Overloading and Extension Methods

Filip Ekberg
Principal Consultant & CEO

@fekberg fekberg.com

How would you add methods to a class you do not own?

Extension methods!

Overloading

Different from overriding!

Overriding is when you override the method that exists in the class you inherit from

Overloading is when you share a method name

You may have completely different parameters or return type

Which **Overload** Is Invoked?

```
void Process(Order order)  { ... }
void Process(object order) { ... }


Process(new Order());
```

Which **Overload** Is Invoked?

```
void Process(Order order)  { ... }
void Process(object order) { ... }


Process(new Order());
```

This one!

Which **Overload** Is Invoked?

```
void Process(Order order)  { ... }
void Process(object order) { ... }


Process(new Order() as object);
```

Which **Overload** Is Invoked?

```
void Process(Order order)  { ... }
void Process(object order) { ... }

Process(new Order() as object);
```

Casting to object will change which overload is executed

Method overloading is used all the time

Example of **Operator Overloading**

How to properly work with dates and times

Dates and Times in .NET

Filip Ekberg

Example of **Operator Overloading**

```
var future = new DateTime(2025, 02, 14);
var today  = new DateTime(2025, 01, 01);
```

Example of **Operator Overloading**

```
var future = new DateTime(2025, 02, 14);
var today  = new DateTime(2025, 01, 01);

var result = future - today;
```

Example of **Operator Overloading**

```
var future = new DateTime(2025, 02, 14);
var today  = new DateTime(2025, 01, 01);

TimeSpan result = future - today;
```

Example of **Operator Overloading**

```
var future = new DateTime(2025, 02, 14);
var today  = new DateTime(2025, 01, 01);

TimeSpan result = future - today;
```

How many **days**, **minutes**, **seconds** **between** the **dates**?

Example of **Operator Overloading**

```
var future = new DateTime(2025, 02, 14);
var today  = new DateTime(2025, 01, 01);

TimeSpan result = future - today;
```

DateTime has an **operator overload** for **-**

If you overload **==**
you also **have to** overload **!=**

Overloadable operators

The following table provides information about overloadability of C# operators:

Operators	Overloadability
+x, -x, !x, ~x, ++, --, true, false	These unary operators can be overloaded.
x + y, x - y, x * y, x / y, x % y, x & y, x | y, x ^ y, x << y, x >> y, x == y, x != y, x < y, x > y, x <= y, x >= y	These binary operators can be overloaded. Certain operators must be overloaded in pairs; for more information, see the note that follows this table.
x && y, x || y	Conditional logical operators cannot be overloaded. However, if a type with the overloaded true and false operators also overloads the `&` or `|` operator in a certain way, the `&&` or `||` operator, respectively, can be evaluated for the operands of that type. For more information, see the User-defined conditional

In this article

Adding an **Operator Overload**

Adding an **Operator Overload**

```
public static
```

Adding an **Operator Overload**

```
public static Order
```

Adding an **Operator Overload**

```
public static Order operator
```

Adding an **Operator Overload**

```
public static Order operator +(Order first, Order second)
```

Adding an **Operator Overload**

```
public static Order operator +(Order first, Order second)
{
    var items = new List<Item>(first.LineItems);
    items.AddRange(second.LineItems);

    return new()
    {
        LineItems           = items,
        IsReadyForShipment  = first.IsReadyForShipment,
        ShippingProvider    = first.ShippingProvider,
        Total               = first.Total + second.Total
    };
}
```

Don’t overuse operator overloading

It may result in unnecessary complexity!

When to Use **Operator Overloading**

When using the types with an operator is natural

Custom, or complex mathematical representations

Comparison

=, !-, <, <=, >, <=

Looking for value based equality?

Wait until you learn about record types!

Could This Be **Converted** into the Given Type?

