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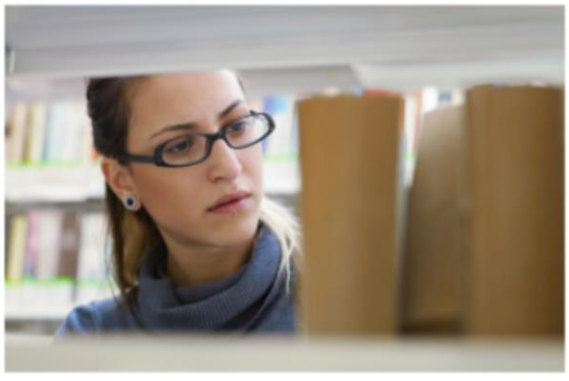
Java Foundations

4-1
What Is a Method?



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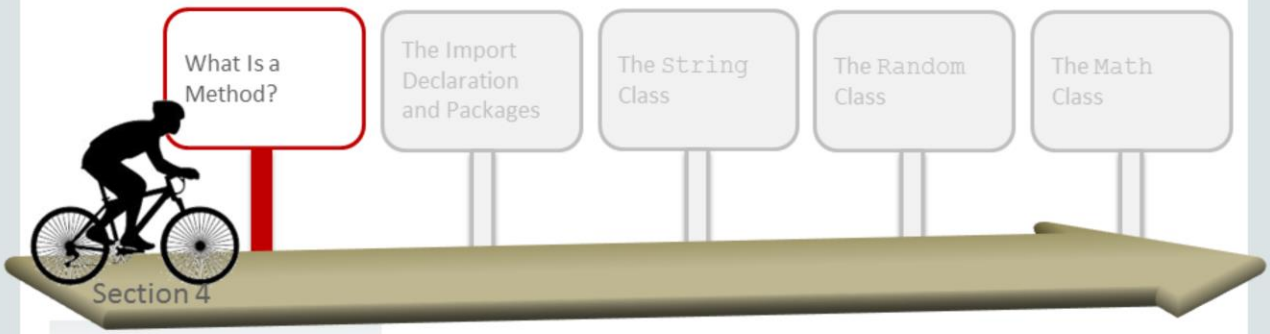
Objectives

This lesson covers the following objectives:

- Structure code within a class
- Instantiate an object
- Understand the benefits of methods
- Use the dot operator (.) to access an object's fields and methods
- Supply arguments to a method
- Return values from a method

Topics

- How to Structure a Class
- Passing Values to Methods
- Returning Values from Methods



Classes You'll Encounter

In Java development, you'll encounter many classes for many different object types, including …

- Classes you'll write yourself
- Classes written by someone else
- Classes belonging to Java

Classes You'll Encounter

- These classes outline objects' …
  - Properties (fields)
  - Behaviors (methods)
- The goal of this lesson is to give you an understanding of how to work with any class, its fields, and its methods.
- The remaining lessons of this section explore important classes provided by Java.
- We'll start by exploring classes and methods a little deeper.

Exercise 1, Part 1

Let's look at a scenario and see how we can model the components involved:

> It's Alex's birthday! You've arranged a group of eight friends to celebrate at a local restaurant. When your party receives their bill, nobody is quite sure what they owe. You only know everyone's total before tax (5%) and tip (15%). But lucky you! You brought your laptop and are asked to write a program that calculates everybody's total.

Your friends know you're taking the Java Foundations course, so you're the perfect person to figure this out!

Exercise 1, Part 2

- Import and edit the `Tip01` project.
- This is what everyone owes before tax (5%) and tip (15%):

Person 1: $10	Person 5: $7
Person 2: $12	Person 6: $15 (Alex)
Person 3: $9	Person 7: $11
Person 4: $8	Person 8: $30

Exercise 1, Part 3

Your program should produce the following output:

```
person1: $12.0
person2: $14.4
person3: $10.8
person4: $9.6
person5: $8.4
person6: $18.0
person7: $13.2
person8: $36.0
```

Modeling Objects

You may have been tempted to model each person's total by writing this:

```
public class Tip01{
   public static void main(String args[]){

        double person1 = 10;
        double total1  = person1*(1 +.05 +.15);
        System.out.println(total1);
   }
}
```

