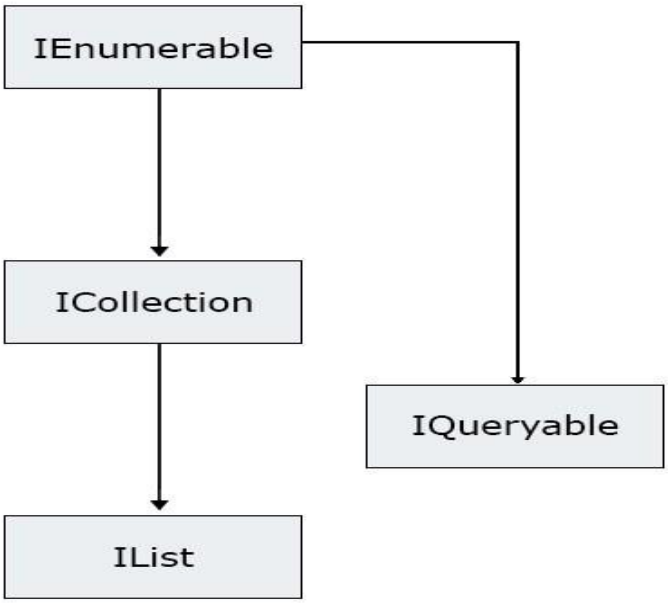


INHERITANCE

An IEnumerable is a list or a container which can hold some items. You can iterate through each element in the IEnumerable. You can not edit the items like adding, deleting, updating, etc. instead you just use a container to contain a list of items. It is the most basic type of list container.
All you get in an IEnumerable is an enumerator that helps in iterating over the elements. An IEnumerable does not hold even the count of the items in the list, instead, you have to iterate over the elements to get the count of items.

ICollection is another type of collection, which derives from IEnumerable and extends it's functionality to add, remove, update element in the list. ICollection also holds the count of elements in it and we does not need to iterate over all elements to get total number of elements.

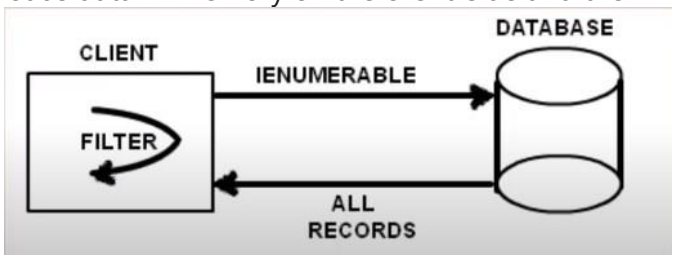
IList extends ICollection. An IList can perform all operations combined from IEnumerable and ICollection, and some more operations like inserting or removing an element in the middle of a list.

The following method just returns null:

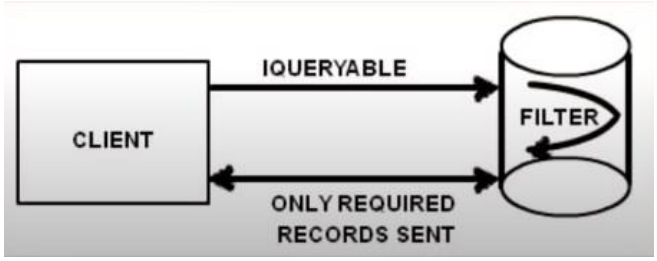
```
IEnumerable<object> Incorrect()
{
   return null;
}
```

IEnumerable vs IQueryable

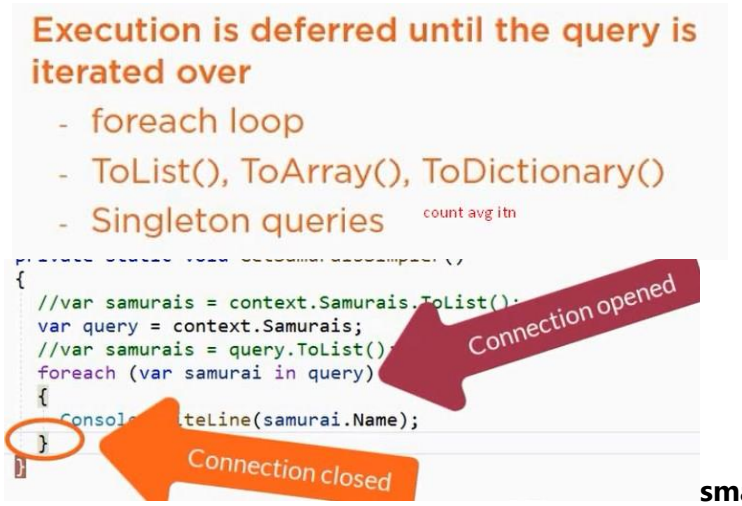
IEnumerable
IEnumerable is suitable for querying data from in-memory collections like List, Array and so on.
While querying data from the database, IEnumerable executes "select query" on the server-side, loads data in-memory on the client-side and then filters the data.



IQueryable
IQueryable is suitable for querying data from out-memory (like remote database, service) collections.
While querying data from a database, IQueryable executes a "select query" on server-side with all filters.



to execute



smarter to get result first than iteretaing

Dispose and Finalize

Method dispose( ) is used to free unmanaged resources whenever it is invoked.
Method finalize( ) is used to free unmanaged resources before the object is destroyed.

the method **dispose**() has to be explicitly invoked by the user whereas, the method **finalize()** is invoked by the garbage collector, just before the object is destroyed.
As you have seen, finalizers can be used to release unmanaged resources when the garbage collector kicks in.
IDisposable provide a
way for the object user to clean up the object as soon as it is finished. However, if the caller forgets to call Dispose(), the unmanaged resources may be held in memory indefinitely.

As keyword
The operator as also is used for type conversion but invalid conversion returns null, not an exception.
Is keyword
The is operator is used to check if the run-time type of an object is compatible with the given type or not. It returns *true* if the given object is of the same type otherwise, return *false*. It also returns *false* for *null* objects for derived objects it will return true

Elvis operator – ?.
The operator lets you access members and elements only when the receiver is not-null, returning null result otherwise.
int? length = people?.Length; // null if people is null

?? Operator

it is placed between two operands and returns the left operand only if its value is not null, otherwise it returns the right operand.

Casting base to extend vs extend to base

It is possible to cast an **instance** of the *extended* class to the base class. It is however **not** possible to cast an instance of the base class to the extended.

```
//Posible
BaseClass baseObj = new ExtendedClass(); // Creating instance of extended and implicit up-cast it to base
ExtendedClass extendedObj = (ExtendedClass)baseObj; // Down-cast of the reference stored in "baseObj" to the extended obj.

//InvalidCastException
BaseClass baseObj1 = new BaseClass();
ExtendedClass extendedObj1 = (ExtendedClass)baseObj1;

//Posible
ExtendedClass ExtendedClass3 = new ExtendedClass();
BaseClass base123 = (BaseClass)ExtendedClass3;
```

foreach loop

The foreach-loop statement is used, when we do not need to change the elements, but just to read them.

always through all elements – from the start to the end(different from for-loop)

The loop variable in foreach-loops is read-only so we cannot modify the current loop item from the loop body.

must implement IEnumerable and provide

```
public IEnumerator GetEnumerator()
{
```

```
// Return the array object's IEnumerator.
return carArray.GetEnumerator();
}
```
the foreach construct will obtain the interface in the background when necessary.

