C# CODE STRUCTURE

.NET

Don’t start jumping into design, creating folders as they come, adding features when you think about it. Sit down for a minute, think clearly about what resources you will need, which technologies or languages you will use, and how to structure all this.

- JULIEN RIO

Procedural Programming

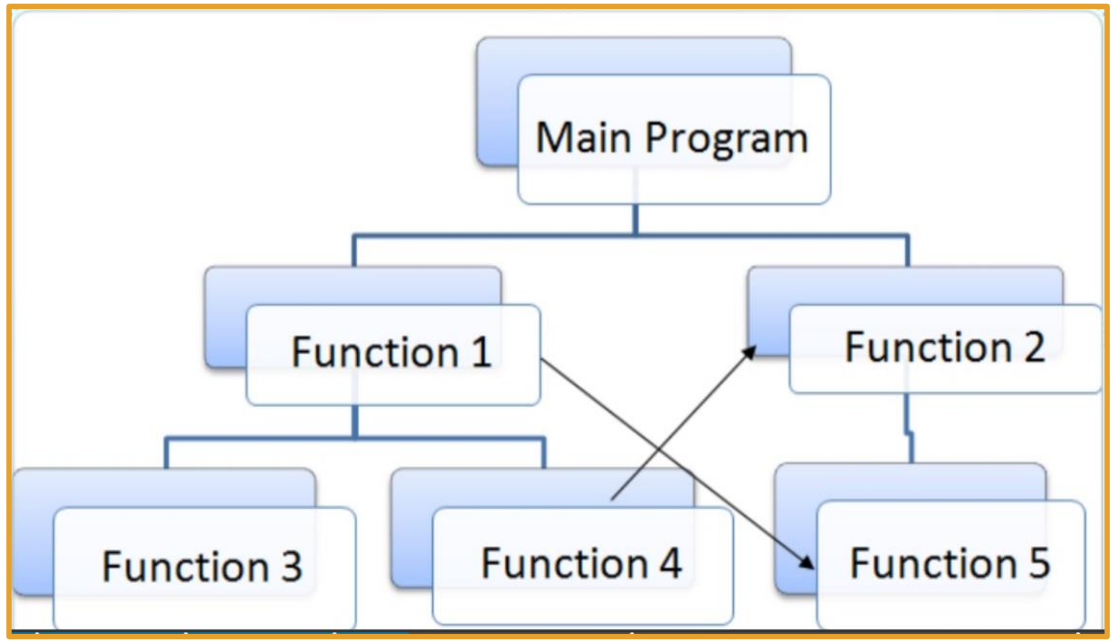
https://en.wikipedia.org/wiki/Procedural_programming

Procedural programming is a programming paradigm derived from ‘structured’ programming.

It’s based on the concept of the procedure call.

Procedures (routines, subroutines, functions, methods) contain a series of computational steps to be carried out.

A method can be called at any point during a program's execution by other methods or by itself (recursion).