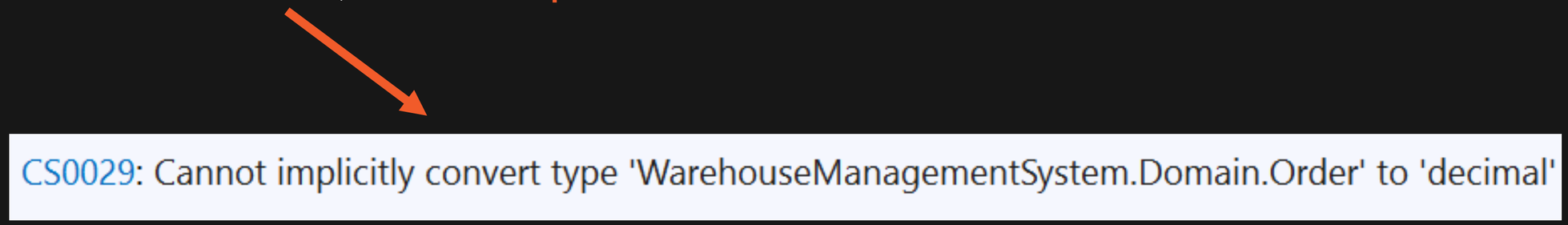
```
Order order = new();

decimal total = order;
```

Could This Be **Converted** into the Given Type?

```
Order order = new();

decimal total = order; // Compiler error!
```



Conversion Operators

Implicit

A safe conversion! The compiler can implicitly determine what type to convert to

Explicit

A conversion that potentially loses data and conversion could throw an exception

Adding **Conversion Operators**

Adding **Conversion Operators**

```
public static implicit operator decimal(Order order)
{
    return order.Total;
}
```

Adding **Conversion Operators**

```
public static implicit operator decimal(Order order)
{
    return order.Total;
}

public static explicit operator Order(List<Item> items)
{
    return new() { LineItems = items.ToArray() };
}
```

Using the **Conversion Operators**

```
Order order = new();
decimal total = order;        // Uses the implicit conversion


List<Item> items = GetItems();
Order order = (Order)items;  // Uses the explicit conversion
```

Conversion Operators

```
public static implicit operator decimal(Order order)
{
    return order.Total;
}

public static explicit operator Order(List<Item> items)
{
    return new() { LineItems = items.ToArray() };
}
```

The resulting type of the conversion

Conversion Operators

```
public static implicit operator decimal(Order order)
{
    return order.Total;
}

public static explicit operator Order(List<Item> items)
{
    return new() { LineItems = items.ToArray() };
}
```

The type you convert from

Conversion Operators

```
public static implicit operator decimal(Order order)
{
    return order.Total;
}
```

Conversion Operators

```
public static implicit operator decimal(Order order)
{
    return order.Total;
}


Order order = new();

decimal total = order;
```

You are not required to implement a conversion both ways!

In many cases it may make sense to do so

Subclassing might not be allowed

Extension Methods

”Enable you to **"add" methods** to **existing types without** creating a new **derived** type, **recompiling**, **or** otherwise **modifying** the original type”

docs.microsoft.com/en-us/dotnet/csharp/programming-guide/classes-and-structs/extension-methods

Extension Methods

Looks like an instance method
Defined in a completely different library than the original type

Lets you add method overloads
You can create methods with the same names as the type you extend as long as they have different parameters

Only for types you can’t control
Don’t introduce extension methods for types in your project, or types that you could otherwise change

Creating an **Extension Method**

```
namespace WarehouseManagementSystem.Domain.Extensions
{




}
```

Creating an **Extension Method**

```
namespace WarehouseManagementSystem.Domain.Extensions
{
    public static class OrderExtensions
    {



    }
}
```

Creating an **Extension Method**

```
namespace WarehouseManagementSystem.Domain.Extensions
{
    public static class OrderExtensions
    {

    }
}
```

Imagine that Order comes from a completely different project that you do not control

Creating an **Extension Method**

```
namespace WarehouseManagementSystem.Domain.Extensions
{
    public static class OrderExtensions
    {
        public static string GenerateReport(                    )



    }
}
```

Creating an **Extension Method**

```
namespace WarehouseManagementSystem.Domain.Extensions
{
    public static class OrderExtensions
    {
        public static string GenerateReport(this Order order)



    }
}
```

Creating an **Extension Method**

```
namespace WarehouseManagementSystem.Domain.Extensions
{
    public static class OrderExtensions
    {
        public static string GenerateReport(this Order order)


    }
}
```