object initializer syntax

```
// Make a Point by setting each property manually.
Point firstPoint = new Point();
firstPoint.X = 10;
firstPoint.Y = 10;
firstPoint.DisplayStats();
// Or make a Point via a custom constructor.
Point anotherPoint = new Point(20, 20);
anotherPoint.DisplayStats();
// Or make a Point using object init syntax. the default constructor is called implicitly.
Point finalPoint = new Point { X = 30, Y = 30 };
```
The final Point variable is not making use of a custom constructor (as one might do traditionally) but
is rather setting values to the public X and Y properties. Behind the scenes, the type's default constructor is invoked, followed by setting the values to the specified properties. To this end, object initialization syntax is just shorthand notation for the syntax used to create a class variable using a default constructor and to set the state data property by property

```
// Here, the default constructor is called explicitly.
Point finalPoint = new Point() { X = 30, Y = 30 };
/ Calling a custom constructor
Point pt = new Point(10, 16) { X = 100, Y = 100 };
```
the following Point declaration results in an X value of 100 and a Y value of 100, regardless of the fact that the constructor arguments specified the values 10 and 16

```
// Calling a more interesting custom constructor with init syntax.
Point goldPoint = new Point(PointColor.Gold){ X = 90, Y = 20 };

// Create and initialize a Rectangle.
Rectangle myRect = new Rectangle
{
TopLeft = new Point { X = 10, Y = 10 },
BottomRight = new Point { X = 200, Y = 200}
}
```
Properties

traditional get and set methods

Although you can encapsulate a piece of field data using traditional get and set methods, .NET Core languages prefer to enforce data encapsulation state data using properties. First, understand that properties are just a container for "real" accessor(get) and mutator(set)

methods, named get and set, respectively. Therefore, as a class designer, you are still able to perform any internal logic necessary before making the value assignment

```
// Accessor (get method).
 public string GetName() => _empName;
 // Mutator (set method).
 public void SetName(string name)
 {
 // Do a check on incoming value
 // before making assignment.
 if (name.Length > 15)
 {
 Console.WriteLine("Error! Name length exceeds 15 characters!");
 }
 else
 {
 _empName = name;
 }
 }
```

Properties

```
// Field data.
 private string _empName;
 private int _empId;
private float _currPay;

 // Properties!
 public string Name
 {
 get { return _empName; }
 set
 {
 if (value.Length > 15)
 {
 Console.WriteLine("Error! Name length exceeds 15 characters!");
 }
 else
 {
 _empName = value;
 }
 }
 }
 // We could add additional business rules to the sets of these properties;
 // however, there is no need to do so for this example.
 public int Id
 {
```

```
 get { return _empId; }
 set { _empId = value; }
 }
 public float Pay
 {
 get { return _currPay; }
 set { _currPay = value; }
 }
```

Automatic Properties

When defining automatic properties, you simply specify the access modifier, underlying data type, property name, and empty get/set scopes. At compile time, your type will be provided with an autogenerated private backing field and a fitting implementation of the get/set logic. The name of the autogenerated private backing field is not visible within your C# codebase. The only way to see it is to make use of a tool such as ildasm.exe.
the compiler implicitly declares a readonly backing field.
As a result, these properties can only be assigned a value in the constructor or inline
Be aware of course that if you are
building a property that requires additional code beyond getting and setting the underlying private field
(such as data validation logic, writing to an event log, communicating with a database, etc.), you will be
required to define a "normal" .NET property type by hand. C# automatic properties never do more than
provide simple encapsulation for an underlying piece of (compiler-generated) private data.

Since C# version 6, it is possible to define a "read-only automatic property" by omitting the set scope. Read-only autoproperties can only be set in the constructor. However, it is not possible to define a write-only property. To solidify, consider the following: // Read-only property? This is OK! public int MyReadOnlyProp { get; } // Write only property? Error! public int MyWriteOnlyProp { set; }

Sealed methods

```
class X {
 protected virtual void F() { Console.WriteLine("X.F"); }
 protected virtual void F2() { Console.WriteLine("X.F2"); }
}
class Y : X {
 sealed protected override void F() {
Console.WriteLine("Y.F"); }
 protected override void F2() { Console.WriteLine("X.F3"); }
}
class Z : Y {
 // Attempting to override F causes compiler error CS0239.
```

```
 // protected override void F() { Console.WriteLine("C.F"); }
 // Overriding F2 is allowed.
 protected override void F2() { Console.WriteLine("Z.F2"); }
}
```

Passing by reference

Hence, whenever an argument of a reference type is passed to a method, the method's parameter receives the reference itself
passing arguments of reference type, only the value of the variable that keeps the address to the object is copied. Note that this does not copy the object itself.
By passing the argument that are of reference type, the only thing that is copied is the variable that keeps the reference to the object, but not the object data.
primitive types are passed by their values, the objects, however, are passed by reference.

```
class Program
{
   static void Main(string[] args)
   {
      int arg;

      // Passing by value.
      // The value of arg in Main is not changed.
      arg = 4;
      squareVal(arg);
      Console.WriteLine(arg);
      // Output: 4

      // Passing by reference.
      // The value of arg in Main is changed.
      arg = 4;
      squareRef(ref arg);
      Console.WriteLine(arg);
      // Output: 16
```

```
    }

    static void squareVal(int valParameter)
    {
        valParameter *= valParameter;
    }

    // Passing by reference
    static void squareRef(ref int refParameter)
    {
        refParameter *= refParameter;
    }
}
```

Coupling

Most of the classes from .NET Common Type System (CTS) and .NET Framework define methods that depend only on the data within their class and the passed arguments. In standard libraries, the methods dependencies from external classes are minimal and that is why they are easy to reuse. The .NET Framework class library strongly follows the idea of loose coupling. Whenever a method reads or modifies global data and depends on 10 additional objects, which must be initialized within the instance of its own class, it is considered a coupled to its environment

Sealed methods

Sealing of methods is done when we rely on a piece of functionality and we don't want it to be altered. We already know that methods are sealed by default. But if we want a base class virtual method to become sealed in a derived class, we use override sealed.

Polymorphism

Polymorphism allows treating objects of a derived class as objects of its base class
it is mostly related to overriding methods in derived classes, in order to change their original behavior

```
Lion lion = new AfricanLion(false, 60);
 lion.CatchPrey(null); // Will print "AfricanLion.CatchPrey", because // the variable lion has a value of type AfricanLion
```

the overwritten method is called and not the base method. This happens, because it is validated what the actual class behind the variable is and whether it implements (overwrites) that method.

Rewriting of methods is also called overriding of virtual methods. Virtual methods as well as abstract methods can be overridden. Abstract methods are actually virtual methods without a specific implementation. All methods defined in an interface are abstract and therefore virtual, although this is not explicitly defined.
When Should We Use Polymorphism? The answer to this question is simple: whenever we want to enable changing a method's implementation in a derived class.

method hiding

```
class A
{
    public virtual void show()
    {
        Console.WriteLine("Hello: Base Class!");
        Console.ReadLine();
    }
}

class B : A
{
    public override void show()
    {
        Console.WriteLine("Hello: Derived Class!");
        Console.ReadLine();
    }
}

class C : B
{
    public new void show()
    {
        Console.WriteLine("Am Here!");
        Console.ReadLine();
    }
}

class Polymorphism
{
    public static void Main()
    {
        A a1 = new A();
        a1.show();
        B b1 = new B();
        b1.show();
        C c1 = new C();
        c1.show();
        A a2 = new B();
        a2.show();
```

```
        A a3 = new C();
        a3.show();
        B b3 = new C();
        b3.show();
    }
  }
}
```

hello base
hello derivered
am here
hello derivered
hello derivered
helllo derivered

za new ako napravis inatanca od svojata klasa ke bide toj metod ako ne go krie i bara drug

```
    C c1 = new C();
```

bez polimorfizam ke bide toj metod
so polimorfizam drug metod
ke odi gore i ke bara duri ako e new ke go zeme

Нема Полиморфизам

```
class Program
  {
    class A {
        public void  F() {
            Console.WriteLine("A.F");
        }
    }
    class B : A
    {
        public  void F()
        {
            Console.WriteLine("B.F");
        }
    }
    static void Main(string[] args)
    {
```

```
        A a = new B();
        a.F();
          //print AF
        Console.ReadLine();
      }
    }



class Program
    {

      class A {
        public virtual void F() {
          Console.WriteLine("A.F");
        }
      }

      class B : A
      {
        public void F()
        {
          Console.WriteLine("B.F");
        }
      }

      static void Main(string[] args)
      {

        A a = new A();
        A b1 = new B();

        B b = new B();

        a.F();
        b1.F();
        b.F();

        Console.ReadLine();

//Output
```

```
        A.f
        A.f
        B.f
    }
}
```

Метод со virtual може да се препокрие но не мора

```
class Program
  {
    class A {
      public virtual void F() {
        Console.WriteLine("A.F");
      }
    }
    class B : A
    {
    }
    static void Main(string[] args)
    {
      A a = new B();
      a.F();
       //print AF
      Console.ReadLine();
    }
  }
```

Чист Полиморфизам

```
class Program
  {
    class A {
      public virtual void F() {
        Console.WriteLine("A.F");
      }
    }
    class B : A
    {
      public override void F()
      {
        Console.WriteLine("B.F");
      }
    }
    static void Main(string[] args)
    {
      A a = new B();
      a.F();
       //print bf
      Console.ReadLine();
    }
  }
```

Метод со abstract мора да се препокрие

```
abstract class A {
      public abstract void F();
    }

    class B : A //compile-error program B does not impement inherited memeber
    {

    }
```

Encapsulation

```
private Paw frontLeft;
private Paw frontRight;
private Paw bottomLeft;
private Paw bottomRight;

private void MovePaw(Paw paw)
 { // ...
 }
public override void Walk()
{ this.MovePaw(frontLeft);
this.MovePaw(frontRight);
this.MovePaw(bottomLeft);
this.MovePaw(bottomRight);
 }
}
```

The public method Walk() calls some other private method 4 times. That way the base class is short – it consists of a single method. The implementation, however, calls another of its methods, which is hidden from the users of the class.