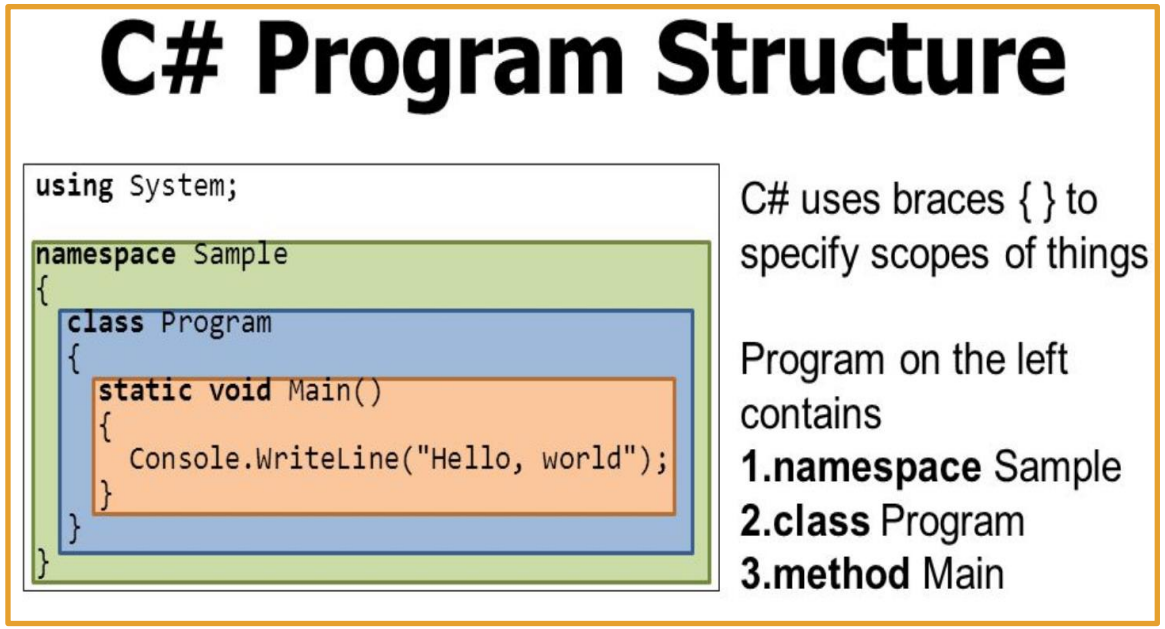
C# Program Structure

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/program-structure

The key organizational concepts in C# are programs, namespaces, types, members, and assemblies. C# programs consist of one or more source files.

- Programs declare ***namespaces***.
- ***Namespaces*** contain ***types*** (***classes/interfaces***).
- ***Types*** contain ***members*** (***fields***, ***methods***, ***Properties***, ***events***)

When C# programs are compiled, they're packaged into ***assemblies*** with file extensions .exe (Executable) or .dll (Dynamic Link Library).



Your first .NET program

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/#hello-world

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Hello World

- To create this program, first download and install the ***.NET Core SDK***.
- Then, execute the command *dotnet new console -o hello* to create a new program in a file names hello with a build script.
- The program and build script are in the files ***Program.cs*** and ***hello.csproj***, respectively.
- In the command line, type ***cd hello***.
- Build and run the application with the run command: **dotnet run**

C# - Hello, World

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/#hello-world

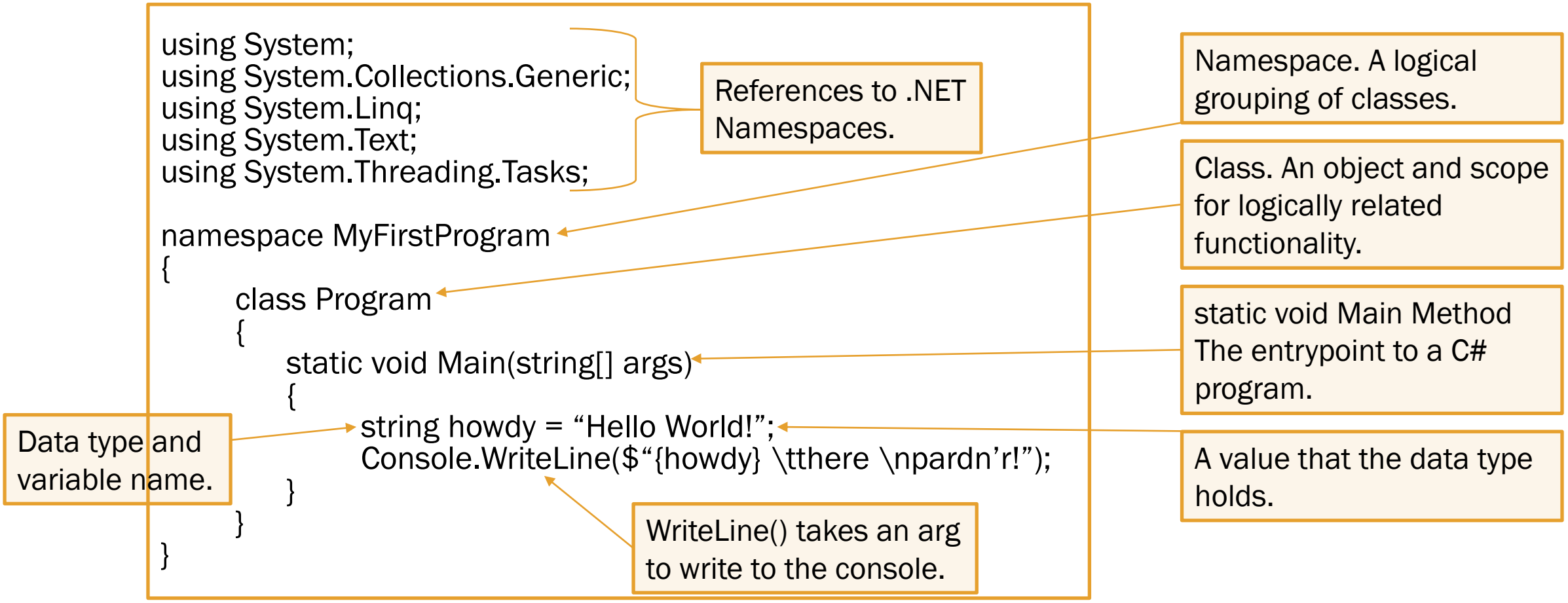
- ***Hello, World*** starts with an using directive referencing the System namespace which contains the Console class, I/O, Collections, *and others.*
- ***Namespaces*** provide a hierarchical means of organizing C# programs and libraries. ***Namespaces*** contain ***types*** and other ***namespaces***.
- "using System" means ***Hello, World*** can use Console.WriteLine as shorthand for System.Console.WriteLine.
- System namespace is provided by the ***Base Class Library***.
- A static method named ***Main*** serves as the entry point of any .NET program.

```
using System;

class Hello
{
    static void Main()
    {
        Console.WriteLine("Hello, World");
    }
}
```

