# Classes, Encapsulation, Methods and Constructors (Continued)

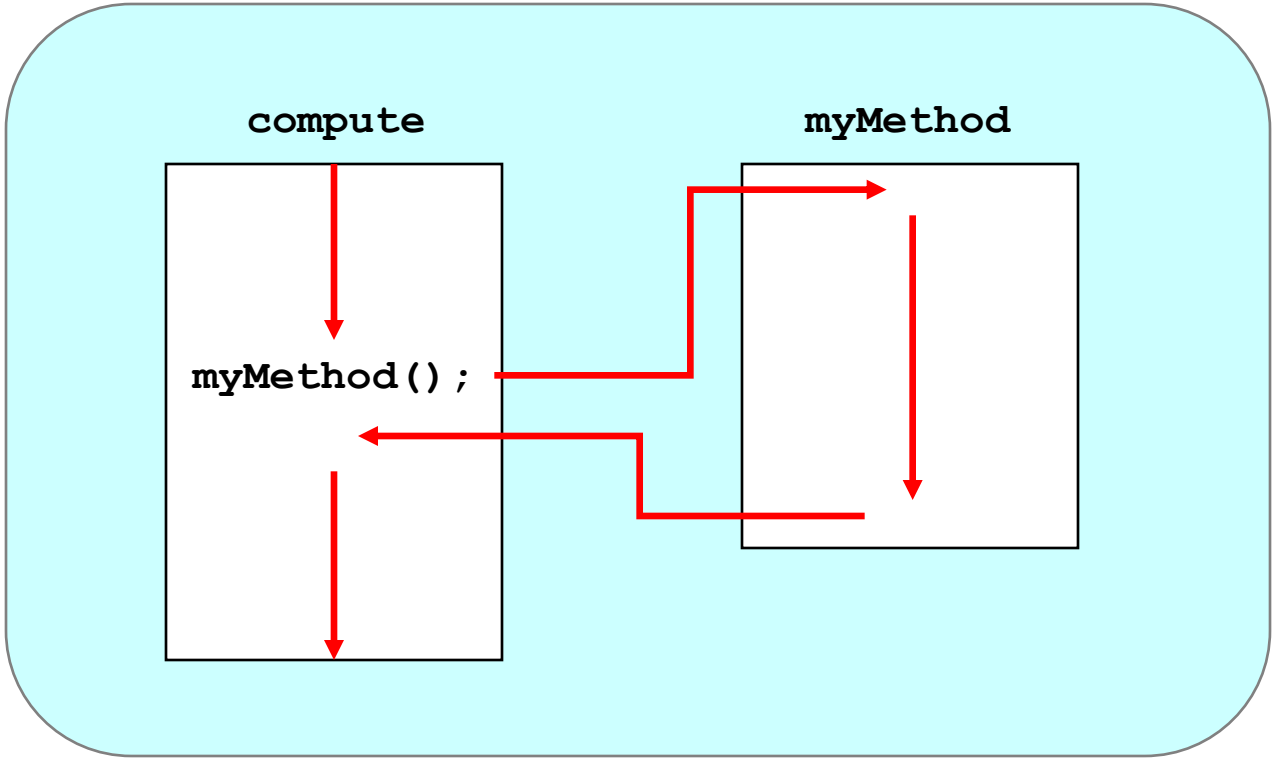
- Class definitions
- Instance data
- Encapsulation and Java modifiers
- Method declaration and parameter passing
- Constructors
- Method Overloading
- Reading for this lecture:L&L, 4.1-4.5 & App E

# Method Declarations

- A *method declaration* specifies the code that will be executed when the method is invoked (called)
- When a method is invoked, the flow of control jumps to the method and executes its code
- When complete, the flow returns to the place where the method was called and continues
- The invocation may or may not return a value, depending on how the method is defined