Interfaces

```
interface IFile
{
   void ReadFile();
   void WriteFile(string text);
}

class FileInfo : IFile
{
   public void ReadFile()
   {
      Console.WriteLine("Reading File");
   }

   public void WriteFile(string text)
   {
      Console.WriteLine("Writing to file");
   }
}
public class Program
{
   public static void Main()
```

```
    {
        IFile file1 = new FileInfo();
        FileInfo file2 = new FileInfo();

        file1.ReadFile();
        file1.WriteFile("content");

        file2.ReadFile();
        file2.WriteFile("content");
    }
}
```

```
Reading File
Writing to file
Reading File
Writing to file
```

Above, we created objects of the FileInfo class and assign it to IFile type variable and FileInfo type variable. When interface implemented implicitly, you can access IFile members with the IFile type variables as well as FileInfo type variable.

Explicit Implementation

An interface can be implemented explicitly using <InterfaceName>.<MemberName>. Explicit implementation is useful when class is implementing multiple interfaces; thereby, it is more readable and eliminates the confusion. It is also useful if interfaces have the same method name coincidently.

```
interface IFile
{
    void ReadFile();
    void WriteFile(string text);
}

class FileInfo : IFile
{
    void IFile.ReadFile()
    {
        Console.WriteLine("Reading File");
    }

    void IFile.WriteFile(string text)
    {
        Console.WriteLine("Writing to file");
    }

    public void Search(string text)
    {
        Console.WriteLine("Searching in file");
    }
}
```

```
public class Program
{
    public static void Main()
    {
        IFile file1 = new FileInfo();
        FileInfo file2 = new FileInfo();

        file1.ReadFile();
        file1.WriteFile("content");
        //file1.Search("text to be searched")//compile-time error

        file2.Search("text to be searched");
        //file2.ReadFile(); //compile-time error
        //file2.WriteFile("content"); //compile-time error
    }
}
```

When you implement an interface explicitly, you can access interface members only through the instance of an interface type

In the above example, `file1` object can only access members of `IFile`, and `file2` can only access members of `FileInfo` class. This is the limitation of explicit implementation.

Implementing Multiple Interfaces

A class or struct can implement multiple interfaces. It must provide the implementation of all the members of all interfaces.

Example: Implement Multiple Interfaces

```
interface IFile
{
    void ReadFile();
}

interface IBinaryFile
{
    void OpenBinaryFile();
    void ReadFile();
}

class FileInfo : IFile, IBinaryFile
{
    void IFile.ReadFile()
    {
        Console.WriteLine("Reading Text File");
    }

    void IBinaryFile.OpenBinaryFile()
    {
```

```
        Console.WriteLine("Opening Binary File");
    }

    void IBinaryFile.ReadFile()
    {
        Console.WriteLine("Reading Binary File");
    }

    public void Search(string text)
    {
        Console.WriteLine("Searching in File");
    }
}

public class Program
{
    public static void Main()
    {
        IFile file1 = new FileInfo();
        IBinaryFile file2 = new FileInfo();
        FileInfo file3 = new FileInfo();

        file1.ReadFile();
        //file1.OpenBinaryFile(); //compile-time error
        //file1.SearchFile("text to be searched"); //compile-time error

        file2.OpenBinaryFile();
        file2.ReadFile();
        //file2.SearchFile("text to be searched"); //compile-time error

        file3.Search("text to be searched");
        //file3.ReadFile(); //compile-time error
        //file3.OpenBinaryFile(); //compile-time error
    }
}
```

Above, the FileInfo implements two interfaces IFile and IBinaryFile explicitly. It is recommended to implement interfaces explicitly when implementing multiple interfaces to avoid confusion and more readability.

An interface can only declare methods and constants

The members of an interface never specify an access modifier (as all interface members are implicitly public and abstract

```
public interface IDrawToForm
   {
      void Draw();
   }
   // Draw to buffer in memory.
   public interface IDrawToMemory
   {
      void Draw();
   }
   // Render to the printer.
   public interface IDrawToPrinter
   {
      void Draw();
   }
   class Octagon : IDrawToForm, IDrawToMemory, IDrawToPrinter
   {
       void IDrawToForm.Draw()
      {

         Debug.WriteLine("Drawing the IDrawToForm...");
      }

      public void Draw()
      {
         // Shared drawing logic.
         Debug.WriteLine("Drawing the Octagon...");
      }
   }

   class Program
   {
      static void Main(string[] args)
      {
         Octagon oct = new Octagon();
         oct.Draw();//ke se povika Drawing the Octagon
        IDrawToForm oct1 = (IDrawToForm)oct;
         oct1.Draw();//ke se povika Drawing the IDrawToForm
      }
   }
```

explicitly implemented members are always implicitly private
implicit are public
Explicit can not be called outside the class cz they are private
and must be casted to be used

```
IDrawToForm oct1 = (IDrawToForm)oct
```

or

```
public class SampleClass : IControl, ISurface
{
   void IControl.Paint()
   {
```

```
        System.Console.WriteLine("IControl.Paint");
    }
    void ISurface.Paint()
    {
        System.Console.WriteLine("ISurface.Paint");
    }
}
```

The class member IControl.Paint is only available through the IControl interface, and ISurface.Paint is only available through ISurface. Both method implementations are separate, and neither are available directly on the class. For example:

```
// Call the Paint methods from Main.

SampleClass obj = new SampleClass();
//obj.Paint();  // Compiler error.

IControl c = obj;
c.Paint();  // Calls IControl.Paint on SampleClass.

ISurface s = obj;
s.Paint(); // Calls ISurface.Paint on SampleClass.

// Output:
// IControl.Paint
// ISurface.Paint
```

abstarct vs interface

od abstrakna klasa ne moze da se napravi objekt
dodeka od interface moze da se napravi objekt kakde toj objekt ke bide od klasata sto go implementira toj interface(toj objekt ke gi ima samo metodite bez data fileds)

Abstract classes Vs Interfaces

Abstract classes can have implementations for some of its members (Methods), but the interface can't have implementation for any of its members.

Interfaces cannot have fields where as an abstract class can have fields.

An interface can inherit from another interface only and cannot inherit from an abstract class, where as an abstract class can inherit from another abstract class or another interface.

A class can inherit from multiple interfaces at the same time, where as a class cannot inherit from multiple classes at the same time.

Abstract class members can have access modifiers where as interface members cannot have access modifiers.

Why use abstract class

```
public class FullTimeEmployee
{
    public int ID { get; set; }
    public string FirstName { get; set; }
    public string LastName { get; set; }
    public int AnnualSalary { get; set; }

    public string GetFullName()
    {
        return this.FirstName + " " + LastName;
    }

    public int GetMonthlySalary()
    {
        return this.AnnualSalary / 12;
    }
}
```

```
public class ContractEmployee
{
    public int ID { get; set; }
    public string FirstName { get; set; }
    public string LastName { get; set; }
    public int HourlyPay { get; set; }
    public int TotalHoursWorked { get; set; }

    public string GetFullName()
    {
        return this.FirstName + " " + LastName;
    }

    public int GetMonthlySalary()
    {
        return this.HourlyPay * this.TotalHoursWorked;
    }
}
```

Notice that, we have designed FullTimeEmployee and ContractEmployee classes as stand-alone classes. Regardless of the employee type, all employees in the organisation are going to have ID, FirstName and LastName properties. We also compute the FullName of any employee by concatenating their FirstName and LastName. This means that, the above two classes (FullTimeEmployee & ContractEmployee) are related and there is, a lot of common functionality duplicated in them.