C# Program Structure

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/program-structure



Generic Host

https://docs.microsoft.com/en-us/aspnet/core/fundamentals/host/generic-host?view=aspnetcore-5.0

- ASP.NET Core templates create a .NET ***Generic Host*** called ***HostBuilder***.
- ***Host*** is an object that encapsulates an apps resources (Dependency Injection, Logging, Configuration).
- When a host starts, it calls **IHostedService.StartAsync** on each implementation of **IHostedService** that it finds in the DI container
- The reason for including all app resources in one object is lifetime management. This controls startup and shutdown of each resource.

The ***host*** is typically (in all but console applications) configured, built, and run by code in **Program.cs**.

Main() calls a ***CreateHostBuilder*** method to

- ***create*** a ***builder*** object and
- ***configure*** a ***builder*** object.

Then, it calls Build() and Run() on the ***HostBuilder*** object.

```
public class Program
{
    public static void Main(string[] args)
    {
        CreateHostBuilder(args).Build().Run();
    }

    public static IHostBuilder CreateHostBuilder(string[] args) =>
        Host.CreateDefaultBuilder(args)
            .ConfigureWebHostDefaults(webBuilder =>
            {
                webBuilder.UseStartup<Startup>();
            });
}
```

Generic Host

https://docs.microsoft.com/en-us/aspnet/core/fundamentals/host/generic-host?view=aspnetcore-5.0

The ***GenericHost*** has default builder settings like:

- Sets the content ***root*** to the path returned by ***GetCurrentDirectory***.
- Enables scope validation and dependency validation when the environment is Development.

Loads app configuration from:
appsettings.json. appsettings.{Environment}.json. Secret Manager when the app runs in the Development environment. Environment variables. Command-line arguments.

Adds the following logging providers:
Console Debug EventSource EventLog (only when running on Windows)

Loads *host* configuration from:
Environment variables prefixed with DOTNET. Command-line arguments.

C# Program Structure A First Look

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/program-structure

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The fully qualified name of this class is **Acme.Collections.Stack**.

Class ***Stack*** contains several ***members***:

A field:	Two methods:	•A nested class:
•top,	•Push •Pop	•Entry.

