Using static keyword

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# Static classes

One use case for static classes is creating utility classes (or “helper classes”) that contain related and frequently-used methods; making 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)

using System;  
  
class Program {  
 static void Main() {  
 Console.WriteLine("calling a static method");  
 }  
}

Using your IDE, check what happens if you do the following:

using System;  
  
class Program {  
 static void Main() {  
 Console test = new Console();  
 }  
}

Indeed, it is *not possible* to instantiate an object when a class is declared static. Further, if a class is declared static, all its members (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 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*.

1. Execute the program
   * If your implementation of 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.

Study the following program implementation but \*do not\* execute it. After reading through the implementation, answer the questions below.

Student.cs

using System;  
  
class Student {  
  
 private int id;  
 private string name;  
 private static string universityName = "Augusta University";  
 private static int studentCount;  
  
 public Student(int id, string name){  
 this.id = id;  
 this.name = name;  
 studentCount++;  
 }  
  
 public static void DisplayStudentCount(){  
 // does this work? uncomment to check  
 // Console.WriteLine(name);  
  
 Console.WriteLine($"Number of students: {studentCount}");  
 }  
  
 public override string ToString(){  
 return $"id: {id}\n"+  
 $"name: {name}\n"+  
 $"university: {universityName}";  
 }  
}

Program.cs

using System;  
  
class Program {  
  
 static void Main() {  
  
 Student alice = new Student(1111, "Alice");  
 Console.WriteLine(alice);  
  
 Student.DisplayStudentCount(); // first time  
  
 Student bob = new Student(1112, "Bob");  
 Console.WriteLine(bob);  
  
 Student.DisplayStudentCount(); // second time  
 }  
}

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);