

C# Crash Course

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```
sessions > csharp_01 > src > HelloWorld.Tests > ProgramTests.cs > { } HelloWorld.Tests > HelloWorld.Tests
6
7     namespace HelloWorld.Tests;
8
9     0 references
10    public class ProgramTests
11    {
12        [Fact]
13        0 references
14        public void Main_given_no_args_prints_Hello_World()
15        {
16            // Arrange
17            using var writer = new StringWriter();
18            Console.SetOut(writer);
19
18            // Act
19            var program = Assembly.Load(nameof(HelloWorld));
20            program.EntryPoint?.Invoke(null, new[] { Array.Empty<string>() });
21
22            // Assert
23            var output = writer.GetStringBuilder().ToString().TrimEnd();
24            output.Should().Be("Hello, World!");
25        }
26    }
```

```
sessions > csharp_01 > src > HelloWorld > Program.cs
1 // See https://aka.ms/new-console-template for more information
2 Console.WriteLine("Hello, World!");
3
```

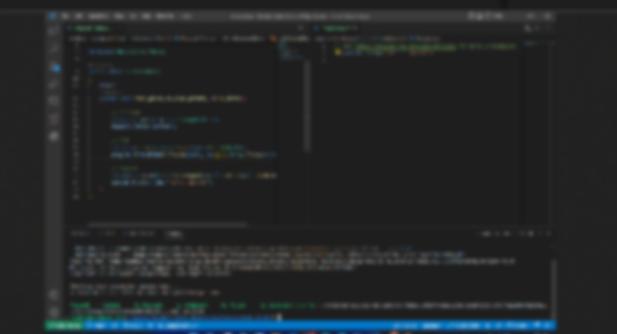
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
HelloWorld -> /home/rasmusl/source/lecture-notes-intern/sessions/csharp_01/src/HelloWorld/bin/Debug/net6.0/HelloWorld.dll
HelloWorld.Tests -> /home/rasmusl/source/lecture-notes-intern/sessions/csharp_01/src/HelloWorld.Tests/bin/Debug/net6.0/HelloWorld.Tests.dll
Test run for /home/rasmusl/source/lecture-notes-intern/sessions/csharp_01/src/HelloWorld.Tests/bin/Debug/net6.0/HelloWorld.Tests.dll
Microsoft (R) Test Execution Command Line Tool Version 17.0.0+68bd10d3aee862a9fbb0bac8b3d474bc323024f3
Copyright (c) Microsoft Corporation. All rights reserved.
```

Starting test execution, please wait...

A total of 1 test files matched the specified pattern.

```
Passed! - Failed: 0, Passed: 1, Skipped: 0, Total: 1, Duration: < 1 ms - /home/rasmusl/source/lecture-notes-intern/sessions/csharp_01/src/HelloWorld.Tests.dll (net6.0)
```



Snipping Tool

Snip copied to clipboard

About Me

Senior Cloud Solution Architect @ Microsoft (2013-)

Associate Professor @ ITU (2014-)

M.Sc. IT, ITU (2012)