Why use abstract class

```
public class FullTimeEmployee
{
    public int ID { get; set; }
    public string FirstName { get; set; }
    public string LastName { get; set; }
    public int AnnualSalary { get; set; }

    public string GetFullName()
    {
        return this.FirstName + " " + LastName;
    }

    public int GetMonthlySalary()
    {
        return this.AnnualSalary / 12;
    }
}
```

```
public class ContractEmployee
{
    public int ID { get; set; }
    public string FirstName { get; set; }
    public string LastName { get; set; }
    public int HourlyPay { get; set; }
    public int TotalHoursWorked { get; set; }

    public string GetFullName()
    {
        return this.FirstName + " " + LastName;
    }

    public int GetMonthlySalary()
    {
        return this.HourlyPay * this.TotalHoursWorked;
    }
}
```

The problem with this design is that, tomorrow, if want to introduce MiddleName property and if we have to include it in the computation of FullName, then we have to make the same change in both the classes. So code maintainability is going to be a big issue with this design.

To avoid these issues, we can move the common functionality into a base class. Using a common base class, we are going to get rid of the duplicated code.

Why use abstract class

The obvious next question is, How should we design the base class?

1. Should we design it as an abstract class

OR

2. Should we design it as a Concrete (Non abstract) class

If we create "BaseEmployee " class as a concrete (Non abstract) class, there is nothing stopping us from creating an instance of BaseEmployee class. We only have 2 types of employees in our organisation - ContractEmployee & FullTimeEmployee. The developers should only able to instantiate ContractEmployee & FullTimeEmployee classes and not BaseEmployee class.

So, in short, we would create an abstract class, when want to move the common functionality of 2 or more related classes into a base class and when, we don't want that base class to be instantiated.

Var keyword

var cannot be used as field data!

var cannot be used as a return value or parameter type!

Must assign value at exact time of declaration

Can't assign null as initial value!

static int GetAnInt()//it is allowed if is same type var and int

{var retVal = 9; return retVal;}

Virtual

If a base class wants to define a method that may be (but does not have to be) overridden by a subclass, it must mark the method with the virtual keyword.

A method, which can be overridden, is called virtual. In .NET, methods are not virtual by default.

In Java, you don't have to write `@Override` in order to override a method with the same signature. It is like that *by default*. That is not the case in C#, as you *have to* prefix `virtual`

A method, which can be overridden in a derived class, is called a virtual method. Methods in .NET by default aren't virtual. If we want to make a method virtual, we mark it with the keyword virtual. Then the derived class can declare and define a method with the same signature.

Virtual methods as well as abstract methods can be overridden. Abstract methods are actually virtual methods without a specific implementation. All methods defined in an interface are abstract and therefore virtual, although this is not explicitly defined

```
public class Object  // zatoa MOZE DA SE MENUVA ToString
public Object();
[…] public virtual bool Equals(object obj);
 […] public static bool Equals(object objA, object objB);
[…] public virtual int GetHashCode();
[…] public Type GetType();
[…] protected object MemberwiseClone();
 […] public virtual string ToString();
```

```
A test = new B();
```

- **at compile time:** the compiler only knows that the variable `test` is of the type `A`. He does not know that we are actually giving him an instance of `B`. Therefore the compile-type of `test` is `A`.
- **at run time:** the type of `test` is known to be `B` and therefore has the run time type of `B`

Consider the following code statement:

```
((A)new B()).Test();
```

We are creating an instance of `B` casting it into the type `A` and invoking the `Test()` method on that object. The compiler type is `A` and the runtime type is `B`.

When the compiler wants to resolve the `.Test()` call he has a problem.

Because `A.Test()` is `virtual` the compiler can not simply call `A.Test` because the instance stored might have overridden the method.

The compile itself can not determine which of the methods to call `A.Test()` or `B.Test()`. The method which is getting invoked is determined by the runtime and not "hardcoded" by the compiler

Virtual -the most derievered

10.5.3 Virtual Methods

When an instance method declaration includes a `virtual` modifier, that method is said to be a virtual method. When no `virtual` modifier is present, the method is said to be a non-virtual method.

The implementation of a nonvirtual method is invariant: The implementation is the same whether the method is invoked on an instance of the class in which it is declared or an instance of a derived class. In contrast, the implementation of a virtual method can be superseded by derived classes. The process of superseding the implementation of an inherited virtual method is known as ***overriding*** that method (§10.5.4).

In a virtual method invocation, the ***runtime type*** of the instance for which that invocation takes place determines the actual method implementation to invoke. In a nonvirtual method invocation, the ***compile-time type*** of the instance is the determining factor. In precise terms, when a method named `N` is invoked with an argument list `A` on an instance with a compile-time type `C` and a runtime type `R` (where `R` is either `C` or a class derived from `C`), the invocation is processed as follows.

- Then, if `M` is a nonvirtual method, `M` is invoked.
- Otherwise, `M` is a virtual method, and the most derived implementation of `M` with respect to `R` is invoked.

but the latest override(of that method (same signature)) is taken into consideration.

abstract method

Clearly, this is not an intelligent design for the current hierarchy. To force each child class to override the Draw() method, you can define Draw() as an abstract method of the Shape class, which by definition means you provide no default implementation whatsoever. To mark a method as abstract in C#, you use the abstract keyword. Notice that abstract members do not provide any implementation whatsoever.

```
abstract class Shape {
 // Force all child classes to define how to be rendered.
 public abstract void Draw(); ...
}
```

■ Note Abstract methods can be defined only in abstract classes. If you attempt to do otherwise, you will be issued a compiler error.

Base

:base(some params)

The idea is that the fields of the base class should be initialized before we start initializing fields of the inheriting class, because they might depend on a base class field.

Static

In C#, unlike VB.NET and Java, you can't access static members with instance syntax.

use of static methods and constants, which do not belong to any particular object.

All objects, created by the description of a given class (that is, instances of a given class), share the static fields of the class.

This initialization will complete during the first invocation to the static field.

od staticen context moze samo staticni raboti(metod,variabli)

The problem with the access to non-static elements of the class of static method has a single solution – these non-static elements are accessed by reference to an object

Like static methods, the keyword this cannot be used in the static properties, as the static property is associated only with the class and does not “recognize” objects of a class.

Static properties can be accessed only through dot notation, applied to the name of the class in which they are declared.

When a class is declared as static, it is an indication that this class contains only static members (i.e. static fields, methods, properties) and cannot be instantiated.

Static constructors can be declared both in static and in non-static classes. They are executed only once when the first of the following two events occurs for the first time:

1. An object of class is created.
2. A static element of the class is accessed (field, method, property).

Most often static constructors are used for initialization of static fields. A static constructor cannot be called directly and is only meant to be called by the common language runtime (CLR). It is invoked automatically.The user has no control on when the static constructor is executed in the program.

A static constructor does not take access modifiers or have parameters.

The static constructor executes before any instance-level constructors

Constructor

If we declare at least one constructor in a given class, the compiler will not create a default constructor for us.

When we do not declare any constructor in a given class, the compiler will create one, known as a default implicit constructor.

If a class has private constructors only, then it cannot be inherited

If a class has private constructors only, then this could indicate many other things. For example, no-one (other than that class itself) can create instances of such a class. Actually, that's how one of the most popular design patterns (Singleton) is implemented.
A class that has only private constructors cannot be instantiated. Such class usually has only static members and is called "utility class"
if we did not specify public the constructor is private and can not be instantiated

Singleton

```
public class Singleton {
// The single instance private static Singleton instance;
// Initialize the single instance
 static Singleton() { instance = new Singleton(); }
// The property for retrieving the single instance
 public static Singleton Instance { get { return instance; } }
// Private constructor: protects against direct instantiation
private Singleton() { }
}
```

We have a hidden (private) constructor in order to limit external instantiations. We have a static variable, which holds the only instance. We initialize it only once in the static constructor of the class. The property for retrieving the single instance is usually called Instance.