Modeling More Objects

When you needed to model two dinner guests, you may have been tempted to copy, paste, and rename:

```
public class Tip01{
   public static void main(String args[]){

        double person1 = 10;
        double total1  = person1*(1 +.05 +.15);
        System.out.println(total1);

        double person2 = 12;
        double total2  = person2*(1 +.05 +.15);
        System.out.println(total2);
   }
}
```

Modeling Many Objects

- What if you needed to figure 1,000 guests?

```
//You might think …
//Do I really have to copy, paste, and rename 1,000
//times?
```

- What if one of your friends forgets their wallet? What if you made a mistake with your formula?

```
//You might think …
//Do I need to make 1,000 edits?!
//There has to be a better way!!!
```

You might never have 1,000 dinner guests in real life. But there are other scenarios where 1,000 objects make sense, like a bank with 1,000 savings accounts.

Variables Offer Flexibility

If the tax rate or tip percentage needs to change …

- We don't need to make 1,000 edits.
- We simply edit each variable once.

```
double tax = 0.05;
double tip = 0.15;

double person1 = 10;
double total1  = person1*(1 +tax +tip);
System.out.println(total1);

double person2 = 12;
double total2  = person2*(1 +tax +tip);
System.out.println(total2);
```

Methods Offer Similar Flexibility

- The same math and printing behaviors are repeated.
- Instead, this logic can be written once in a method.

```
double tax = 0.05;
double tip = 0.15;

double person1 = 10;
double total1  = person1*(1 +tax +tip);
System.out.println(total1);

double person2 = 12;
double total2  = person2*(1 +tax +tip);
System.out.println(total2);
```

When to Use Methods

It's a good idea to write a method if you …

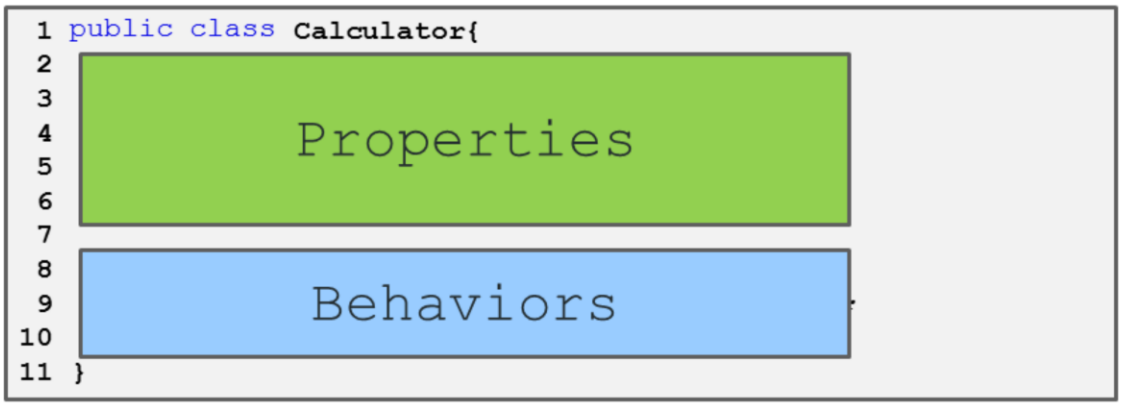
- Find yourself repeating very similar lines of code, including calculations
- Need to describe an object's behavior

How to Use a Main Method

- The main method is known as a driver.
  - Use it to drive the events of a program.
  - Use it to access fields and methods or other classes.
- The main method doesn't describe the behavior of any particular object.
  - Keep it separate from your object classes.
  - Use only one main method for each application.

What Do Object Classes Look Like?

- Code should fit the following format.
- Let's see how we can get our code to look like this:



Step 1) Move Fields from the Main Method

```
public class Calculator{
        //Fields
        public double tax = 0.05;
        public double tip = 0.15;
        public double originalPrice = 10;




        public static void main(String args[]){
                //double tax = 0.05;
                //double tip = 0.15;

                //double person1 = 10;
                double total1 = person1*(1 +tax +tip);
                System.out.println(total1);
        }
}
```

Step 2) Move Repeated Behaviors from the Main Method

```
public class Calculator{
        //Fields
        public double tax = 0.05;
        public double tip = 0.15;
        public double originalPrice = 10;

        //Methods
        public void findTotal(){
                //Calculate total after tax and tip
                //Print this value
        }

        public static void main(String args[]){
                //double total1 = person1*(1 +tax +tip);
                //System.out.println(total1);
        }


}
```

You'll write this method in the next exercise.

