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## Random class

This lab serves multiple goals:

- To illustrate how programs can generate random numbers,
- To introduce you to using existing libraries,
- (Optional) to understand what a cryptographically secure random number generator is and why it matters.

## Generating Random Numbers

The `Random` class from the C# standard library can be used to generate random numbers in any given range. In this lab, you will practice using the `Random` class.

Start by reading the corresponding chapter in the lecture notes<sup>1</sup>, then create a new project and practice generating and displaying to the screen different random numbers:

1. Generate any random integer
2. Generate a random integer between -10 and 10 including these boundary values
3. Generate a random double

Note you only need 1 instance of the `Random` class to generate these numbers.

Solution:

```
Random rand = new Random(); // Creation of a random
↪ number generator.
Console.WriteLine("A random number:" + rand.Next()); //
↪ This is any random (int) number.
Console.WriteLine("A random number between -10 and 10:" +
↪ (rand.Next(21)-10)); // This number will be between 0
↪ and 20, then we subtract 10 from it.
```

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<sup>1</sup><https://princomp.github.io/book.html#random>

```

Console.WriteLine("A random number between -10 and 10:" +
↪ rand.Next(-10, 11)); // Alternate solution
Console.WriteLine("A random double:" +
↪ rand.NextDouble()); // This is any random (double)
↪ number.

```

Execute the program a few times to make sure the outputs are different each time.

Once you have successfully generated the 3 random numbers described above, add the following enhancements to the program:

1. Generate any random integer *5 times*
2. Generate a random integer between -10 and 10 including these boundary values, *10 times*
3. Generate a random double, *5 times*

Execute the program again, a few times, to make sure these values change on each execution.

## Manipulating Two Arrays

This problem combines random number generation with arrays. Using a `Random` object, write a program that:

1. declares two arrays of `int` of size `8`,
2. initializes the values of the first array with random numbers between `0` and `9`,
3. initializes the values of the second array with random numbers between `0` and `9`,
4. displays the contents of the two arrays in a table, and for each index, a letter indicating whether the first array "won" or "lost" a contest with the second array:
  - "W" if the value in the first array is greater than the value in the second array
  - "T" if they are equal, and
  - "L" if it is less

An example execution of this program would display:

0	8	L
5	3	W
3	3	T
1	2	L
3	1	W
9	0	W

```
9      0      W
1      5      L
```

In this example, the first array contains "0 5 3 1 3 9 9 1" and the second contains "8 3 3 2 1 0 0 5".

## Pushing Further (Optional)

### Cryptographically secure random numbers

Random number generation is only pseudo-random, meaning these are algorithmically generated numbers that approximate a sequence of truly random numbers. Using the default `Random` class is not recommended for applications that need cryptographically secure random numbers (e.g. to generate suggested passwords).

When an application needs cryptographically secure random numbers, `RandomNumberGenerator` class should be used instead. It works as follows:

```
using System;
using System.Security.Cryptography; // include
    ↪ definition!

class Program
{
    static void Main()
    {
        // choose secure (!) random integer
        // between 0 (inclusive) and 100 (exclusive)
        int secureRandom =
            ↪ RandomNumberGenerator.GetInt32(100);

        // display cryptographically secure int
        Console.WriteLine(secureRandom);

        // choose secure (!) random integer
        // between 50 (inclusive) and 500 (exclusive)
        int anotherSecureRandom =
            RandomNumberGenerator.GetInt32(50, 500);

        // display cryptographically secure int
        Console.WriteLine(anotherSecureRandom);
    }
}
```

You can learn more about secure random numbers by reading through:

- the technical description of RandomNumberGenerator class<sup>2</sup>
- discussion on how to choose which Random generator to use<sup>3</sup>

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<sup>2</sup><https://docs.microsoft.com/en-us/dotnet/api/system.security.cryptography.randomnumbergenerator>

<sup>3</sup><https://stackoverflow.com/q/1257299>