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## Objects and References

Solutions for those exercises.<sup>1</sup>

### Questions

1. What is the difference between **ref** and **out**?
  - ref** variables are “read-only”, their value cannot change inside a method.
  - ref** is a keyword, **out** is not.
  - There isn’t any: they are both used to pass a reference to a method.
  - out** variables may not be initialized going into the method, but have to receive a value inside the method.
  - There isn’t any: they are both used to pass a value to a method.

### Warm-up Exercises

1. Consider the following code:

```
using System;

class Program
{
    static void Main()
    {
        int x = 1;
        int y = 2;
        int z;
        char c = Foo(x, ref y, out z);
        char d = Foo(x, ref y, out z, '%');
    }

    static char Foo(
        int x,
        ref int y,
```

---

<sup>1</sup><https://princomp.github.io/solutions/oop/references>

```

    out int z,
    char symb = '*'
)
{
    x++;
    y--;
    z = x + y;
    return symb;
}
}

```

- (a) What are the values of x, y and z
- Before the Foo method is called?
  - Inside the Foo method?
  - After the Foo method executed?
- (b) What is the value of c?
- (c) What is the value of d?

## Problems

- Write the AddRev method (header included) such that the following:

```

int x0 = 4,
    y0 = 3;
AddRev(ref x0, ref y0);
Console.WriteLine($"x0 is {x0}, y0 is {y0}.");

```

would display

x0 is 7, y0 is 1.

- Write the AddLog method (header included) such that the following:

```

string log;
int x1 = 4,
    y1 = 3;
int result = AddLog(x1, y1, out log);
Console.WriteLine(log + "\n" + result);

```

would display

4 + 3 = 7.  
7

- Write the AddReset method (header included) such that the following:

```

int x2 = 2,
    y2 = 3,
    z2;
AddReset(ref x2, ref y2, out z2);
Console.WriteLine($"x2 = {x2}, y2 = {y2}, z2 =
↪ {z2}.");

```

would display

x2 = 0, y2 = 0, z2 = 5.

4. Consider the “regular” implementation of the Rectangle class:

```

using System;
class Rectangle
{
    private int length;
    public int Length
    {
        get { return length; }
        set { if (value < 0) { throw new
↪ ArgumentNullException(); } else length =
↪ value; }
    }

    private int width;
    public int Width
    {
        get { return width; }
        set { if (value < 0) { throw new
↪ ArgumentNullException(); } else width =
↪ value; }
    }

    public Rectangle(int wP, int lP)
    {
        Width = wP;
        Length = lP;
    }

    public override string ToString()
    {
        return $"Width: {Width}\nLength: {Length}";
    }
}

```

And try to answer the following questions.

(a) Write a Draw method that takes one *optional* char parameter

and draw a rectangle of the calling object's width and length using that character if provided, \* otherwise. If your method is correctly implemented, then

```
Rectangle r0 = new Rectangle(3, 2);
```

```
r0.Draw();  
r0.Draw('-');
```

should display

```
***  
***
```

```
---  
---
```

- (b) Write a Copy method that does not take arguments, and return a copy of the calling object. If your method is correctly implemented, then

```
Rectangle original = new Rectangle(5, 10);  
Rectangle copy = original.Copy();  
Console.WriteLine("Original:\n" + original +  
    ↪ "\nCopy:\n" + copy + "\n");  
copy.Length = 12;  
Console.WriteLine("\nOriginal:\n" + original +  
    ↪ "\nCopy:\n" + copy + "\n");
```

should display

```
Original:  
Width: 5  
Length: 10  
Copy:  
Width: 5  
Length: 10
```

```
Original:  
Width: 5  
Length: 10  
Copy:  
Width: 5  
Length: 12
```

If the length of the original object changed after `copy.Length = 12;` was executed, then your method makes a *shallow* copy instead of a "deep" copy.

- (c) Write an `Equals` method that return **true** if the calling object and the argument are both non-null rectangles with the same length and width, **false** otherwise. If your method is correctly implemented, then

```
Rectangle r1 = new Rectangle(5, 10);
Rectangle r2 = new Rectangle(5, 10);
Rectangle r3 = null;
Rectangle r4 = r1;
Rectangle r5 = new Rectangle(10, 5);
```

```
Console.WriteLine(
    "r1 and r2 identical: " + r1?.Equals(r2)
    + "\nr1 and r3 identical: " + r1?.Equals(r3)
    + "\nr3 and r1 identical: " + r3?.Equals(r1)
    + "\nr3 and r3 identical: " + r3?.Equals(r3)
    + "\nr1 and r4 identical: " + r1?.Equals(r4)
    + "\nr1 and r5 identical: " + r1?.Equals(r5)
);
```

should display

```
r1 and r2 identical: True
r1 and r3 identical: False
r3 and r1 identical:
r3 and r3 identical:
r1 and r4 identical: True
r1 and r5 identical: False
```