has a return statement without any specified value. i.e. **`return;`**
- This may seem useless, but in practice void is used often.
- A good example is when a methods only purpose is to print to the screen.
- If no return statement is used in a method of type void, it automatically returns at the end

Method Arguments

- Methods can take input in the form of arguments.
- Arguments are used as variables inside the method body.
- Like variables, arguments must have their type specified.
- Arguments are specified inside the paren-theses that follow the name of the method.

Example Method

- Here is an example of a method that divides two doubles:

```
double divide(double a, double b) {
     double answer;
     answer = a / b;
     return answer;
}
```

Method Arguments

- Multiple method arguments are separated by commas:

```
double pow(double x, double y)
```

- Arguments may be of different types

```
int indexOf(String str, int fromIndex)
```

The Method Body

- The body of a method is a block specified by curly brackets i.e { }. The body defines the actions of the method.
- The method arguments can be used anywhere inside of the body.
- All methods must have curly brackets to specify the body even if the body contains only one statement or no statements.

Invoking Methods

- To call a method, specify the name of the method followed by a list of comma separated arguments in parentheses:

```
    pow(2, 10); //Computes 2^10
```

- If the method has no arguments, you still need to follow the method name with empty parentheses:

```
    size();
```

Static Methods

- Some methods have the keyword **`static`** before the return type:

```
static double divide(double a, double b) {
    return a / b;
}
```

- We'll learn what it means for a method to be static in a later lecture

- For now, all the methods we write in lab will be static.

main – **A Special Method**

- The only method that we have used in lab up until this point is the **`main`** method.
- The main method is where a Java program always starts when you run a class file
- The **`main`** method is static and has a strict signature which must be followed:

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

main **Method (con't)**

```
class SayHi {
   public static void main(String[] args) {
     System.out.println("Hi, " + args[0]);
  }
}
```

- If you were to type `java Program arg1 arg2 … argN` on the command line, anything after the name of the class file is automatically entered into the `args` array:

```
java SayHi Sonia
```

- In this example `args[0]` will contain the String "Sonia", and the output of the program will be "Hi, Sonia".

Methods Pop Quiz 2

- What are the four parts of a method and what are their functions?

Methods Pop Quiz 2

- What are the four parts of a method and what are their functions?
  - Return type – data type returned by the method
  - Name – name of the method
  - Arguments – inputs to the method
  - Body – sequence of instructions executed by the method

Methods Pop Quiz 2 (con’t)

- What is used to separate multiple arguments to a method?

Methods Pop Quiz 2 (con't)

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- How do you invoke a method?

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- What is used to outline the body of a method?

  Curly brackets { }

- How do you invoke a method?

  Specify the name of the method followed by a list of comma-separated arguments in parentheses, i.e. method_name(arg1, arg2, …, argn)

What is wrong with the following ?

```
static double addSometimes(num1, num2){
   double sum;
   if (num1 < num2){
     sum = num1 + num2;
     String completed = “completed”;
     return completed;
   }
}
```

What is wrong with the following ?

```
static double addSometimes(num1, num2){
    double sum;
    if (num1 < num2){
      sum = num1 + num2;
      String completed = “completed”;
      return completed;
    }
}
```

- Types for the arguments num1 and num2 are not specified
- String completed does not match the correct double return type
- Method addSometimes does not always return an answer. This will cause an error in Java because we specified that addSometimes would always return a double.

Example main method

```
class Greetings {
    public static void main(String args[]) {
        String greeting = "";
        for (int i=0; i < args.length; i++) {
            greeting += "Jambo " + args[i] + "! ";
        }
        System.out.println(greeting);
    }
}
```

- After compiling, if you type
  `java Greetings Alice Bob Charlie`
  prints out "Jambo Alice! Jambo Bob! Jambo Charlie!"

Another Example

```
class Max {
    public static void main(String args[]) {
        if (args.length == 0) return;

        int max = Integer.parseInt(args[0]);
        for (int i=1; i < args.length; i++) {
            if (Integer.parseInt(args[i]) > max) {
                max = Integer.parseInt(args[i]);
    }
       }
       System.out.println(max);
    }
}
```

- After compiling, if you type `java Max 3 2 9 2 4` the program will print out 9

Important Points Covered ….

- Methods capture a piece of computation we wish to perform repeatedly into a single abstraction
- Methods in Java have 4 parts: return type, name, arguments, body.
- The return type and arguments may be either primitive data types (i.e. int) or complex data types (i.e. Objects), which we will cover next lecture
- **main** is a special Java method which the java interpreter looks for when you try to run a class file
- **main** has a strict signature that must be followed:

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