Thesis: *Forecalc – Developing a core spreadsheet implementation in F#*

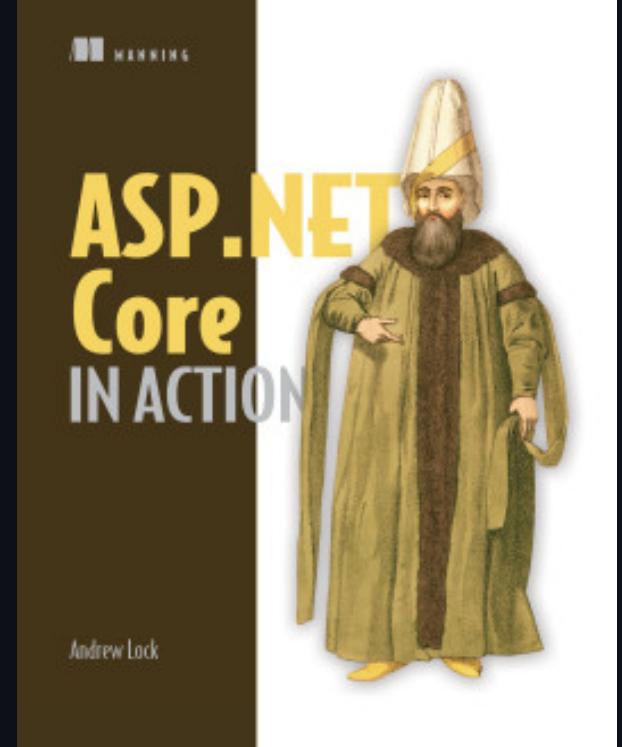
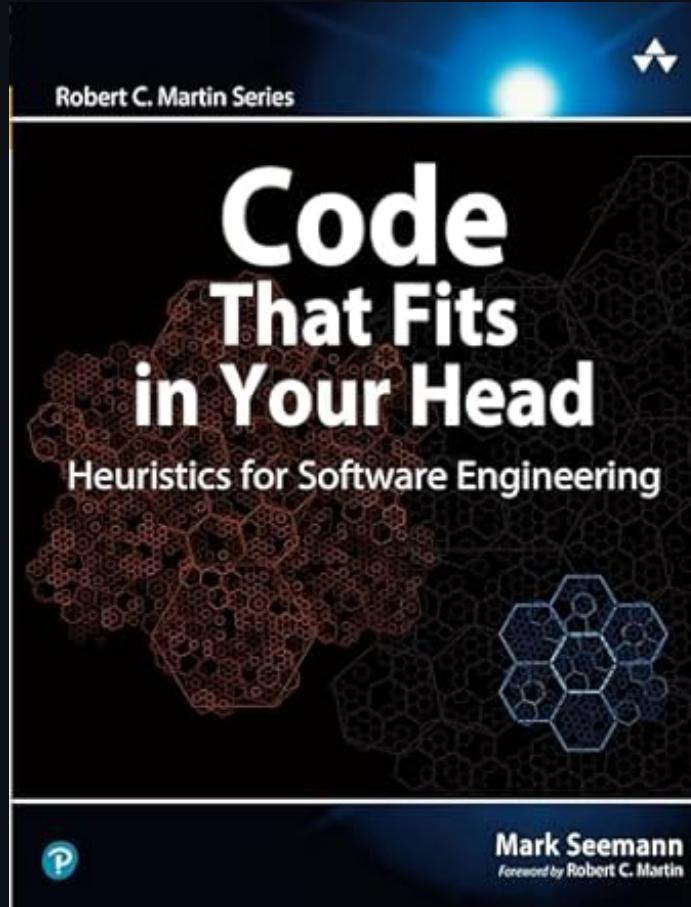
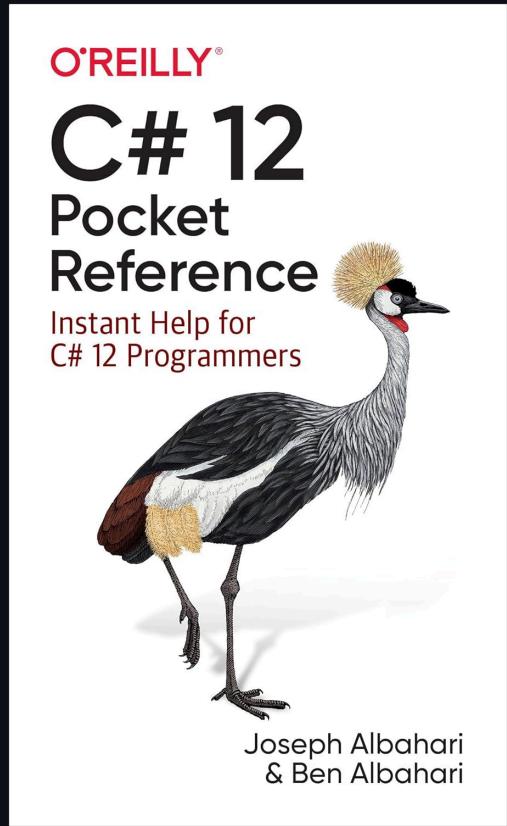


Source

<https://github.com/ondisk/crash>

Disclaimer

Books



Online Training

C# language documentation

Free Foundational C# with Microsoft Certification

LinkedIn Learning

C#

"C# is intended to be a simple, modern, general-purpose, object-oriented programming language."