Step 3) Remove the Main Method

```
public class Calculator{
	//Fields
	public double tax = 0.05;
	public double tip = 0.15;
	public double originalPrice = 10;

	//Methods
	public void findTotal(){
		//Calculate total after tax and tip
		//Print this value
	}

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


}
```

Success!

```
public class Calculator{
	//Fields
	public double tax = 0.05;
	public double tip = 0.15;
	public double originalPrice = 10;

	//Methods
	public void findTotal(){
		//Calculate total after tax and tip
		//Print this value
	}
}
```

Where Do I Put the Main Method?

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

              //Create Calculator object instance
              Calculator calc = new Calculator();

              calc.tip = 0.10;       //Altering a field
              calc.findTotal();      //Calling a method
       }
}
```

- Put the main method in another class, such as a test class.
- The main method drives the action of the program:
  - It creates instances of objects.
  - It calls an instance's fields and methods by using the **dot operator** (.).

Variables for Objects

```
int          age  = 22;
String       str  = "Happy Birthday!";
Scanner      sc   = new Scanner();
Calculator   calc = new Calculator();
```

type name value

- Objects, like primitives, are represented by variables.
- Most objects require the **new** keyword when they're initialized to create **new instances**.
  - This is called **instantiating** an object.
  - There are some exceptions, like `String` objects, that don't require the **new** keyword.

Using the Dot Operator

Place the dot operator (.) after a variable's name to access its fields or methods.

```
public class CalculatorTest {
        public static void main(String args[]){
                Calculator calc = new Calculator();
                calc.printTip();                //prints 0.15
                calc.tip = 0.10;
                calc.printTip();                //prints 0.10
        }
}
```

```
public class Calculator{
        public double tip = 0.15;      //initialized value 0.15
        public void printTip(){
                 System.out.println(tip);
        }
}
```

Exercise 2, Part 1

- Import and open the `Tip02` project.
- Complete the `findTotal()` method, which should:
  - Calculate a total based on the `tax`, `tip`, and `originalPrice` fields
  - Print a person's total

Exercise 2, Part 2

- From the main method:
  - Instantiate a `Calculator` object named `calc`.
  - Observe NetBeans after typing `"calc".`
  - Access this object's fields and methods to print the total for each person at the birthday party.
- Change `tip` and `tax` if you prefer different values.

Topics

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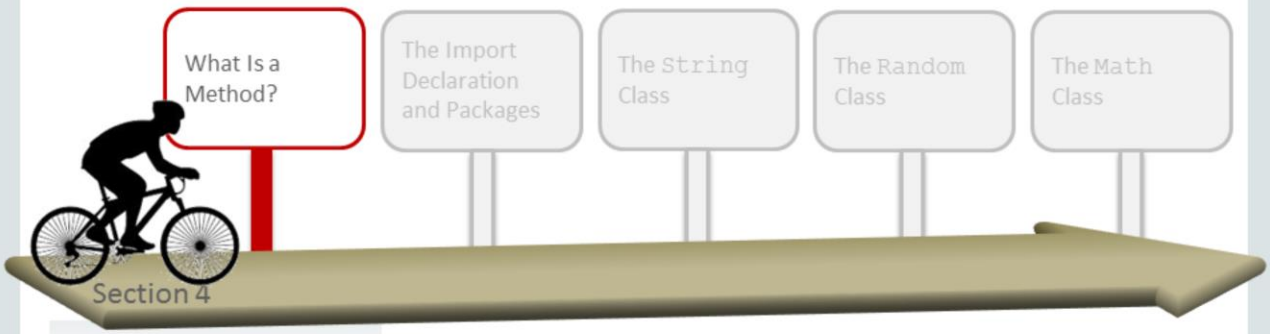


What You May Have Written

You may have written your program like this:

- Two lines are required for each person.
- And more if you decide to print names or change tax/tip values.

