

C# Generics, Collections, Iterators, and Regular Expressions

Rasmus Lystrøm
Associate Professor
ITU
rne@itu.dk

The screenshot shows the Visual Studio Code editor with two C# files open: `ProgramTests.cs` and `Program.cs`. The `ProgramTests.cs` file contains a test class `ProgramTests` with a single test method `Main_given_no_args_p` decorated with `[Fact]`. The test method uses `Arrange`, `Act`, and `Assert` to verify that the `Program.Main` method outputs "Hello World!". The `Program.cs` file contains a simple `Program` class with a `Main` method that writes "Hello World!" to the console.

The terminal window at the bottom shows the output of running the tests using `dotnet test`. The output indicates that the test run was successful, with 1 test passed in 3,4618 seconds.

```
File Edit Selection View Go Debug Terminal Help
ProgramTests.cs x
HelloWorld.Tests > ProgramTests.cs > {} HelloWorld.Tests > HelloWorld
1 using System;
2 using System.IO;
3 using Xunit;
4
5 namespace HelloWorld.Tests
6 {
7     0 references | Run All Tests | Debug All Tests
8     public class ProgramTests
9     {
10         [Fact]
11         0 references | Run Test | Debug Test
12         public void Main_given_no_args_p
13         {
14             // Arrange
15             using var writer = new StringWriter();
16             Console.SetOut(writer);
17
18             // Act
19             Program.Main(new string[0]);
20
21             // Assert
22             var output = writer.GetStringBuilder().ToString();
23             Assert.Equal("Hello World!", output);
24         }
25     }
26 }
27
28 Program.cs x
HelloWorld > Program.cs > ...
1 using System;
2
3 namespace HelloWorld
4 {
5     1 reference
6     public class Program
7     {
8         1 reference
9         public static void Main(string[] args)
10         {
11             Console.WriteLine("Hello World!");
12         }
13 }
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```

Agenda

Notes: Updating packages and improved testing

Generics

Iterators, enumerators, and enumerations

Collections

Regular Expressions

Updating packages and improved testing

List outdated packages

```
dotnet list package --outdated
```

Add code coverage tool

```
dotnet add package coverlet.msbuild
```

Install extension: Coverage Gutters

Watch for changes and run tests

```
dotnet watch --project .\Lecture02.Tests test /p:CollectCoverage=true \  
/p:CoverletOutputFormat=lcov /p:CoverletOutput=./obj/lcov.info
```

Generics

“Parametric Polymorphism”

Built-in

Create your own?

Type Constraints

(Co- and contravariance)

ArrayList → List<T>

// Non-generic

```
IList list = new ArrayList();  
list.Add("hello");  
var s = (string)list[0];
```

// Generic

```
IList<string> list = new List<string>();  
list.Add("hello");  
var s = list[0];
```

Create your own generic class

```
public class MyStack<T>
{
    public void Clear() { }

    public T Peek() { }

    public T Pop() { }

    public void Push(T item) { }
}
```

Create your own generic class 2

```
class MyMap<TKey, TValue>
{
    void Add(TKey key, TValue value) { }
    bool ContainsKey(TKey key) { }
    bool ContainsValue(TValue key) { }
    TValue this[TKey key] { get; set; }
}
```

Create your own generic method

```
public string Serialize<T>(T obj) {}
```

```
public T2 Convert<T1, T2>(T1 obj) { }
```


Type constraints

```
public class MyConstrainedGenericClass<T>  
    where T : class, new() { }
```

```
public class MyConstrainedGenericClass<T>  
    where T : struct { }
```

```
public class MyConstrainedGenericClass<T1, T2>  
    where T1 : Foo  
    where T2 : IBar { }
```

```
public T2 MyConstrainedMethod<T1, T2>(T1 item)  
    where T1 : Foo  
    where T2 : IBar, new() { }
```

Built-in generics