The ***Entry*** class further contains three ***members***

Two fields:	A parameterized constructor
•next •data	

Will this code compile and run?

```
using System;
namespace Acme.Collections
{
    public class Stack
    {
        Entry top;
        public void Push(object data)
        {
            top = new Entry(top, data);
        }

        public object Pop()
        {
            if (top == null)
            {
                throw new InvalidOperationException();
            }
            object result = top.data;
            top = top.next;
            return result;
        }

        class Entry
        {
            public Entry next;
            public object data;
            public Entry(Entry next, object data)
            {
                this.next = next;
                this.data = data;
            }
        }
    }
}
```

C# Structure – Classes

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects

- Classes are the most fundamental of C#'s types.
- A class is a data structure that combines state (fields) and actions (methods) into a single unit.
- A class provides a template for ***instances*** of the class, known as objects.
- New classes are created using class declarations.
- Point myPoint = new Point(1,2);

```
public class Point
{
    public int x, y;
    public Point(int x, int y)
    {
        this.x = x;
        this.y = y;
    }
}
```

C# Structure – Classes

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects

A ***class*** declaration starts with a header that specifies

- the attributes and modifiers of the ***class***,
- the name of the ***class***,
- the base ***class***, and
- the interfaces implemented by the ***class***.

The header is followed by the ***class*** body, which consists of a list of member declarations written between the delimiters { and }.

```
public class Point
{
    public int x, y;
    public Point(int x, int y)
    {
        this.x = x;
        this.y = y;
    }
}
```

C# Structure - Classes

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/program-structure

The fully qualified name of this class is Acme.Collections.Stack.

Class Stack contains several ***members***:

A field:	Two methods:	A nested class:
•top,	•Push •Pop	•Entry.

The Entry class contains three ***members***

Two fields:	A parameterized constructor
•Next •data	

```
using System;
namespace Acme.Collections
{
    public class Stack
    {
        Entry top;
        public void Push(object data)
        {
            top = new Entry(top, data);
        }

        public object Pop()
        {
            if (top == null)
            {
                throw new InvalidOperationException();
            }
            object result = top.data;
            top = top.next;
            return result;
        }

        class Entry
        {
            public Entry next;
            public object data;
            public Entry(Entry next, object data)
            {
                this.next = next;
                this.data = data;
            }
        }
    }
}
```