```
public class CalculatorTest{
   public static void main(String args[]){
        Calculator calc = new Calculator();

        calc.originalPrice = 10;
        calc.findTotal();

        calc.originalPrice = 12;
        calc.findTotal();
   }
}
```

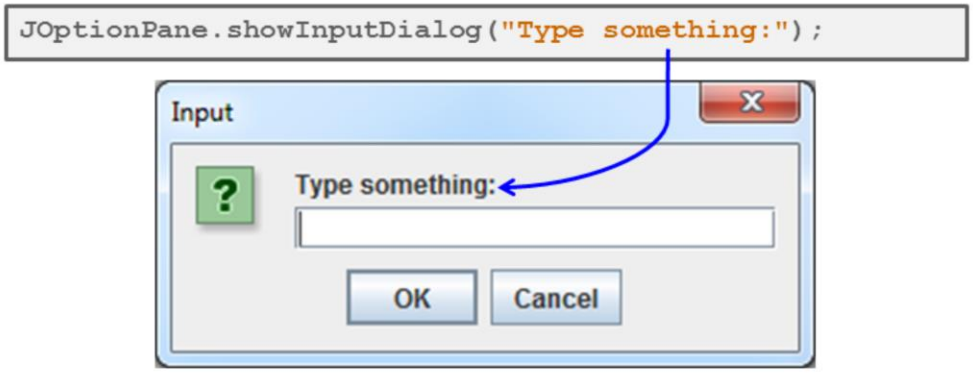
Becoming More Flexible

- But it's possible to do the same work in a single line.
- It's also dangerous to write programs that access fields directly.
  - You'll learn about this later.
  - The goal of this lesson is just to prepare you to work with important Java-provided classes.

```
calc.originalPrice = 10;          //Dangerous
calc.findTotal();
```

Remember the JOptionPane

- When we add the `String` literal `"type something:"` to the method call, we're supplying **arguments** to the method.
- This argument alters the resulting JOptionPane.



When Can Methods Accept Arguments?

- You'll find that many methods are affected by arguments.
- But methods must be written in a way to accept arguments. Otherwise, the compiler complains.
- The calculate method is written to accept no arguments.

```
Calculator calc = new Calculator();
calc.calculate();                    //Good
calc.calculate(3);                   //Fail
calc.calculate(3, 2.0);              //Fail
```

```
public void calculate(){
   //How do I calculate?
}
```

Method Argument Animation

But this calculate method is written to accept two arguments:

- The first argument must be an `int`.
- The second argument must be a `double`.

```
Calculator calc = new Calculator();
calc.calculate(3, 2.0);
```

```
public void calculate(int x, double y){
    System.out.println(x/y);            //prints 1.5
}
```

- The variable `int x` is assigned a value of 3.
- The variable `double y` is assigned a value of 2.0.

Argument Order Matters

- What happens if we reverse the order of our arguments?

```
Calculator calc = new Calculator();
calc.calculate(2.0, 3);
```

- We get a compiler error:
  - `int x` cannot be assigned a `double` value.
  - The first argument must be an `int`.

```
public void calculate(int x, double y){
    System.out.println(x/y);
}
```

2.0 3

Exercise 3, Part 1

- Import and open the `Tip03` project.
- From the main method:
  - Use a `Calculator` object instance and supply arguments to `findTotal()` to print the total for each person.
  - **Hint:** Observe the `findTotal()` method in the `Calculator` class to figure out how many arguments this method accepts.

Exercise 3, Part 2

Who does each total belong to?

- Modify the `findTotal()` method to accept an additional String `name` argument.
- Concatenate the print statement to include `name`.
- Observe NetBeans' complaint in the main method and revise your `findTotal()` method calls.

Method Arguments and Parameters

- An **argument** is a value that's passed during a method call:

```
Calculator calc = new Calculator();
calc.calculate(3, 2.0);      //should print 1.5
```

Arguments

- A **parameter** is a variable that's defined in the method declaration:

3 2.0

```
public void calculate(int x, double y){
   System.out.println(x/y);
}
```

Parameters

Note: When it's called, a value that's passed into the method is called an **argument,** whereas a variable that's defined in the method declaration is called a **method parameter.**

In this example, 3 and 2.0 are arguments passed to be the values of x and y within the calculate method.

Method Parameters: Examples

Methods may have any number or type of parameters:

```
public void calculate0(){
    System.out.println("No parameters");
}
```

```
public void calculate1(int x){
    System.out.println(x/2.0);
}
```

```
public void calculate2(int x, double y){
    System.out.println(x/y);
}
```

```
public void calculate3(int x, double y, int z){
    System.out.println(x/y +z);
}
```


Methods can take any number of parameters and use these values within the method code block.

The Scope of Parameters

- Methods need to be told what to do with the arguments they receive.
- You do that by using method parameters.
  - **Method parameters** are variables that exist within the entire scope of a method. They're created within the method declaration.
  - **Scope** refers to the {block of code} belonging to a method following its declaration.