ECMA-334 ISO/IEC 23270:2018(E)

C# language specification, 5th edition, December 2017

Why C#

- Popular cf. [Stack Overflow Annual Developer Survey 2025](#) at 27%
- Ubiquitous
- Open Source
- Cross-platform
- Industry / Enterprise
- Tool for your toolbox
- .NET CLR

Why not C#

It's just like Java

- Curly brackets and semicolons from C
- Statically typed
- Object-oriented
- Single inheritance
- Cross-platform
- Open source
- Industry / enterprise
- JVM

A photograph showing a person from behind, sitting at a desk in an office environment. The person is wearing a denim jacket and has their hair tied back. They are facing three computer monitors, each displaying a code editor with multiple windows open, likely showing different files or parts of a large project. The monitors are arranged side-by-side. On the desk in front of the person, there is a stack of four white books and a black computer mouse. The background shows other office equipment and possibly a window or another workstation.

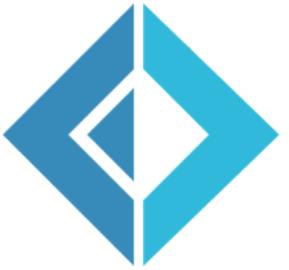
.NET - a brief introduction

.NET

.NET is a free, cross-platform, open source developer platform for building many different types of applications.

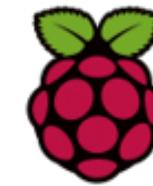
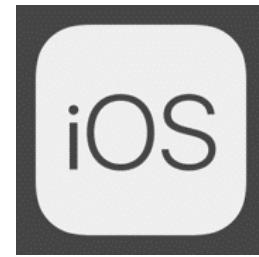
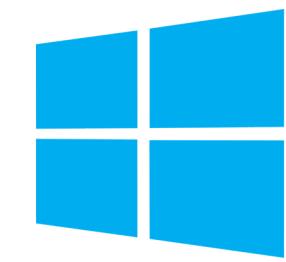
With .NET, you can use multiple languages, editors, and libraries to build for web, mobile, desktop, games, IoT, and more.

<https://dotnet.microsoft.com/en-us/learn/dotnet/what-is-dotnet>



.NET Languages

<https://dotnet.microsoft.com/en-us/languages>



.NET Platforms

.NET Timeline

2002: .NET Framework, Visual C#, Visual J#, Visual Basic, Visual Studio .NET

2005: .NET Framework 2.0, F#, Generics

2007: .NET Framework 3.5, Auto-properties, Linq, Lambda

2010: .NET Framework 4.0, Dynamic, Parallel

2012: .NET Framework 4.5, Async/await

2016: .NET Core, Open Source on [GitHub!](#), Visual Studio Code

2017: .NET Core 2

2019: .NET Core 3, .NET Framework 4.8

2020: .NET 5

2021: .NET 6, Visual Studio 2022

2022: .NET 7

2023: .NET 8

2024: .NET 9

.NET Framework vs. .NET (Core)

.NET Framework

The .NET Framework (pronounced as "dot net") is a proprietary software framework developed by Microsoft that **runs primarily on Microsoft Windows**.

It was the predominant implementation of the Common Language Infrastructure (CLI) until being superseded by the cross-platform .NET project.

Version 4.8 (2019) is the *last and final* version.

Security patches only going forward.

.NET Framework vs. .NET (Core)

.NET

The .NET platform (pronounced as "dot net") is a free and open-source, managed computer software framework for Windows, Linux, and macOS operating systems.

The project is mainly developed by Microsoft employees by way of the .NET Foundation and is released under an MIT License.

Released yearly each november with *even* versions having *LTS* (3 years).

Next version will be **.NET 10 (LTS)** due November 2025.

Demo

Hello, World!

Inspect the `Console` class

Top-level statements

Hello, [User]!

Inspect the `String` class and an instance of it

Pair Programming

Two programmers work together at one workstation

One, the driver, writes code while the other, the observer or navigator, reviews each line of code as it is typed in. The two programmers switch roles frequently.

Note: You switch *at least* between each exercise.

Exercise 1

Create a console application.

The application should display `Hello, World!` when run.

The application should display `Hello, <input>!` when run with `<input>` as the first command line argument.

The application should crash with an `ArgumentOutOfRangeException` if run with more than one command line argument.