Constatnts

constants always have the same value
the readonly fields are called run-time constants – constants, because their values cannot be changed after assignment and run-time, Fields, declared as readonly, allow one-time initialization either in the moment of the declaration or in the class constructors.
const
compile-time constants, because they are replaced with the value during the compilation process.
They can be accessed without to create an instance (an object) of the class
Although the constants declared with a modifier const are static fields, they must not and cannot use the static modifier in their declaration.
Constants declared with modifier const must be of primitive, enumeration or reference type, and if they are of reference type, this type must be either a string or the value, that we assign to the constant, must be null.
When we want to declare reference type constants, which cannot be calculated during compilation of the program, we must use a combination of static readonly modifiers, instead of const modifier.

The compiletime constants (const) must be initialized at the moment of declaration, while the run-time constants (static readonly) can be initialized at a later stage, for example in one of the constructors of the class in which they are defined.
readonly mora? static ako treba da bide pristapena od druga klasa

Class
Without specifying **public** the **class is** implicitly internal . This **means** that the **class is** only visible inside the same assembly(project). When you specify **public** , the **class is** visible outside the assembly
Just to know, if we want to use a class with access level public from other namespace, different from the current, we should use the reserved word for including different namespaces using or every time we should write the full name of the class
class can be:
1. Static class
2. Abstract class
3. Partial class
4. Sealed class
5.private class only nested

It is also possible to apply the static keyword directly on the class level. When a class has been defined as static, it is not creatable using the new keyword, and it can contain only members or data fields marked with the static keyword. If this is not the case, you receive compiler errors.

Abstarct class can not be instantiated.
A class that has only private constructors cannot be instantiated((other than that class itself))
When a class is declared as static, it is an indication that this class contains only static members (i.e. static fields, methods, properties) and cannot be instantiated.

Inner Classe
Consider an example. Let's have a class for car – Car. Each car has an engine and doors. Unlike the car's door, however, the engine makes no sense regarded as being outside the car, because without it, the car cannot run, i.e. we have composition
When the connection between the two classes is a composition, the class, which consequently is a part of another class, is convenient to be declared as inner class. Therefore, if you declare the class for a car: Car would be appropriate to create an inner class Engine, which will reflect the appropriate concept for the car engine:

Sealed Class
The string class has no virtual methods. In fact, inheriting string is entirely forbidden for inheritance through the keyword sealed in its declaration.

public sealed class String //zatoa NE MOZE DA SE NASLEDUVA OD STRING I DA SE MENUVAAT FUNKCIITE
[...] public String(char* value);
[...] public int IndexOf(string value);
[...] public string Normalize();
[...] public string[] Split(params char[] separator);
[...] public string Substring(int startIndex);
[...] public string ToLower(CultureInfo culture);

Partial Class

we created a partial class called User in User1.cs class we created a partial class called User in User2.cs class.When you execute the above code, the compiler will combine these two partial classes into one User class the compiler will combine all the partial classes into single class while executingthe application in c# programming langauge.

Utility Class

a class (or structure) that exposes only static functionality is often termed a *utility class*.
When designing a utility class, it is good practice to apply the static keyword to the class definition.

Abstract Class

Each class with at least one abstract method must be abstract. Makes sense, right? However, the opposite is not true. It is possible to define a class as an abstract one, even when there are no abstract methods in it.

it is perfectly fine (and common) for abstract classes to define any number of constructors that are called *indirectly* when derived classes are allocated.

Namespaces

the namespaces in C# are named group of classes

String

to change the value, it will be saved to a new location in the dynamic memory and the variable will point to it.Access to the character of a certain position in a string is done with the operator [] (indexer), but it is allowed only to read characters (and not to write to them)
The change of either variable will affect only itself because of the immutability of the type string, as when a change occurs, a copy of the changed string will be created. This is not true for the rest of the reference types (the normal, mutable types) because with them the changes are made directly in the address in memory and all references point to this changed address

Memory Optimization for Strings (Interning)

When not initializing the strings with literals, no interning is used. However, if we want to use interning specifically, we can make it through the use of the method Intern(...):

Override
It is used to modify a virtual or abstract method

Exception
Exceptions in .NET are two types – system and application. System exceptions are defined in .NET libraries and are used by the framework, while application exceptions are defined by application developers and are used by the application software. When we, as developers, design our own exception classes, it is a good practice to inherit from ApplicationException and not directly from SystemException (or even worse – directly from Exception). SystemException should only be inherited internally within the .NET Framework.

Stack and Heap
Stack is used for static **memory** allocation and **Heap** for dynamic **memory** allocation, both stored in the computer's **RAM** . Variables allocated on the **stack** are stored directly to the **memory** and access to this **memory** is very fast, and it's allocation is dealt with when the program is compiled

ArrayList
Represents a dynamically sized collection of objects listed in sequential order
is Non-Generic
It is an Object Type, so you can store any data type into it.
Boxing and Unboxing will happen.
array list i list imaat kapacitet 4 koga ke se stavi barem edno
koga ke se napravi insert vo arraylist se pretvara vo object
vo C# moze primitivni tipovi da se cuvaat vo List i vo ArrayList i vo staticarray

List
list e genericka
array list i list imaat kapacitet 4 koga ke se stavi barem edno
vo C# moze primitivni tipovi da se cuvaat vo List i vo ArrayList i vo staticarray

The Remove method always removes the first instance it encounters.
true if item is successfully removed; otherwise, false. This method also returns false if item was not found in the List<T>.
The value can be null for reference types.
If type T implements the IEquatable<T> generic interface, the equality comparer is the Equals method of that interface; otherwise, the default equality comparer is Object.Equals.
This method performs a linear search; therefore, this method is an O(*n*) operation, where *n* is Count.

Except

The set difference of two sets is defined as the members of the first set that don't appear in the second set.
This method returns those elements in first that don't appear in second. It doesn't return those elements in second that don't appear in first. Only unique elements are returned.

```
double[] numbers1 = { 2.0, 2.0, 2.1, 2.2, 2.3, 2.3, 2.4, 2.5 };
double[] numbers2 = { 2.2 };

IEnumerable<double> onlyInFirstSet = numbers1.Except(numbers2);

foreach (double number in onlyInFirstSet)
    Console.WriteLine(number);

/*
 This code produces the following output:

 2
 2.1
 2.3
 2.4
 2.5
*/
```

If you want to compare sequences of objects of some custom data type, you have to implement the IEquatable<T> generic interface in a helper class. The following code example shows how to implement this interface in a custom data type and override GetHashCode and Equals methods.

```
public class ProductA: IEquatable<ProductA>
{
    public string Name { get; set; }
    public int Code { get; set; }
```

```
    public bool Equals(ProductA other)
    {
        if (other is null)
            return false;

        return this.Name == other.Name && this.Code == other.Code;
    }

    public override bool Equals(object obj) => Equals(obj as ProductA);//go koristi Equals gore
    public override int GetHashCode() => (Name, Code).GetHashCode();//mislam ne mora
GetHashCode
}
```

Task

A Task can be seen as a convenient and easy way to execute something asynchronously and in parallel. In other programming languages and frameworks this may be known as a promise - "I promise will return to you at some point". A task will by default use the Threadpool, which saves resources as creating threads can be expensive. A threadpool is.. a pool of threads, which are ready to carry out instructions (if they are no occupied of course). You can see a Task as a higher level abstraction upon threads. Which could be a reason why they are under the System.Threading namespace.

Inheretance properties

In addition to Yacoub's answer, in this case, Enemy would not contain the properties, and methods that Ogre has.

```
public class Enemy
{
    public int Property1 { get; set; }
    public int Property2 { get; set; }
}

public class Ogre : Enemy
{
    public int Property3 { get; set; }
}
```

Let's say you inherit Enemy in your Ogre class. This mean that your Ogre will effectively contain 3 properties: 1,2 and 3.

In your example you're assigning an `Ogre` to an `Enemy` type. The Enemy type doesn't contain a "Property3" and therefor you won't be able to work with the extended class "`Ogre`" in an `Enemy` cast object.

```
//This will work
Ogre newOgre = new Ogre();
int newInt = newOgre.Property3;

//This wont.
Enemy newOgre = new Ogre();
int newInt = newOgre.Property3;
```

LINQ

LINQ comes in two syntactical flavors: The Query and the **Method** syntax. They can do almost the same, but while the query syntax is almost a new language within C#, the **method** syntax looks just like regular C# **method** calls.