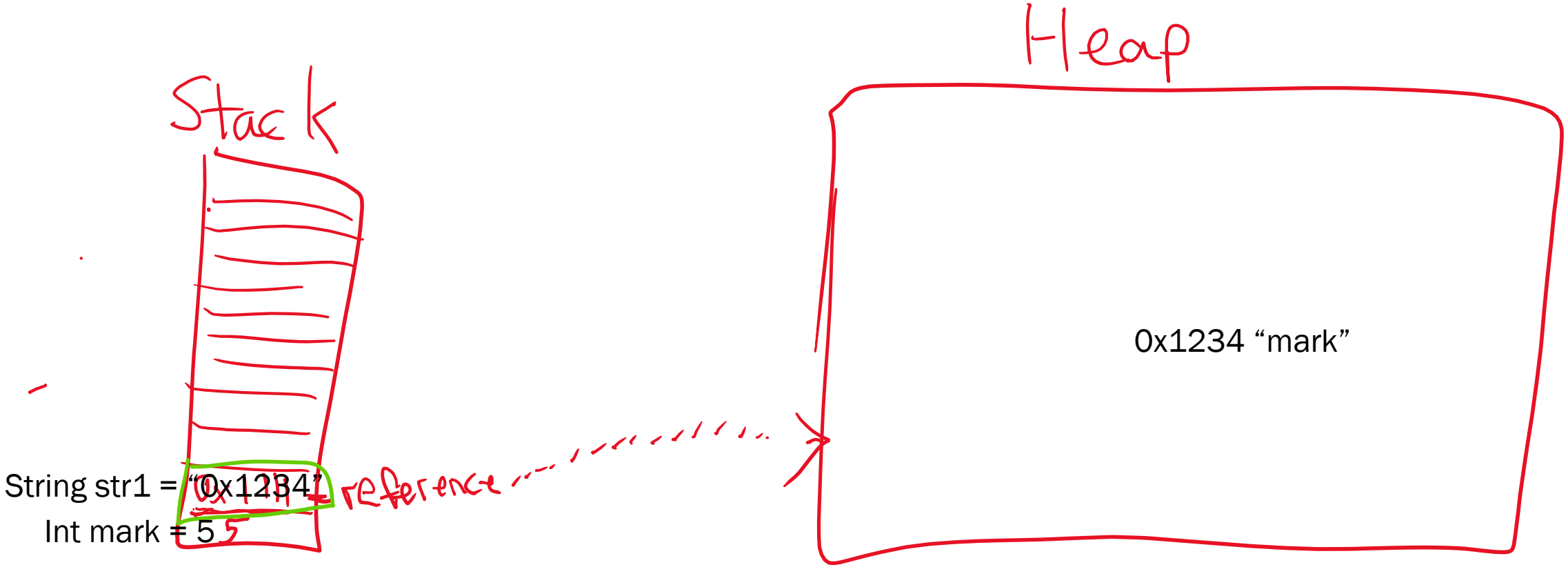
C# Structure – Data Types

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/types-and-variables

C# supports two kinds of variable ***types***:

Value types	Reference types
These are the built-in primitive data types, such as char, int, and float, as well as user-defined types declared with struct. These types directly contain their data.	Classes and other complex data types that are constructed from the primitive types. These types contain a reference to a location in memory where the data is directly held.
`int i = 123;`	`Child child3 = new Child();`

Stack and Heap



C# Structure – Expressions

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/expressions
https://docs.microsoft.com/en-us/dotnet/csharp/language-reference/operators/

- Expressions are constructed from ***operands*** and ***operators***.
- Operators are: +, -, *, /, ***new***
- *Operands are what the operators act upon: literals, fields, local variables, expressions*
- *Precedence* of the operators controls the order in which the individual operators are evaluated. (Basically PEMDAS).

```
var a = 2 + 2 * 2;
Console.WriteLine(a); //  output: 6
```

```
var a = (2 + 2) * 2;
Console.WriteLine(a); //  output: 8
```

```
int a = 13 / 5 / 2;
int b = 13 / (5 / 2);
Console.WriteLine($"a = {a}, b = {b}");
// output: a = 1, b = 6
```

C# Structure – Statements

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/statements

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The actions of any program are expressed using ***statements***. C# uses various ***statement*** types.

- A ***block*** consists of a list of statements written between the delimiters ***{ }***.
- ***Declaration*** used to create variables and constants.
- ***Expression*** statements are used to evaluate actions taken on values.
- ***Selection*** statements are used for "flow control".
- ***Iteration*** statements include the while, do, for, and foreach statements. They repeat until a predetermined condition is met.
- ***Jump*** statements are used to transfer control. This group contains the break, continue, goto, throw, return, and yield statements.

C# Structure – Block and Declaration Statements

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/statements

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A ***block*** permits multiple statements to be written in contexts where a single statement is allowed. A block consists of a list of statements written between the delimiters { }.

Declaration statements are used to declare local variables and constants.

Local Variable Declaration

```
static void Declarations(string[] args)
{
    int a;
    int b = 2, c = 3;
    a = 1;
    Console.WriteLine(a + b + c);
}
```

Local Constant Declaration

```
static void ConstantDeclarations(string[] args)
{
    const float pi = 3.1415927f;
    const int r = 25;
    Console.WriteLine(pi * r * r);
}
```

C# Structure - Expression Statements

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/statements

Expression statements are used to evaluate expressions: method invocations, object allocations using the new operator, assignments using =, compound assignment operators, increment (++) and decrement (--) operations and async/await expressions.

```
static void Expressions(string[] args)
{
    int i;
    i = 123;                // Expression statement
    Console.WriteLine(i);   // Expression statement
    i++;                    // Expression statement
    Console.WriteLine(i);   // Expression statement
}
```