Demo

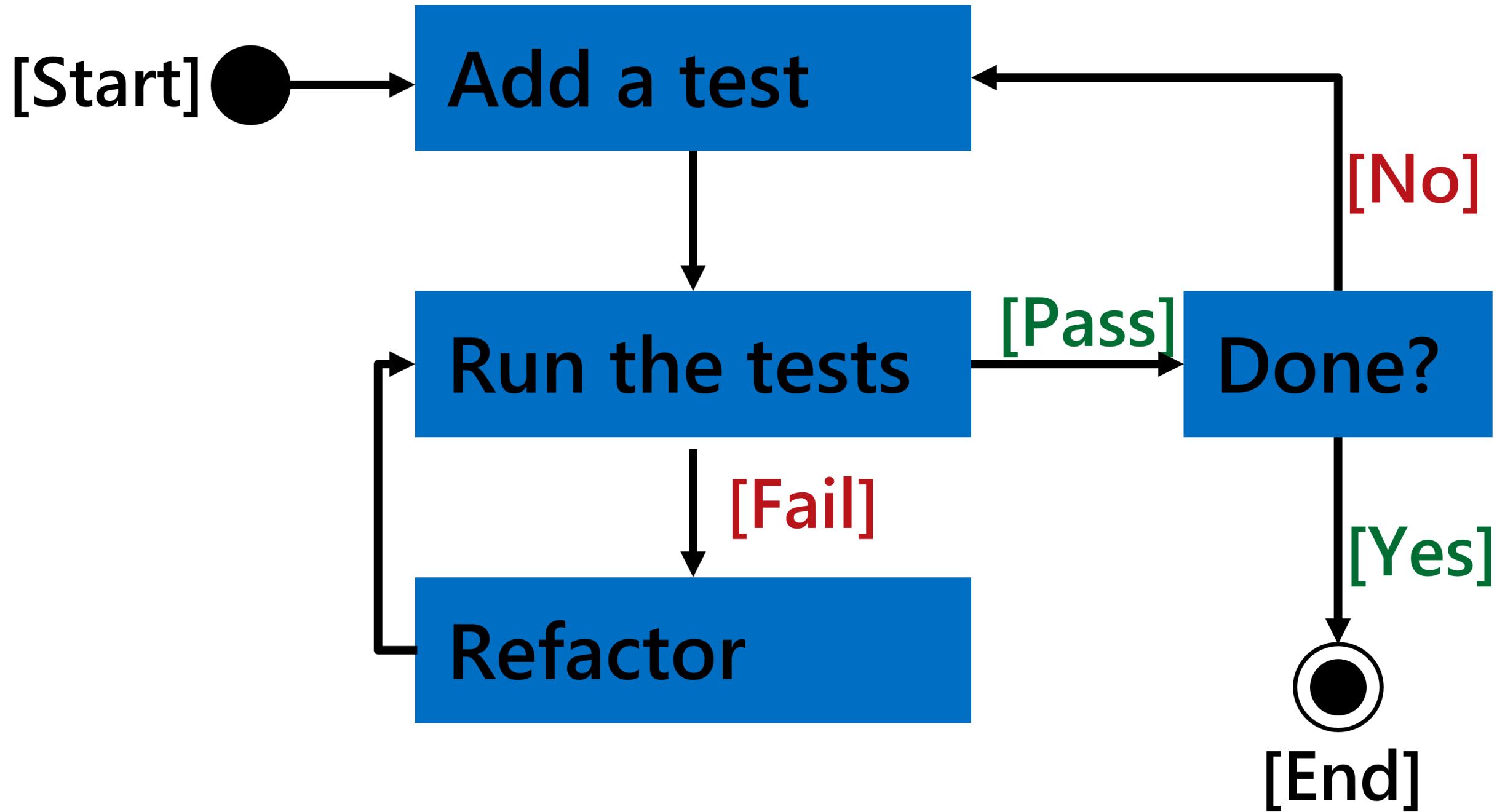
Debugging Hello, World!



Test-Driven Development

Test-Driven Development

- What?
- Why?
- How?