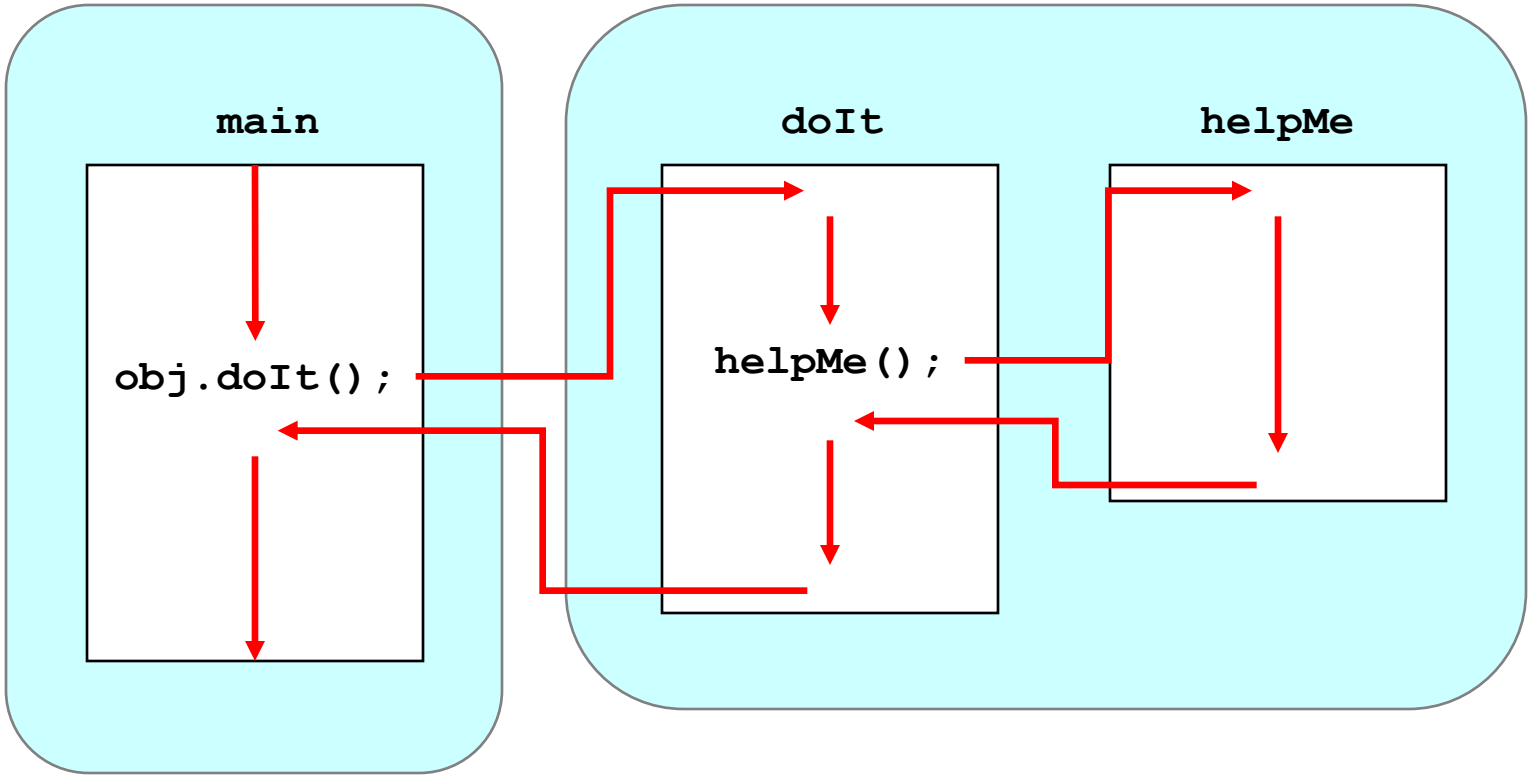
# Method Control Flow

- If the called method is in the same class, only the method name is needed



# Method Control Flow

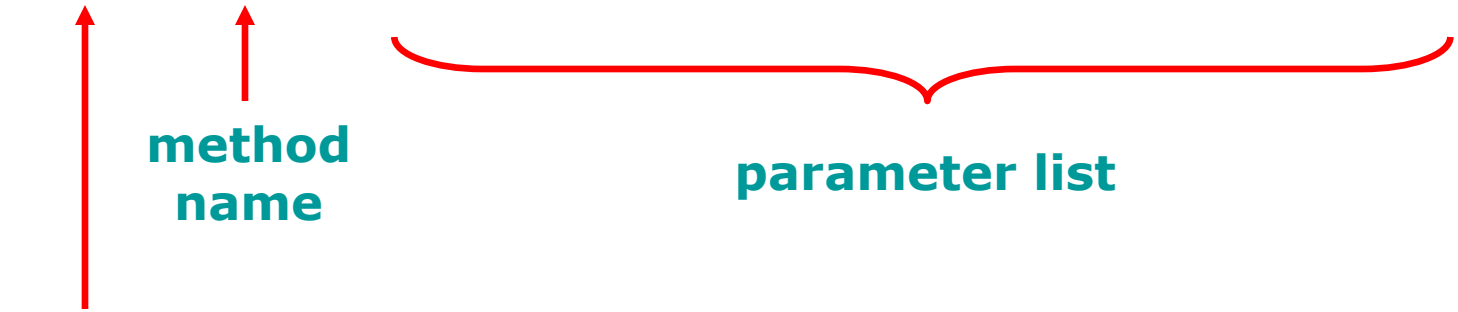
- The called method is often part of another class or object