C# Structure - Selection Statements

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/statements

Selection statements are used to select one of a number of possible statements for execution based on the value of some expression. This group contains the ***if*** and ***switch*** statements.

```
static void IfStatement(string[] args)
{
    if (args.Length == 0)
    {
        Console.WriteLine("No arguments");
    }
    else
    {
        Console.WriteLine("One or more arguments");
    }
}
```

```
static void SwitchStatement(string[] args)
{
    int n = args.Length;
    switch (n)
    {
        case 0:
            Console.WriteLine("No arguments");
            break;
        case 1:
            Console.WriteLine("One argument");
            break;
        default:
            Console.WriteLine($"{n} arguments");
            break;
    }
}
```

C# Structure - Iteration Statements

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/statements

Iteration statements are used to execute repeatedly an embedded statement. This group contains the ***while***, ***do***, ***for***, and ***foreach*** statements.

```
static void WhileStatement(string[] args)
{
    int i = 0;
    while (i < args.Length)
    {
        Console.WriteLine(args[i]);
        i++;
    }
}
```

```
static void ForEachStatement(string[] args)
{
    foreach (string s in args)
    {
        Console.WriteLine(s);
    }
}
```

```
static void ForStatement(string[] args)
{
    for (int i = 0; i < args.Length; i++)
    {
        Console.WriteLine(args[i]);
    }
}
```

```
static void DoStatement(string[] args)
{
    string s;
    do
    {
        s = Console.ReadLine();
        Console.WriteLine(s);
    } while (!string.IsNullOrEmpty(s));
}
```

C# Structure - Jump Statements

https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/statements

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Jump statements are used to transfer control. This group contains the break, continue, goto, throw, return, and yield statements.

```
static void BreakStatement(string[] args)
{
    while (true)
    {
        string s = Console.ReadLine();
        if (string.IsNullOrEmpty(s))
            break;
        Console.WriteLine(s);
    }
}
```

```
static void ContinueStatement(string[] args)
{
    for (int i = 0; i < args.Length; i++)
    {
        if (args[i].StartsWith("/"))
            continue;
        Console.WriteLine(args[i]);
    }
}
```

```
static int Add(int a, int b)
{
    return a + b;
}
static void ReturnStatement(string[] args)
{
   Console.WriteLine(Add(1, 2));
   return;
}
```

C# Structure – Methods

https://docs.microsoft.com/en-us/dotnet/csharp/methods

A method (procedure, function) is a code block that contains a series of statements. A program calls the method and includes any required arguments. Every C# command is executed within a method.

The ***Main*** method is the entry point for every C# application.

Methods are declared in a ***class*** or ***struct*** by specifying a method signature that contains:

- (optional) access level
- (optional) modifiers
- Return value
- Method name
- Method parameters

```
// Anyone can call this.
public void StartEngine() {/* Method statements here */ }

// Only derived classes can call this.
protected void AddGas(int gallons) { /* Method statements here */ }

// Derived classes can override the base class implementation.
public virtual int Drive(int miles, int speed) { /* Method statements here */ return 1; }
```

C# Structure – Method Invocation

https://docs.microsoft.com/en-us/dotnet/csharp/methods#method-invocation

There are two types of methods:

Instance and ***Static***

Instance methods

Require an object be instantiated to be called –
myClassInstance.doWork();

```
class TestMotorcycle : Motorcycle
{
   public override double GetTopSpeed()
   {
      return 108.4;
   }

   static void Main()
   {

      TestMotorcycle moto = new TestMotorcycle();

      moto.StartEngine();
      moto.AddGas(15);
      moto.Drive(5, 20);
      double speed = moto.GetTopSpeed();
      Console.WriteLine("My top speed is {0}", speed);
   }
}
```

C# Structure – Method Invocation

https://docs.microsoft.com/en-us/dotnet/csharp/methods#method-invocation

There are two types of methods:

Instance and ***Static***

Static methods

Can be called without instantiating an object –
myClassName.doWork();

```
public class Example
{
   public static void Main()
   {
      // Call with an int variable.
      int num = 4;
      int productA = Square(num);

      // Call with an integer literal.
      int productB = Square(12);

      // Call with an expression that evaluates to int.
      int productC = Square(productA * 3);
   }

   static int Square(int i)
   {
      // Store input argument in a local variable.
      int input = i;
      return input * input;
   }
}
```