Red-Green-Refactor

Demo

Test-Driven C#

Including:

- Solution Structure
- NuGet
- `dotnet outdated`

Built-in Types

```
bool boolean = true;
char character = 'a';
char[] array = ['a', 'b', 'c'];
void // return no value
var // implicitly typed local variable
```

```
// Integral numeric types
byte b = 255;
int i = 2147483647;
long l = 9223372036854775807;
short s = 32767;
```

```
// Floating point numeric types
decimal d = 79228162514264337593543950335;
double d = 1.79769313486232E+308;
float f = 3.402823E+38;
```

```
sbyte b = 127;
uint ui = 4294967295;
ulong ul = 18446744073709551615;
ushort us = 65536;
```

Reference types
object obj;
string str;
dynamic dyn;

Operators

- `=`, `+=`, `-=`, `*=`, `/=`
- `+`, `-`, `*`, `/`, `%`
- `&`, `&&`, `|`, `||`, `^`
- `==`, `!=`, `<`, `>`, `<=`, `>=`, `is`, `as`,
- `??`, `?`, `:`
- `!`, `?`
- `=>`
- `(` `)`

C# operators and expressions

Conditionals

```
int number = 42;
string output;

if (number == 42)
{
    output = "You have the answer!";
}
else
{
    output = "You do not have the answer!";
}
```

```
var output = number == 42
? "You have the answer!"
: "You do not have the answer!"
```

Methods

```
public static bool IsEven(int number)
{
    return number % 2 == 0;
}
```

```
private string _name;

public void PrintName()
{
    Console.WriteLine(_name);
}
```

Switch Statement

```
static void ShowCard(int cardNumber)
{
    switch (cardNumber)
    {
        case 13:
            Console.WriteLine("King");
            break;
        case 12:
            Console.WriteLine("Queen");
            break;
        case 11:
            Console.WriteLine("Jack");
            break;
        default:
            Console.WriteLine(cardNumber);
            break;
    }
}
```

Strings

```
int number = 42;

string answer1 = "The answer is " + number;

var answer2 = $"The answer is {number}";

var same = answer1 == answer2; // true

var escaped = "C:\\\\Users\\\\account\\\\Source\\\\Repos\\\\crash\\\\src\\\\Exercise3\\\\Wizards.csv";

var verbatim = @"C:\\Users\\account\\Source\\Repos\\crash\\src\\Exercise3\\Wizards.csv";
```

foreach

```
string[] cars = {"Mercedes Benz", "BMW", "Porsche";  
foreach (var car in cars)  
{  
    Console.WriteLine(car);  
}
```

for

```
for (int i = 0; i < 5; i++)
{
    Console.WriteLine(i);
}
```

while

```
int i = 0;
while (i < 5)
{
    Console.WriteLine(i);
    i++;
}
```

Note: There is also a do / while loop

break

```
var numbers = Enumerable.Range(1, 1000);

foreach (var number in numbers)
{
    if (i == 42)
    {
        Console.WriteLine("Found it!");
        break;
    }
}
```

continue

```
var numbers = Enumerable.Range(1, 1000)
    .OrderBy(_ => Guid.NewGuid())
    .Take(10);

foreach (var number in numbers)
{
    if (i % 2 == 1)
    {
        continue;
    }
    Console.WriteLine($"Found even number: {i}");
}
```

Exercise 2

Clone: `git clone https://github.com/ondfisk/crash.git`

Implement a set of functions using the keywords `foreach`, `for`, `while`, `break`, `continue` and:

- `src/Exercise2/ArrayFunctions.cs`
- `tests/Exercise2.Tests/ArrayFunctionsTests.cs`

Implement test `-->` Implement (part of) method.

Rinse and repeat.

Enums

```
public enum Currency
{
    DNK,
    EUR,
    USD,
    GBP
}
```

Records

```
public record Money(Currency Currency, decimal Amount);  
  
Money eur = new(Currency.EUR, 42);  
  
Money dnk = eur with { Currency = Currency.DNK, Amount = eur.Amount * 7.6m };
```

Classes

```
public class Container
{
    private readonly int _initialCapacity;

    private int _capacity;

    public int Capacity => _capacity;

    public Container(int capacity) => _initialCapacity = _capacity = capacity;

    public void IncreaseCapacity(int extra)
    {
        _capacity += extra;
    }
}

var container = new Container(42);

container.IncreaseCapacity(624);

Console.WriteLine($"The container has currently a capacity of: {container.Capacity}");
```

Classes

```
public class Container
{
    public int Capacity { get; set; }
}

var container = new Container();
container.Capacity = 42;

var container = new Container { Capacity = 42 };
```

Properties

```
public class SomeType
{
    public required string Needed { get; set; }

    public required string NeededSetOnce { get; init; }

    public int ReadOnly { get; } = 42;

    public int WriteOnly { private get; set; }

    public string? ModifyInput
    {
        get;
        set => field = value.Trim();
    }
}
```

Note: Other modifiers: `internal` , `protected` , and `protected internal` .