In LINQ, Method Syntax is used to call the extension methods of the Enumerable or Queryable static classes. It is also known as **Method Extension Syntax** or **Fluent**. However, the compiler always converts the query syntax in method syntax at compile time

LINQ can interact with any type implementing the IEnumerable interface, including simple arrays as well as generic and nongeneric collections of data.

Later Execution

Another important point regarding LINQ query expressions is that they are not actually evaluated until you iterate over the sequence. Formally speaking, this is termed deferred execution

Immediate Execution

When you need to evaluate a LINQ expression from outside the confines of foreach logic, you are able to call any number of extension methods defined by the Enumerable type such as ToArray(), ToDictionary(),

and ToList(). These methods will cause a LINQ query to execute at the exact moment you call them to obtain a snapshot of the data.

Recall that the query operators of LINQ are designed to work with any type implementing IEnumerable (either directly or via extension methods)
Thankfully, it is still possible to iterate over data contained within nongeneric collections using the generic Enumerable.OfType() extension method.
When calling OfType() from a nongeneric collection object (such as the ArrayList), simply specify the type of item within the container to extract a compatible IEnumerable object

```
// Here is a nongeneric collection of cars.
 ArrayList myCars = new ArrayList() {
 new Car{ PetName = "Henry", Color = "Silver", Speed = 100, Make = "BMW"},
 new Car{ PetName = "Daisy", Color = "Tan", Speed = 90, Make = "BMW"},
 new Car{ PetName = "Mary", Color = "Black", Speed = 55, Make = "VW"},
 new Car{ PetName = "Clunker", Color = "Rust", Speed = 5, Make = "Yugo"},
 new Car{ PetName = "Melvin", Color = "White", Speed = 43, Make = "Ford"}
 };
 // Transform ArrayList into an IEnumerable<T>-compatible type.
 var myCarsEnum = myCars.OfType<Car>();
 // Create a query expression targeting the compatible type.
 var fastCars = from c in myCarsEnum where c.Speed > 55 select c;
```

As you know, nongeneric types are capable of containing any combination of items, as the members of these containers (again, such as the ArrayList) are prototyped to receive System.Objects. For example, assume an ArrayList contains a variety of items, only a subset of which are numerical. If you want to obtain a subset that contains only numerical data, you can do so using OfType() since it filters out each element whose type is different from the given type during the iterations

```
// Extract the ints from the ArrayList.
 ArrayList myStuff = new ArrayList();
 myStuff.AddRange(new object[] { 10, 400, 8, false, new Car(), "string data" });
 var myInts = myStuff.OfType<int>();
 // Prints out 10, 400, and 8.
 foreach (int i in myInts)
 {
 Console.WriteLine("Int value: {0}", i);
 }
```

String

•Literal string: Characters enclosed in double-quote characters. They can use escape characters like \t for tab.
• Verbatim string: A literal string prefixed with @ to disable escape characters so that a backslash is a backslash.

• Interpolated string: A literal string prefixed with $ to enable embedded formatted variables. You will learn more about this later in this chapter.

Data Types

value types and reference types.

C# provides a simple mechanism, termed boxing, to store the data in a value type within a reference variable

```
static void SimpleBoxUnboxOperation() {
// Make a ValueType (int) variable.
int myInt = 25;
// Box the int into an object reference.
 object boxedInt = myInt;
}
```

The opposite operation is also permitted through unboxing. Unboxing is the process of converting the value held in the object reference back into a corresponding value type on the stack

```
static void SimpleBoxUnboxOperation()
{
 // Make a ValueType (int) variable.
 int myInt = 25;
 // Box the int into an object reference.
 object boxedInt = myInt;
 // Unbox the reference back into a corresponding int.
 int unboxedInt = (int)boxedInt;
}
```

Extension Methods

```
public static class StringHelper
{
    public static string ChangeFirstLetterCase(this string inputString)
    {
        if (inputString.Length > 0)
        {
            char[] charArray = inputString.ToCharArray();
            charArray[0] = char.IsUpper(charArray[0]) ?
                char.ToLower(charArray[0]) : char.ToUpper(charArray[0]);
            return new string(charArray);
        }

        return inputString;
    }
}
```

```
static void Main()
{
    string strName = "pragim";
    string result = strName.ChangeFirstLetterCase();

    //string result = StringHelper.ChangeFirstLetterCase(strName);

    Console.WriteLine(result);
}
```

When you define extension methods, the first restriction is that they must be defined within a static class therefore, each extension method must be declared with the static keyword. The second point is that all extension methods are marked as such by using the this keyword as a modifier on the first (and only the first) parameter of the method in question. The “this qualified” parameter represents the item being extended.

Given that DisplayDefiningAssembly() has been prototyped to extend System.Object, every type now has this new member, as Object is the parent to all types in the .NET Core platform. However, ReverseDigits() has been prototyped to extend only integer types; therefore, if anything other than an integer attempts to invoke this method, you will receive a compile-time error.

public static int ReverseDigits(this int i)
public static void DisplayDefiningAssembly(this object obj)

Delegate

```
using System;

delegate int NumberChanger(int n);
namespace DelegateAppl {
```

```
  class TestDelegate {
    static int num = 10;

    public static int AddNum(int p) {
      num += p;
      return num;
    }
    public static int MultNum(int q) {
      num *= q;
      return num;
    }
    public static int getNum() {
      return num;
    }
    static void Main(string[] args) {
      //create delegate instances
      NumberChanger nc1 = new NumberChanger(AddNum);
      NumberChanger nc2 = new NumberChanger(MultNum);

      //calling the methods using the delegate objects
      nc1(25);
      Console.WriteLine("Value of Num: {0}", getNum());
      nc2(5);
      Console.WriteLine("Value of Num: {0}", getNum());
      Console.ReadKey();
    }
  }
}
```

When the above code is compiled and executed, it produces the following result –

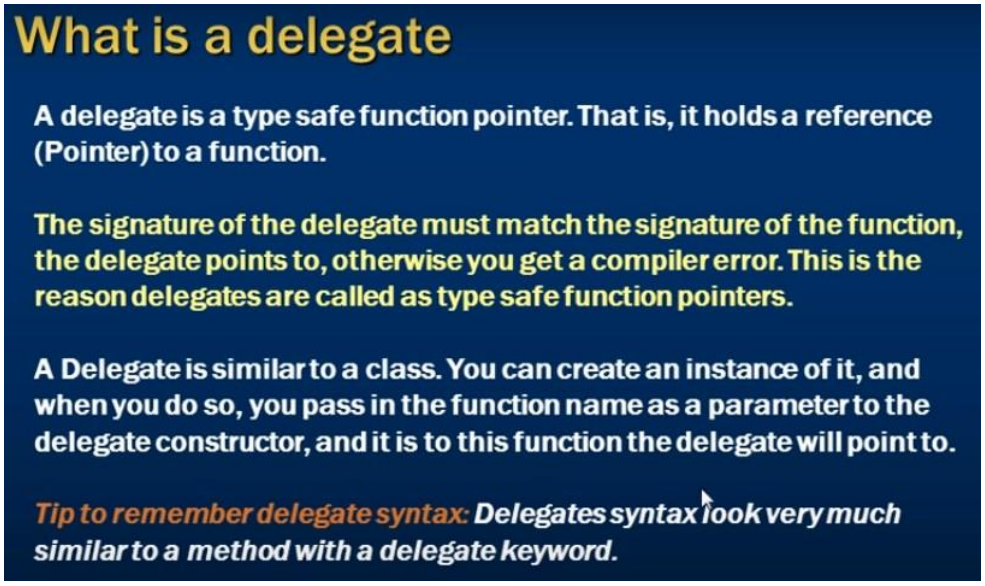
```
Value of Num: 35
Value of Num: 175
```

```
using System;

public delegate void HelloFunctionDelegate(string Message);

class Pragim
{
    public static void Main()
    {
        HelloFunctionDelegate del = new HelloFunctionDelegate(Hello);
        del("Hello from Delegate");
        //A delegate is a type safe
    }

    public static string Hello(string strMessage)
    {
        Console.WriteLine(strMessage);
    }


}
```

HelloFunctionDelegate.HelloFunctionDelegate(void (string) target)

Error:
'string Pragim.Hello(string)' has the wrong return type

Hello must be of type void



The difference between `Func` and `Action` is simply whether you want the delegate to return a value (use `Func`) or not (use `Action`).