```
public void calculate(int x, double y){
        System.out.println(x/y);
}
```

Referencing Method Parameters

- A variable may be referenced anywhere within its current block after being declared.
- A variable can't be referenced outside the block where it was declared or before being declared.

```
public void calculate(int x, double y){
      System.out.println(x/y);
}
```

Scope of x

```
public void calculate2(){
      System.out.println(2*x);   //What is x?
}
```

Not scope of x

Topics

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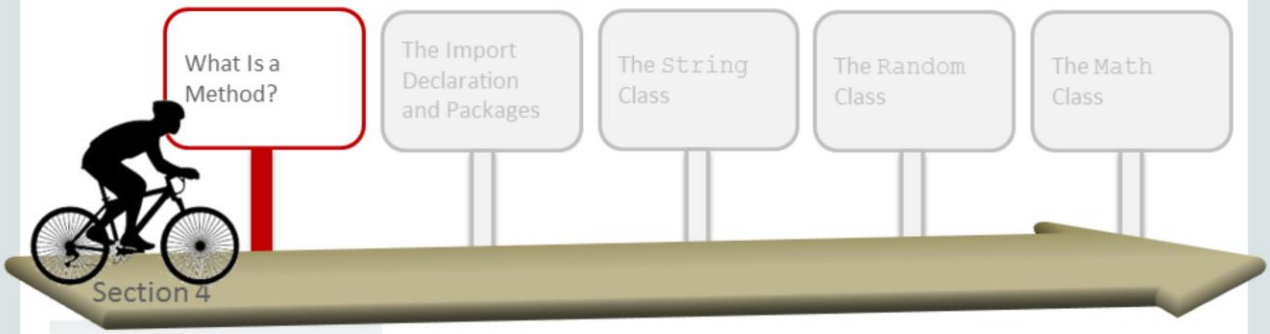


Finding the Grand Total: Scenario

Your friends are impressed with how much you're learning from the Java Foundations course! Alex asks, "What should the entire table's total be?" Knowing the answer to this question would help make sure everyone has contributed and that the server has received the correct amount.

How can this be included in your code?

Your friends know you're taking the Java Foundations course, so you're the perfect person to figure this out!

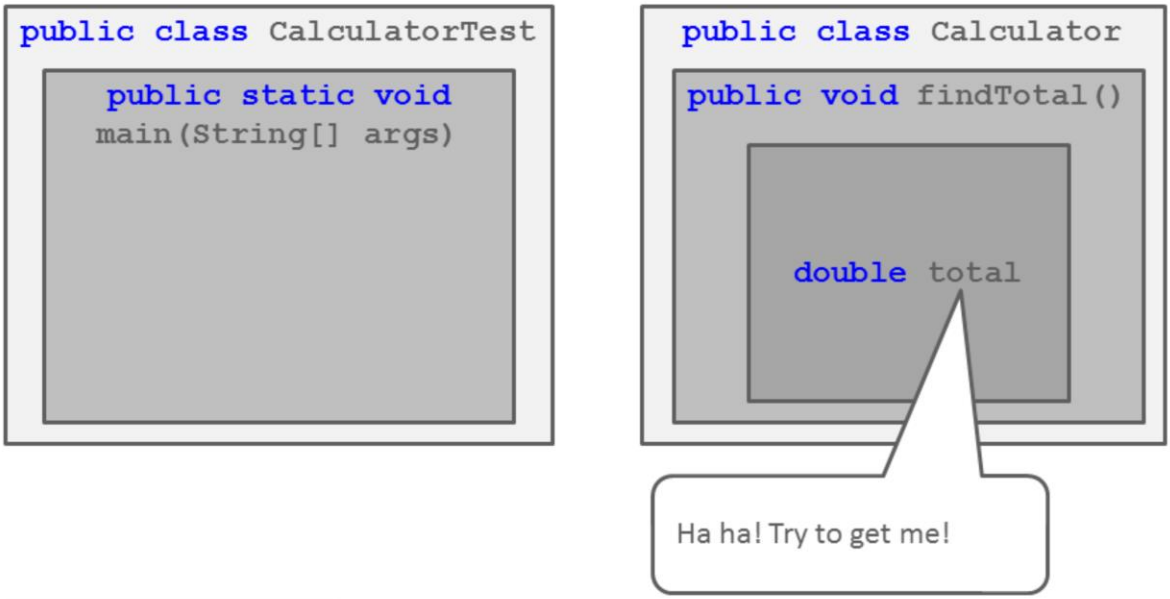
Adding Totals

Another way to think about this:

- I've calculated a value within a method …
- But it's stored as a variable that can't exist outside the scope of its method block …
- How do I get this value out of there?