This indicates that it is an **extension method** for the type **Order**

Creating an **Extension Method**

```
namespace WarehouseManagementSystem.Domain.Extensions
{
    public static class OrderExtensions
    {
        public static string GenerateReport(this Order order)
        {
            return $"This is the report for {order.OrderNumber}";
        }
    }
}
```

Using an **Extension Method**

```
using namespace WarehouseManagementSystem.Domain.Extensions;

Order order = new();

var report = order.GenerateReport();
```

Extension methods can **only access public properties** and **methods** on the **instance**

Extension Methods with Parameters

```
namespace WarehouseManagementSystem.Domain.Extensions
{
    public static class OrderExtensions
    {
        public static string GenerateReport(this Order order,
                                             string recipient) { ... }
    }
}
```

Extension Methods with Parameters

```
namespace WarehouseManagementSystem.Domain.Extensions
{
    public static class OrderExtensions
    {
        public static string GenerateReport(this Order order,
                                             string recipient) { ... }
    }
}

Order order = new();

var report = order.GenerateReport(“Filip Ekberg”);
```

Extension methods have the lowest priority!

The compiler will never choose an extension method if a better alternative exists on the type

Using an **Extension Method**

```
using namespace WarehouseManagementSystem.Domain.Extensions;

Order order = new();

var report = OrderExtensions.GenerateReport(order);
```

How would you **build** a reusable **(generic) extension method**?

Consider that the **domain library** in the solution is **installed through** the **company NuGet server**

Only build **extension** methods **for types outside** of your **control**

What Makes It an **Extension Method**

It is defined in a static class

It is a static method

The first parameter uses the this keyword

You can share your library as a NuGet package

Introducing **System.Linq**

Powerful set of extension methods

Extends for example IEnumerable<T> and IQueryable<T>

LINQ

“Language-Integrated Query (**LINQ**) is the name for a set of technologies based on the integration **of query capabilities** directly **into** the **C#** language.”

Example:

```
order.LineItems.Where(item => item.Price > 60)
```

docs.microsoft.com/en-us/dotnet/csharp/programming-guide/concepts/linq/

Example of **Intersect**

```
var first   = new[] { 1, 2, 3, 4 };
var second  = new[] { 2, 3 };

var common = first.Intersect(second);
```

Extension methods can be a **powerful** addition and **help others** that have **similar needs**

Example of a Fluent Chain

Example of a Fluent Chain

```
var cheapestItems = order.LineItems
```

Example of a Fluent Chain

```
var cheapestItems = order.LineItems
                        .Where(item => item.Price > 60)
```

Example of a Fluent Chain

```
var cheapestItems = order.LineItems
                        .Where(item => item.Price > 60)
                        .OrderBy(item => item.Price)
```

Example of a Fluent Chain

```
var cheapestItems = order.LineItems
                        .Where(item => item.Price > 60)
                        .OrderBy(item => item.Price)
                        .Take(5);
```

Overloading

Overloading is when you share a method name

Requires different parameters and could have a different return type

Can be an extension method

A method overload can be defined as an extension method but the compiler will always try to use methods on the type

Example of **Operator Overloading**

Example of **Operator Overloading**

```
public static
```

Example of **Operator Overloading**

```
public static Order
```

Example of **Operator Overloading**

```
public static Order operator
```

Example of **Operator Overloading**

```
public static Order operator +(Order first, Order second) { ... }
```

Check the **documentation** to follow **exactly** how to **overload** a **specific operator**

Use **explicit conversion** if your conversion can **throw** an exception or **lose** data

Example **Extension Methods**

Example **Extension Methods**

```
public static class IEnumerableExtensions
{
    public static IEnumerable<T> Find<T>(this IEnumerable<T> source,
                                         Func<T, bool> isMatch)
    { ... }
}
```

Example **Extension Methods**

```
public static class IEnumerableExtensions
{
    public static IEnumerable<T> Find<T>(this IEnumerable<T> source,
                                         Func<T, bool> isMatch)
    { ... }
}

public static class OrderExtensions
{
    public static string GenerateReport(this Order order)
    { ... }
}
```

Next: **Anonymous Types**