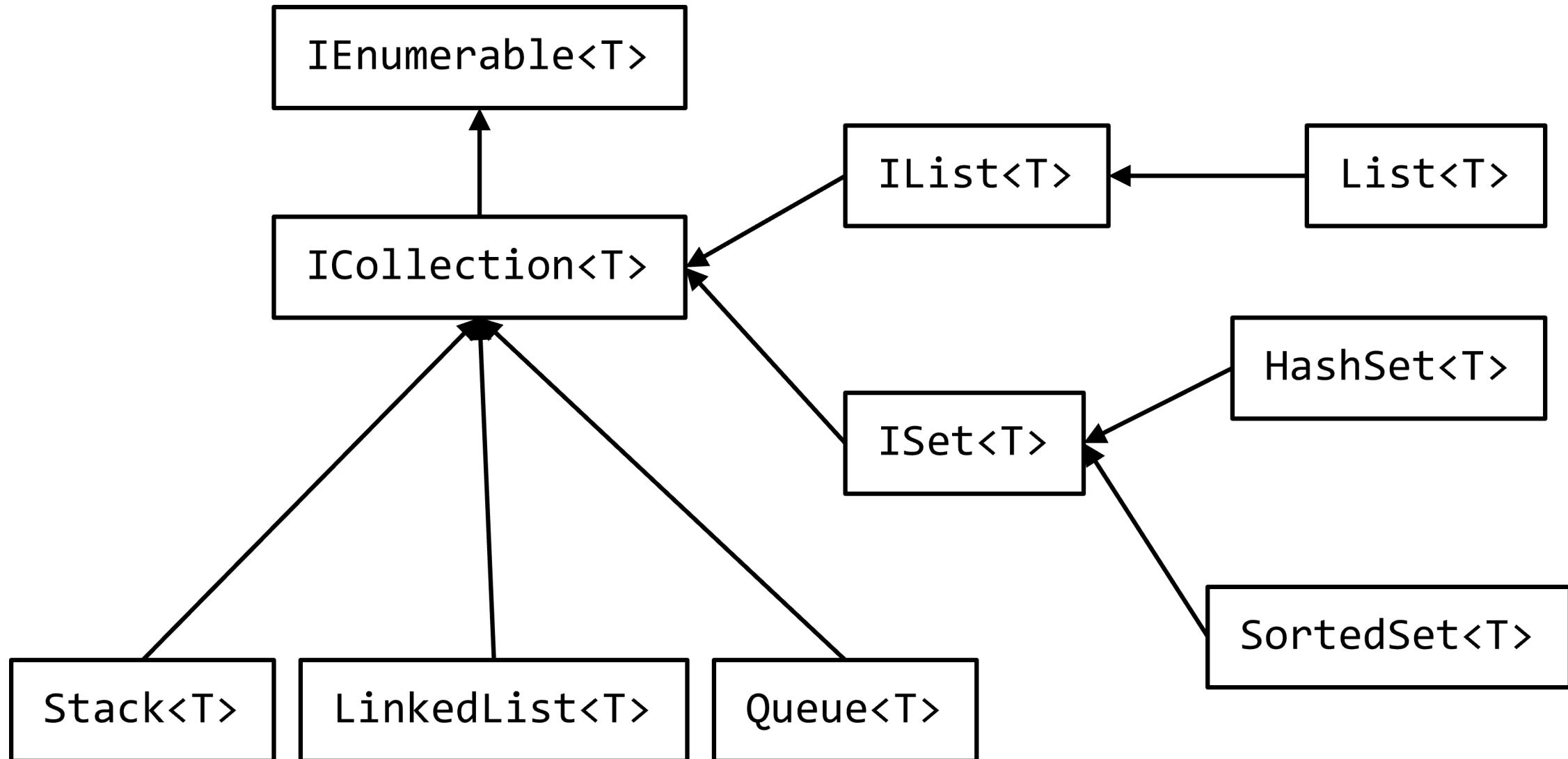
Exercise 3

Part 1, 2, and 3



Generic collections

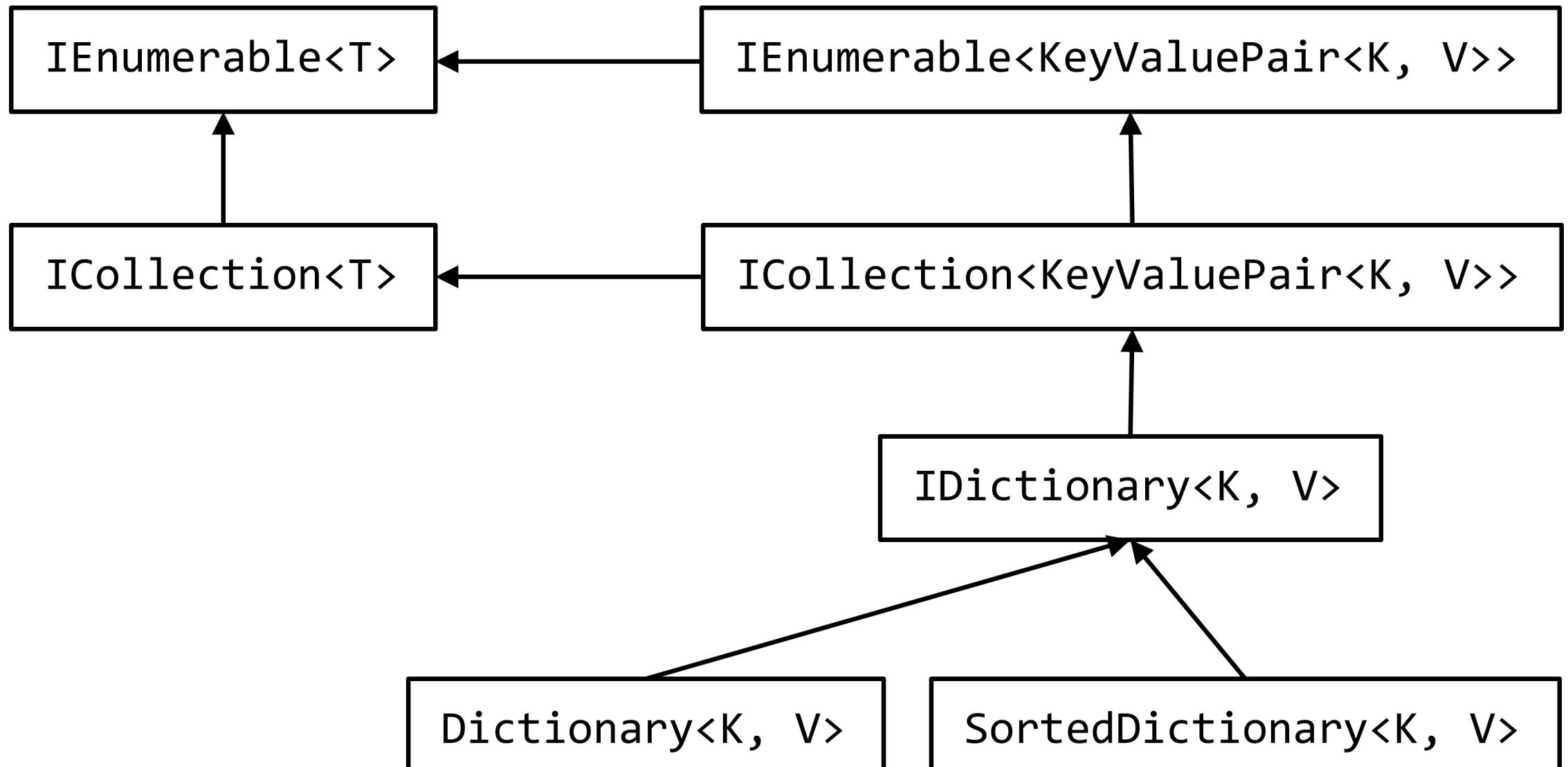
System.Collections.Generic



Generic collections

```
List<int> list = [ 1, 2, 3 ];  
  
ISet<int> stack = new HashSet<int> { 1, 2, 3 };  
  
var queue = new Queue<int>();  
queue.Enqueue(42);  
var peek = queue.Peek();  
var item = queue.Dequeue();  
  
var stack = new Stack<string>();  
stack.Push("Item");  
var peek = stack.Peek();  
var item = stack.Pop();
```