# Method Header

- A method declaration begins with a *method header*

```
char calc (int num1, int num2, String message)
```




**The parameter list specifies the type and name of each parameter**

**The name of a parameter in the method declaration is called a *formal parameter***

# Method Body

- The method header is followed by the *method body*

```
char calc (int num1, int num2, String message)
{
   int sum = num1 + num2;
   char result = message.charAt (sum);

   return result;
}
```

The return expression must be consistent with the return type

`sum` and `result` are local data

They are created each time the method is called, and are destroyed when it finishes executing

# Local Data

- Local variables can be declared inside a method
- The formal parameters of a method are also *local variables* when the method is invoked
- When the method finishes, all local variables are destroyed (including the formal parameters)
- Keep in mind that instance variables, declared at the class/object level, exist for as long as the object exists

# The return Statement

- The *return type* of a method indicates the type of value that the method sends back to the caller
- A method that does not return a value has a `void` return type
- A *return statement* specifies the value that will be returned upon completion of the method code

```
return expression;
```

- Its expression must conform to the return type

# Parameters

- When a method is called, the *actual parameters* in the call are copied into the *formal parameters* in the method header

```
ch = obj.calc (25, count, "Hello");
```

```
char calc (int num1, int num2, String message)
{
   int sum = num1 + num2;
   char result = message.charAt (sum);

   return result;
}
```

# Objects as Parameters

- Another important issue related to method design involves parameter passing
- Parameters in a Java method are *passed by value*
- A copy of the actual parameter (the value passed in) is stored into the formal parameter (in the method header)
- Therefore passing parameters is similar to an assignment statement
- When an object is passed to a method, the actual parameter and the formal parameter become aliases of each other

# Passing Objects to Methods

- What a method does with a parameter may or may not have a permanent effect (outside the method)

- See ParameterTester.java (page 333-334)
- See ParameterModifier.java (page 335)
- See Num.java (page 336)

- Note the difference between changing the internal state of an object versus changing the value of a reference to point to a different object

# Method Overloading

- *Method overloading* is the process of giving a single method name multiple definitions
- If a method is overloaded, the method name is not sufficient to determine which method is being called
- The *signature* of each overloaded method must be unique
- The signature includes the number, type, and order of the parameters

# Method Overloading

- The compiler determines which method is being invoked by analyzing the parameters

**Invocation**

```
result = tryMe(25, 4.32)
```

```
float tryMe(int x)
{
    return x + .375;
}

float tryMe(int x, float y)
{
    return x*y;
}
```

# Method Overloading

- The `println` method is overloaded:

```
println (String s)
println (int i)
println (double d)
```

and so on...

- The following lines invoke different versions of the `println` method:

```
System.out.println ("The total is:");
System.out.println (3);
```

# Method Overloading

- The return type of the method is not part of the signature
- Overloaded methods cannot differ only by their return type
- Constructors can be overloaded and often are
- Overloaded constructors provide multiple ways to initialize a new object

# Accessors and Mutators

- A class usually provides methods to indirectly access and modify the private data values
- An *accessor method* returns the current value of a variable
- A *mutator method* changes the value of a variable
- The names of accessor and mutator methods take the form `getX` and `setX`, respectively, where `X` is the name of the value
- They are sometimes called “getters” and “setters”

# Mutator Restrictions

- The use of mutators gives the class designer the ability to restrict a client's options to modify an object's state
- A mutator is often designed so that the values of variables can be set only within particular limits
- For example, the `setFaceValue` mutator of the `Die` class should restrict the value to the valid range (1 to `MAX`)