`Func` is probably most commonly used in LINQ - for example in projections:

```
list.Select(x => x.SomeProperty)
```

`Action` is more commonly used for things like `List<T>.ForEach`: execute the given action for each item in the list. I use this less often than `Func`, although I *do* sometimes use the parameterless version for things like `Control.BeginInvoke` and `Dispatcher.BeginInvoke`.

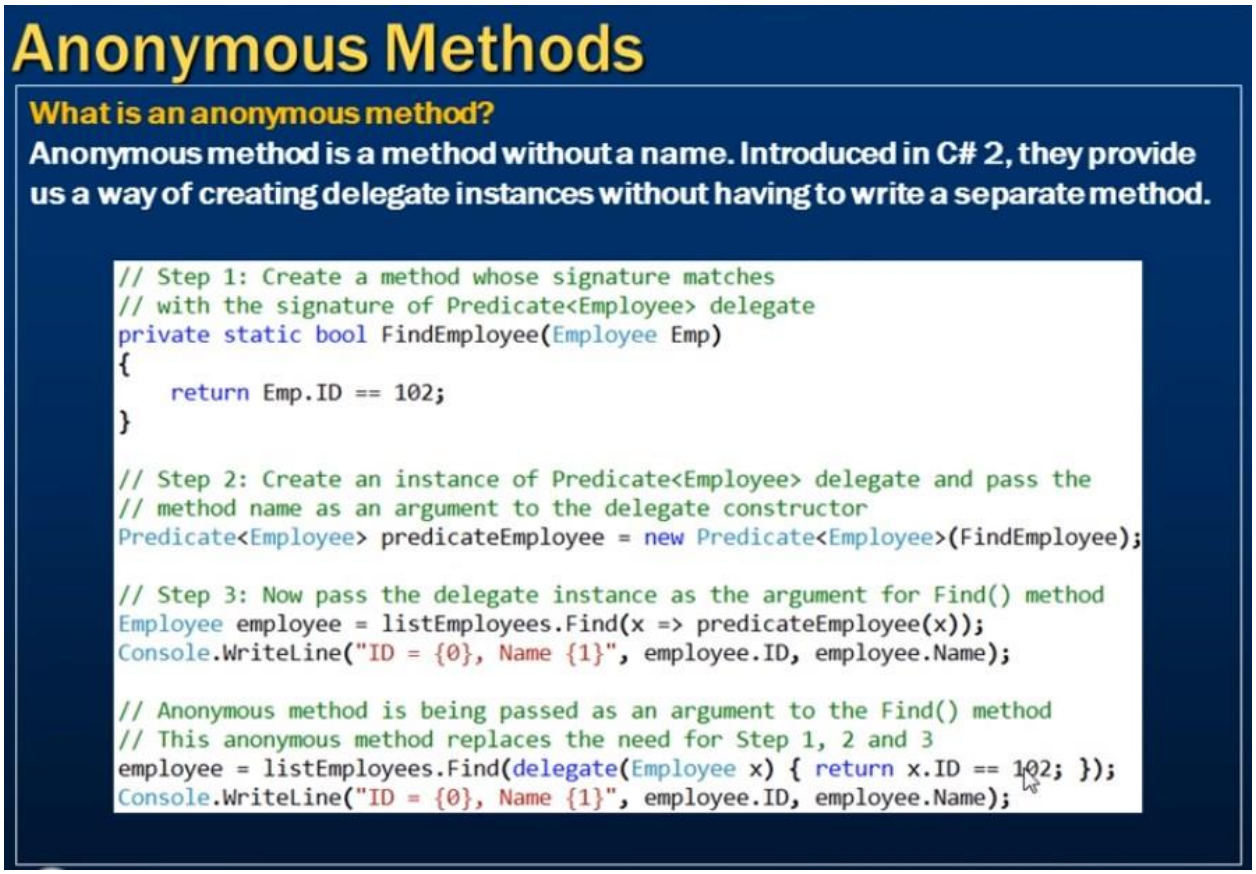
`Predicate` is just a special cased `Func<T, bool>` really, introduced before all of the `Func` and most of the `Action` delegates came along. I suspect that if we'd already had `Func` and `Action` in their various guises, `Predicate` wouldn't have been introduced...

although it *does* impart a certain meaning to the use of the delegate, whereas `Func` and `Action` are used for widely disparate purposes.

`Predicate` is mostly used in `List<T>` for methods like `FindAll` and `RemoveAll`.

Anonymous Types

Anonymous Method



Lambda

=> is the C# lambda operator

a lambda expression is little more than an anonymous method

A lambda expression is written by first defining a parameter list, followed by the => token (C#'s token for the lambda operator found in the lambda calculus), followed by a set of statements (or a single statement) that will process these arguments. From a high level, a lambda expression can be understood as follows:

ArgumentsToProcess => StatementsToProcessThem

Within the LambdaExpressionSyntax() method, things break down like so:

List evenNumbers = list.FindAll(i => (i % 2) == 0);

```
// "i" is our parameter list.
// "(i % 2) == 0" is our statement set to process "i".
```

The parameters of a lambda expression can be explicitly or implicitly typed. Currently, the underlying data type representing the i parameter (an integer) is determined implicitly. The compiler is able to figure out that i is an integer based on the context of the overall lambda expression and the underlying delegate. However, it is also possible to explicitly define the type of each parameter in the expression by wrapping the data type and variable name in a pair of parentheses, as follows:

```
// Now, explicitly state the parameter type.
List evenNumbers = list.FindAll((int i) => (i % 2) == 0);
```

As you have seen, if a lambda expression has a single, implicitly typed parameter, the parentheses may be omitted from the parameter list. If you want to be consistent regarding your use of lambda parameters, you can always wrap the parameter list within parentheses, leaving you with this expression: `List evenNumbers = list.FindAll((i) => (i % 2) == 0);`

Finally, notice that currently the expression has not been wrapped in parentheses (you have of course wrapped the modulo statement to ensure it is executed first before the test for equality). Lambda expressions(meaning the body) do allow for the statement to be wrapped as follows:

```
// Now, wrap the expression as well.
List evenNumbers = list.FindAll((i) => ((i % 2) == 0));
```

The first lambda expression was a single statement that ultimately evaluated to a Boolean. However, as you know, many delegate targets must perform a number of code statements. For this reason, C# allows you to build lambda expressions using multiple statement blocks. When your expression must process the parameters using multiple lines of code, you can do so by denoting a scope for these statements using the expected curly brackets. Consider the following example update to the LambdaExpressionSyntax() method:

```
// Now process each argument within a group of
// code statements.
List<int> evenNumbers = list.FindAll((i) =>
{
Console.WriteLine("value of i is currently: {0}", i);
bool isEven = ((i % 2) == 0);
return isEven;
});
```

The lambda expressions you have seen in this chapter so far processed a single parameter. This is not a requirement, however, as a lambda expression may process multiple arguments (or none). To illustrate the first scenario of multiple arguments, add the following incarnation of the SimpleMath type:

Finally, if you are using a lambda expression to interact with a delegate taking no parameters at all, you may do so by supplying a pair of empty parentheses as the parameter. Thus, assuming you have defined the following delegate type: `public delegate string VerySimpleDelegate();`

```
VerySimpleDelegate d = new VerySimpleDelegate( () => {return "Enjoy your string!";} );
```

Using the new expression syntax, the previous line can be written like this:

```
VerySimpleDelegate d2 = new VerySimpleDelegate(() => "Enjoy your string!");
```

which can also be shortened to `VerySimpleDelegate d3 = () => "Enjoy your string!";`

as of C# 6, it is permissible to use the => operator to simplify member implementations. Specifically, if you have a method or property
that consists of exactly a single line of code in the implementation, you are not required to define a scope via curly bracket. You can instead leverage the lambda operator and write an expression-bodied member
In C# 7, you can also use this syntax for class constructors, finalizers, and get and set accessors on property members. Be aware, however, this new shortened syntax can be used anywhere at all, even when your code has nothing to do with delegates or events. So, for example, if you were to build a trivial class to add two numbers, you might write the following:

```
class SimpleMath
{
 public int Add(int x, int y)
 {
 return x + y;
 }
 public void PrintSum(int x, int y)
 {
 Console.WriteLine(x + y);
 }
}
```