System.Collections.Generic - Key/Value



Lambda Expressions

λ

Lambda Expressions

```
Action<string> write = s => Console.WriteLine(s);
```

```
Func<int, int> square = a => a * a;
```

```
Predicate<City> b = c => c.Name.StartsWith("B");
```

```
Converter<double, double> fahrenheitToCelsius = c => c * 9.0 / 5.0 + 32.0;
```

```
...
```

Local Functions

```
int square(int a) { return a * a; }

Console.WriteLine(square(16));
```

Anonymous types

```
var question = new
{
    Title = "The answer...?",
    Answer = 42
};
```

Tuples

```
var s = Tuple.Create("Clark Kent", "Superman");

var b = ("Bruce Wayne", "Batman");

var f = (name: "Barry Allen", alterEgo: "The Flash");

var random = new Random();

IEnumerable<(float x, float y)> GenerateRandomCoordinates()
{
    yield return (random.NextSingle() * 100, random.NextSingle() * 100);
}
```

Collection Initializer

```
IEnumerable<City> cities = new []
{
    new City(1, "Berlin"),
    new City(2, "Hamburg"),
    new City(3, "Frankfurt")
};
```

Data: Collection + Object Initializer

```
IEnumerable<City> cities =  
[  
    new { Id = 1, Name = "Berlin" },  
    new { Id = 2, Name = "Hamburg" },  
    new { Id = 3, Name = "Frankfurt" }  
];
```



Extension Methods

Built-in Extension methods

```
var count = cities.Count();

var sort = cities.OrderBy(c => c.Name);

var filter = cities.Where(c => c.Name.Contains("i"));

var pick = cities.FirstOrDefault(c => c.Id == 2);

var all = cities.All(c => c.Name.Length < 10);

var any = cities.Any(c => c.Name.StartsWith("B"));

var project = cities.Select(c => c.Name);
```

Create your own extension method

```
public static class Extensions
{
    public static int WordCount(this string str) =>
        str.Split(new[] { ' ', '.', '?' },
                 StringSplitOptions.RemoveEmptyEntries)
        .Length;
}
```

Extension methods

Demo

Exercise 3

Part 4, 5, 6, 7, and 8



Thank you

Appendix

Create a C# console app with a test library

```
mkdir MyApp  
cd MyApp
```

```
dotnet new console -o src/MyApp  
dotnet new xunit -o tests/MyApp.Tests
```

```
dotnet new sln  
dotnet sln add src/MyApp  
dotnet sln add tests/MyApp.Tests  
dotnet add tests/MyApp.Tests reference src/MyApp
```

```
dotnet build  
dotnet test  
dotnet run --project src/MyApp
```

```
dotnet list package --outdated  
dotnet tool install dotnet-outdated-tool --global  
dotnet outdated -u
```

The C# class

```
namespace Namespace;

public class Class
{
    private string _field;

    protected DateTime _fieldAvailableInSubClass;

    public string Property { get => _field; } // Getter

    public int AutoProperty { get; set; }

    public Class() { }

    public string InstanceMethod(string parameter)
    {
        return $"Hello {parameter}";
    }

    public virtual bool OverridableInstanceMethod(bool parameter) => !parameter;

    public static void StaticMethod() { }

    private void PrivateInstanceMethod() { }

    public event EventHandler Event;

    protected virtual void OnEvent(EventArgs e)
    {
        EventHandler handler = Event;
        handler?.Invoke(this, e);
    }

    public delegate void MyEventHandler(object sender, EventArgs e);
}
```

Naming Conventions

Composed names

currentLayout , CurrentLayout

Variables and fields

vehicle , leftElement

Private fields

_vehicle , _leftElement

Methods

CurrentVehicle() , Size()

Properties

Pi , Name , Size

Classes

Basic Unit Test

```
public class Ticker
{
    public int Counter { get; private set; }
    public void Increment() => Counter++;
    public Ticker(int start = 0) => Counter = start;
}

public class TickerTests
{
    [Fact]
    public void Increment_when_called_increases_Counter_by_1()
    {
        // Arrange
        var sut = new Ticker(41);

        // Act
        sut.Increment();

        // Assert
        sut.Counter.Should().Be(42);
    }
}
```