7.9 Pass-By-Value vs. Pass-By-Reference

The preceding example demonstrated how arrays and primitive-type array elements are passed as arguments to methods. We now take a closer look at how arguments in general are passed to methods. Two ways to pass arguments in method calls in many programming languages are **pass-by-value** and **pass-by-reference** (sometimes called **call-by-value** and **call-by-reference**). When an argument is passed by value, a *copy* of the argument's *value* is passed to the called method. The called method works exclusively with the copy. Changes to the called method's copy do *not* affect the original variable's value in the caller.

When an argument is passed by reference, the called method can access the argument's value in the caller directly and modify that data, if necessary. Pass-by-reference improves performance by eliminating the need to copy possibly large amounts of data.

Unlike some other languages, Java does *not* allow you to choose pass-by-value or pass-by-reference—*all arguments are passed by value*. A method call can pass two types of values to a method—copies of primitive values (e.g., values of type `int` and `double`) and copies of references to objects. Objects themselves cannot be passed to methods. When a method modifies a primitive-type parameter, changes to the parameter have no effect on the original argument value in the calling method. For example, when line 30 in `main` of Fig. 7.13 passes `array[3]` to method `modifyElement`, the statement in line 44 that doubles the value of parameter `element` has *no* effect on the value of `array[3]` in `main`. This is also true for reference-type parameters. If you modify a reference-type parameter so that it refers to another object, only the parameter refers to the new object—the reference stored in the caller's variable still refers to the original object.

Although an object's reference is passed by value, a method can still interact with the referenced object by calling its `public` methods using the copy of the object's reference. Since the reference stored in the parameter is a copy of the reference that was passed as an argument, the parameter in the called method and the argument in the calling method refer to the *same* object in memory. For example, in Fig. 7.13, both parameter `array2` in method `modifyArray` and variable `array` in `main` refer to the *same* array object in memory. Any changes made using the parameter `array2` are carried out on the object that `array` references in the calling method. In Fig. 7.13, the changes made in `modifyArray` using `array2` affect the contents of the array object referenced by `array` in `main`. Thus, with a reference to an object, the called method *can* manipulate the caller's object directly.

Performance Tip 7.1

Passing references to arrays, instead of the array objects themselves, makes sense for performance reasons. Because Java arguments are passed by value, if array objects were passed, a copy of each element would be passed. For large arrays, this would waste time and consume considerable storage for the copies of the elements.