Alternatively, you could now write code like the following:

```
class SimpleMath
{
 public int Add(int x, int y) => x + y;
 public void PrintSum(int x, int y) => Console.WriteLine(x + y);
}
```

It is worth pointing out that the LINQ programming model also makes substantial use of lambda expressions to help simplify your coding efforts

Given that the whole reason for lambda expressions is to provide a clean, concise manner to define an anonymous method (and therefore indirectly a manner to simplify working with delegates)

Delegate VS Aanonymous Method Vs Lambda Expressions

that lambda expressions can be used anywhere you would have used an anonymous method or a strongly typed delegate (typically with far fewer keystrokes)

anonimnen metod moze da zameni delegat

lamnda moze da zameni anonimed metod

To begin, consider the FindAll() method of the generic List class. This method can be called when you need to extract a subset of items from the collection and is prototyped like so:

```
// Method of the System.Collections.Generic.List<T>
class.public List<T> FindAll(Predicate match)
```

As you can see, this method returns a new List that represents the subset of data. Also notice that the sole parameter to FindAll() is a generic delegate of type System.Predicate. This delegate type can point to any method returning a bool and takes a single type parameter as the only input parameter.

```
// This delegate is used by FindAll() method   to extract out the subset.
public delegate bool Predicate(T obj);
```

When you call FindAll(), each item in the List is passed to the method pointed to by the Predicate object. The implementation of said method will perform some calculations to see whether the incoming data matches the necessary criteria and will return true or false. If this method returns true, the item will be added to the new List that represents the subset (got all that?).

Before you see how lambda expressions can simplify working with FindAll(), let's work the problem out in longhand notation, using the delegate objects directly. Add a method (named TraditionalDelegateSyntax()) within your Program type that interacts with the System.Predicate type to discover the even numbers in a List of integers.

```
using System;
using System.Collections.Generic;
class Program
{
 static void Main(string[] args)
 {
 Console.WriteLine("***** Fun with Lambdas *****\n");
 TraditionalDelegateSyntax();
 Console.ReadLine();
 }
 static void TraditionalDelegateSyntax()
 {
 // Make a list of integers.
 List<int> list = new List<int>();
 list.AddRange(new int[] { 20, 1, 4, 8, 9, 44 });

// Call FindAll() using traditional delegate syntax.
```

```
 Predicate<int> callback = IsEvenNumber;
 List<int> evenNumbers = list.FindAll(callback);
 Console.WriteLine("Here are your even numbers:");
 foreach (int evenNumber in evenNumbers)
 {
 Console.Write("{0}\t", evenNumber);
 }
 Console.WriteLine();
 }
 // Target for the Predicate<> delegate.
 static bool IsEvenNumber(int i)
 {
 // Is it an even number?
 return (i % 2) == 0;
 }
}
```

Here, you have a method (IsEvenNumber()) that is in charge of testing the incoming integer parameter to see whether it is even or odd via the C# modulo operator, %. If you execute your application, you will find the numbers 20, 4, 8, and 44 print to the console. While this traditional approach to working with **delegates** behaves as expected, the IsEvenNumber() method is invoked only in limited circumstances – specifically when you call FindAll(), which leaves you with the baggage of a full method definition. While you could make this a local function, if you were to instead use an **anonymous method**, your code would clean up considerably. Consider the following new method of the Program class:

```
static void AnonymousMethodSyntax()
{
 // Make a list of integers.
 List<int> list = new List<int>();
 list.AddRange(new int[] { 20, 1, 4, 8, 9, 44 });
 // Now, use an anonymous method.
 List<int> evenNumbers =
 list.FindAll(delegate(int i) { return (i % 2) == 0; } );
 Console.WriteLine("Here are your even numbers:");
 foreach (int evenNumber in evenNumbers)
 {
 Console.Write("{0}\t", evenNumber);
 }
 Console.WriteLine();
}
```

In this case, rather than directly creating a Predicate delegate object and then authoring a standalone method, you are able to inline a method anonymously. While this is a step in the right direction, you are still required to use the delegate keyword (or a strongly typed Predicate), and you must ensure that the parameter list is a dead-on match.

Lambda expressions can be used to simplify the call to FindAll() even **more**. When you use lambda syntax, there is no trace of the underlying delegate object whatsoever. Consider the following new method to the Program class:

```
static void LambdaExpressionSyntax()
{
 // Make a list of integers.
 List<int> list = new List<int>();
 list.AddRange(new int[] { 20, 1, 4, 8, 9, 44 });
 // Now, use a C# lambda expression.
 List<int> evenNumbers = list.FindAll(i => (i % 2) == 0);
 Console.WriteLine("Here are your even numbers:");
 foreach (int evenNumber in evenNumbers)
 {
 Console.Write("{0}\t", evenNumber);
 }
 Console.WriteLine();
}
```

In this case, notice the rather strange statement of code passed into the FindAll() method, which is in fact a lambda expression. In this iteration of the example, there is no trace whatsoever of the Predicate delegate (or the delegate keyword, for that matter). All you have specified is the lambda expression.

i => (i % 2) == 0

Before I break this syntax down, first understand **that lambda expressions can be used anywhere you would have used an anonymous method or a strongly typed delegate (typically with far fewer keystrokes)**. Under the hood, the C# compiler translates the expression into a standard anonymous method making use of the Predicate delegate type (which can be verified using ildasm.exe or reflector.exe). Specifically, the following code statement:

```
// This lambda expression...
List<int> evenNumbers = list.FindAll(i => (i % 2) == 0);
```

is compiled into the following approximate C# code:

```
// ...becomes this anonymous method.
List<int> evenNumbers = list.FindAll(delegate (int i)
{
 return (i % 2) == 0;
});
```

Base vs This

Use base when there is inheritance, and a parent class already provides the functionality that you're trying to achieve.

Use this when you want to reference the current entity (or self), use it in the constructor's header/signature when you don't want to duplicate functionality that is already defined in another constructor.

Basically, **using base and this in a constructor's header is to keep your code DRY, making it more maintainable and less verbose**

Here's an absolutely meaningless example, but I think it illustrates the idea of showing how the two can be used.

```
class Person
{
    public Person(string name)
    {
        Debug.WriteLine("My name is " + name);
    }
}

class Employee : Person
{
    public Employee(string name, string job)
        : base(name)
    {
        Debug.WriteLine("I " + job + " for money.");
    }

    public Employee() : this("Jeff", "write code")
    {
        Debug.WriteLine("I like cake.");
    }
}
```

Usage:

```
var foo = new Person("ANaimi");
// output:
//  My name is ANaimi

var bar = new Employee("ANaimi", "cook food");
// output:
//  My name is ANaimi
//  I cook food for money.

var baz = new Employee();
```

```
// output:
//  My name is Jeff
//  I write code for money.
//  I like cake.
```

FirstOrDefault returns a first item of potentially multiple (**or default** if none exists). **SingleOrDefault** assumes that there is a single item and returns it (**or default** if none exists). Multiple items are a violation of contract, an exception is thrown

First()

- Returns **first** element of a sequence.
- It **throw** an **error** when There is no element in the result or source is null.
- you should use it,If more than one element is expected and you want only **first** element.

`.First` will throw an exception when there are no results. `.FirstOrDefault` won't, it will simply return either null (reference types) or the default value of the value type. (e.g like `0` for an int.) The question here is not when you want the default type, but more: Are you willing to handle an exception or handle a default value? Since exceptions should be exceptional, `FirstOrDefault` is preferred when you're not sure if you're going to get results out of your query. When logically the data should be there, exception handling can be considered.

I would use `First()` when I know or expect the sequence to have at least one element. In other words, when it is an exceptional occurrence that the sequence is empty.

Use `FirstOrDefault()` when you know that you will need to check whether there was an element or not. In other words, when it is legal for the sequence to be empty. You should not rely on exception handling for the check. (It is bad practice and might hurt performance).

Single<TSource>(IEnumerable<TSource>)

Returns the only element of a sequence, and throws an exception if there is not exactly one element in the sequence.

The Single<TSource>(IEnumerable<TSource>) method throws an exception if the input sequence is empty. To instead return `null` when the input sequence is empty, use SingleOrDefault.