Advanced Arrays

<https://csci-1301.github.io/about#authors>

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# Array Manipulation Practice

Read the following instructions (“set-up” and “your goal”) completely and carefully before starting.

## Set-Up

For this exercise:

* Download and extract [ArrayManipulation](ArrayManipulation.zip) project.
* It contains two .cs files, ArrayLib.cs and Program.cs.
* Compile and execute it.
* Observe Program.cs: this is a *test program* that you **should not modify**. It will be useful to test the methods that you will be writing in the ArrayLib.cs class file. For each method, this program displays the expected value, and what is actually returned. As you can see, only the Display method seems to be always correct.
* Now, read ArrayLib.cs. Every method used by Program.cs has a header, but all the bodies are returning “default” values or do nothing, with the exception of Display. This method was written for you.

## Your goal

* Your goal is to write the body of the methods in the ArrayLib class.
* Do not change any method headers in ArrayLib class.
* Modify only method bodies, so that they return the “right” values, according to their description (in comments after their headers) and the test given in Program.cs.
* You can change their order within ArrayLib, and you can implement them in any order.
* Some of them are actually easier to write, and they are not the first ones: can you find a method that seems easy enough to start your project?

If you have the time and interest, have a look at the challenges offered at the end of the ArrayLib.cs file.

You can find a possible solution [in this archive](Solution_ArrayManipulation.zip).

# Pushing Further (Optional)

Here, we will explore the difference between value and reference types. Since arrays are reference types, it is important for you to understand how reference types work.

Let us show why this notion is so critical with an example:

int[] arrayA = { 1, 2, 3, 4, 5 }; // Declare a simple array of integers  
  
// I'd like to make a copy of that array. Let me try the following:  
int[] arrayCopyWrong = arrayA;  
  
foreach (int i in arrayCopyWrong)  
 Console.Write(i + " ");  
  
Console.WriteLine();  
  
// It seems to be working! Except that if we change a value in our copy:  
arrayCopyWrong[0] = 6;  
  
// It also changes the value in our original array!  
foreach (int i in arrayA)  
 Console.Write(i + " ");  
  
Console.WriteLine();

Try running this program yourself to see what happens. The problem is that when we wrote the assignment statement int[] arrayCopyWrong = arrayA, we copied the *reference* to the array, but not the array itself. We now have two ways of accessing our array, using arrayA or arrayCopyWrong, but still only one array.

To correctly copy the array, we need to do something like the following:

int[] arrayB = { 1, 2, 3, 4, 5 };  
// Create a new array object and assign it to a new reference variable  
int[] arrayCopyRight = new int[arrayB.Length];  
  
// Copy each value in the array, one by one:  
for(int i = 0 ; i < arrayB.Length; i++)  
 arrayCopyRight[i] = arrayB[i];  
  
// If we change a value in our copy:  
arrayCopyRight[0] = 6;  
  
// It changes the value only in that copy:  
foreach (int i in arrayB)  
 Console.Write(i + " ");  
  
Console.WriteLine();  
  
foreach (int i in arrayCopyRight)  
 Console.Write(i + " ");   
  
Console.WriteLine();

Try running this program. Can you see the difference?

Array is actually a class (documented at <https://msdn.microsoft.com/en-us/library/system.array(v=vs.110).aspx>), and as such provides several methods. If you have two arrays, array1 and array2 containing the same type of values and of size at least x, you can copy the first x values of array1 into array2 using Array.Copy(array1, array2, x);. Try using this method with the previous example to create a copy of arrayB.