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# Using static keyword

This lab serves multiple goals:

* To teach you how a static class differs from a non-static one,
* To illustrate the usefulness of static classes,
* To teach you how a non-static class can manipulate static fields.

## Static Classes – Warm-Up

One use case for static classes is creating utility classes (or “helper classes”) that contain related and frequently-used methods Using a static class makes those methods easily callable anywhere in the program. Some examples of static classes in C# are the Math and Console classes.

Pay attention to how these classes are used:

* A Console object is never instantiated before use.
* The WriteLine method is called referring to the *name of the class* (not an object identifier):
* Console.WriteLine("calling a static method");

| ❓ Question |
| --- |
| Using your IDE, check what happens if you do the following: Console test = new Console();. |

Solution:

Indeed, it is *not possible* to instantiate an object when a class is declared static. Furthermore, if a class is declared static, all its members (e.g., attributes, methods, constructors, etc.) must also be declared static.

### Static Calculator

In your IDE create a new project. Then add a new class file called Calculator.cs

In Calculator.cs:

1. Declare a static class and name it Calculator.
2. Add 5 public methods to the Calculator class. Each method takes 2 arguments x and y of type double:
   1. Add method that returns the result of x + y.
   2. Subtract method that returns the result of x - y.
   3. Multiply method that returns the result of x \* y.
   4. Divide method that returns the result of x / y.
   5. Modulo method that returns the result of x % y.

After implementing Calculator,

1. Open the file that contains the program’s Main method
2. Paste the following code inside the Main method:

* double x = 10d, y = 2d;  
    
  Console.WriteLine($"{x} + {y} = {Calculator.Add(x, y)}");  
  Console.WriteLine($"{x} - {y} = {Calculator.Subtract(x, y)}");  
  Console.WriteLine($"{x} \* {y} = {Calculator.Multiply(x, y)}");  
  Console.WriteLine($"{x} / {y} = {Calculator.Divide(x, y)}");  
  Console.WriteLine($"{x} % {y} = {Calculator.Modulo(x, y)}");
* Again, notice how
  + no instance of Calculator is created before use, and
  + each Calculator method is called referring to the *name of the class*.
* Execute the program
  + If your implementation of the Calculator class matches the instructions, you will see meaningful output after executing the program.
  + Otherwise, review the instructions again and retrace your implementation steps to resolve any issues.

## Static Members in a Non-static Class

A non-static class can contain both static and non-static class members.

Download, extract, and study this [project](https:/princomp.github.io/code/projects/Student.zip) implementation, but *do not* execute it. After reading through the implementation, answer the questions below.

1. How many non-static attributes does the Student class have?
2. How many static attributes does the Student class have?
3. How many non-static methods does the Student class have?
4. How many static methods does the Student class have?
5. What is the output of each of the following lines in “Program.cs”:
   1. Console.WriteLine(alice);
   2. Student.DisplayStudentCount(); // first time
   3. Console.WriteLine(bob);
   4. Student.DisplayStudentCount(); // second time
6. If the studentCount attribute was *not* static, what would be the output of:
   1. Student.DisplayStudentCount(); // first time
   2. Student.DisplayStudentCount(); // second time
7. When a class contains both static and non-static members, is it possible to refer to non-static members inside a static method? For example, if we try to refer to the name attribute inside DisplayStudentCount, will it work? Why or why not?

Check your answers by creating a matching program in your IDE and executing it.

To check the last question, in Student.cs, uncomment the following line and verify its behavior matches your answer:

// Console.WriteLine(name);