```
public void findTotal(double price, String name){
   double total = price*(1+tax+tip);
   System.out.println(name +": $" +total);
}
```

Adding Totals



Adding Totals

- If you thought about writing your program like this:

```
public class CalculatorTest{
   public static void main(String args[]){
       Calculator calc = new Calculator();

       calc.findTotal(10);
       calc.findTotal(12);

       System.out.println(calc.findTotal(10) + calc.findTotal(12));
   }
}
```

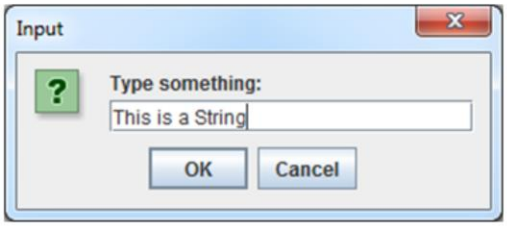
- You're half correct.
- But NetBeans gives you the following error:

```
'void' type not allowed here
```

What Is a Void Type?

- `showInputDialog()` is a String type method.
  - It returns a value that can be stored as a `String`.

```
String input = JOptionPane.showInputDialog("Type something:");
```

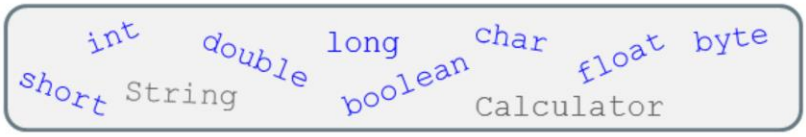


- Void type methods don't return any values.
  - There are no values to store after a void method is called.

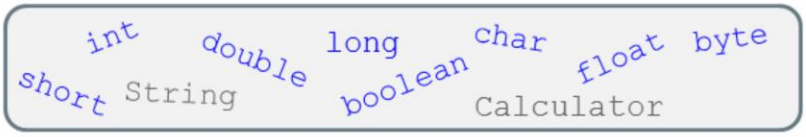
```
System.out.println("println is a void type method");
```

Method Return Types

- Variables can have values of many different types:



- Method calls also return values of many different types:



- How to make a method return a value:
  - Declare the method to be a nonvoid return type.
  - Use the keyword **`return`** within a method, followed by a value.

Method Return Types: Examples

Methods must return data that matches their return type:

```
public void printString(){
    System.out.println("Hello");
}
```

```
public String returnString(){
    return("Hello");
}
```

```
public int sum(int x, int y){
    return(x + y);
}
```

```
public boolean isGreater(int x, int y){
    return(x > y);
}
```


Void methods don't need a return statement. Void methods are incapable of returning a value in Java, although they can have a return statement. The type of value that a method returns must match the declared return type. For example, a boolean type method must return a boolean. A String type method must return a String.

Method Return Animation

The following code examples produce equivalent results:

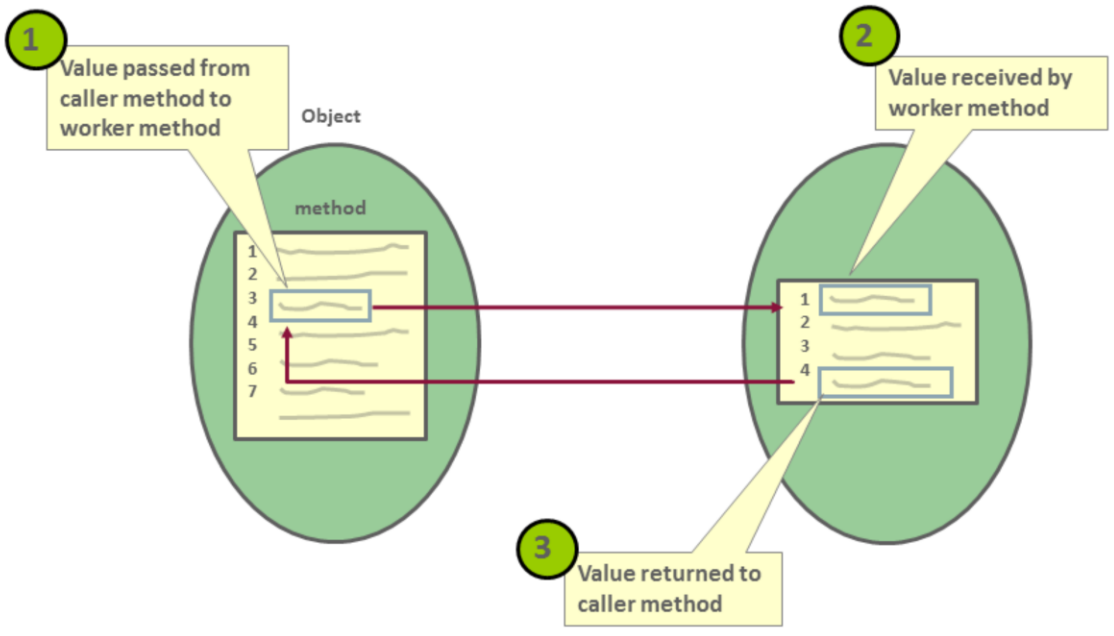
```
public static void main(String[] args){
   int num1 = 1, num2 = 2;
   int result = num1 + num2;
   System.out.println(result);
}
```

```
public static void main(String[] args){
   int num1 = 1, num2 = 2;
   int result = sum(num1, num2);
   System.out.println(result);
}

public static int sum(int x, int y){
   return(x + y);
}
```


In the top example, `num1` and `num2` are added together. In the bottom example, this logic is put into the sum method. Values are passed to the sum method and added. The resulting integer value is passed back and assigned to the result variable. For now, ignore the `static` keyword in the sum method.

Passing Arguments and Returning Values



Exercise 4, Part 1

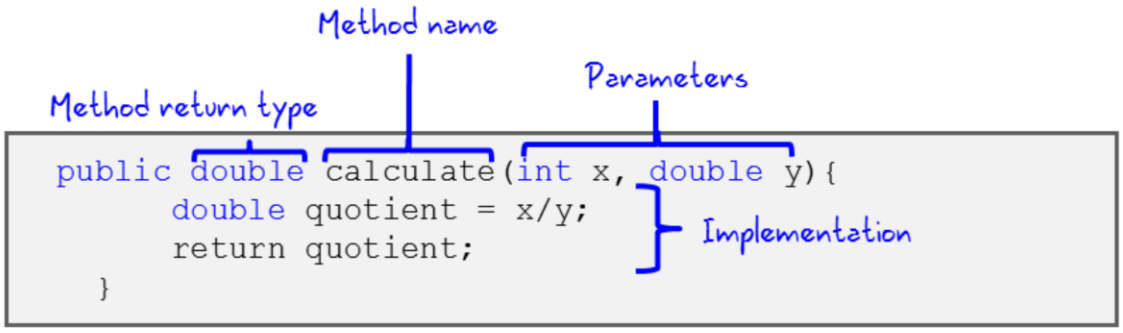
- Edit your `Tip03` solution.
  - Or import the `Tip04` project.
- Find and print the entire table's total, including tax and tip.
  - You'll need to edit `findTotal()` so that it returns its calculated value.

It's also possible to find the total by creating a field within the `Calculator` class and adding to it each time you call `findTotal()`. However, it isn't always (but sometimes is) desirable to store a calculated value as a field. This field could also be tampered with. The total could be incorrect if someone wants to refresh their memory and check their individual total again. And if we chose that solution, we wouldn't have any reason to show you how cool it is for methods to return values!

Exercise 4, Part 2

- Person8 forgot their wallet. And Alex's meal was meant to be a birthday present. Modify `findTotal()` so that the cost of their meals are shared equally with the rest of the party.
- Recalculate the entire table's total. This number shouldn't have changed.

Summary About Method Syntax



Summary

In this lesson, you should have learned how to:

- Structure code within a class
- Instantiate an object
- Understand the benefits of methods
- Use the dot operator to access an object's fields and methods
- Supply arguments to a method
- Return values from a method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