```
public interface IComparer<in T>
{
    int Compare(T x, T y);
}
```



Contravariance

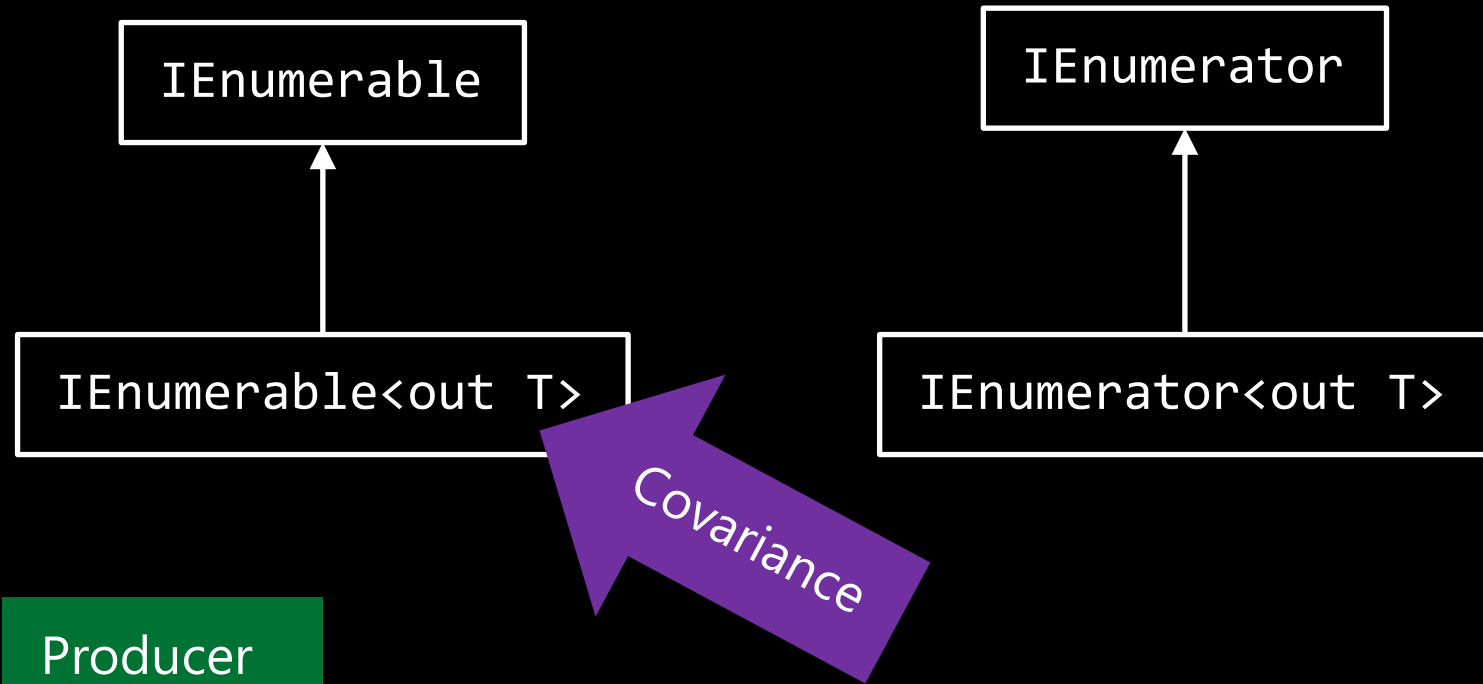
```
public interface IEnumerable<out T> : IEnumerable
{
    IEnumerator<T> GetEnumerator();
}
```



Covariance

Generic collections

Iterators



Producer

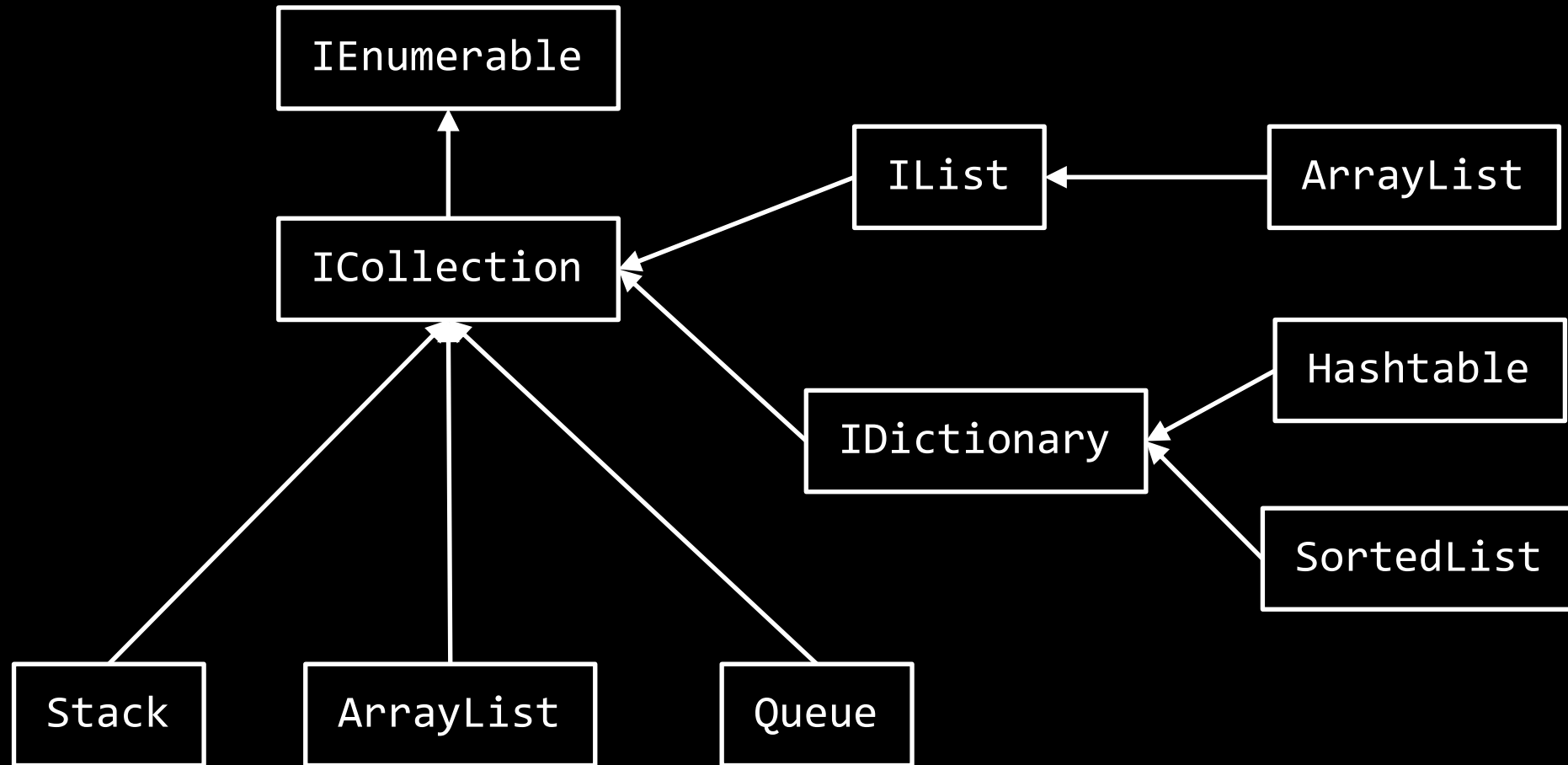
Building block for LINQ

```
yield return T;
```

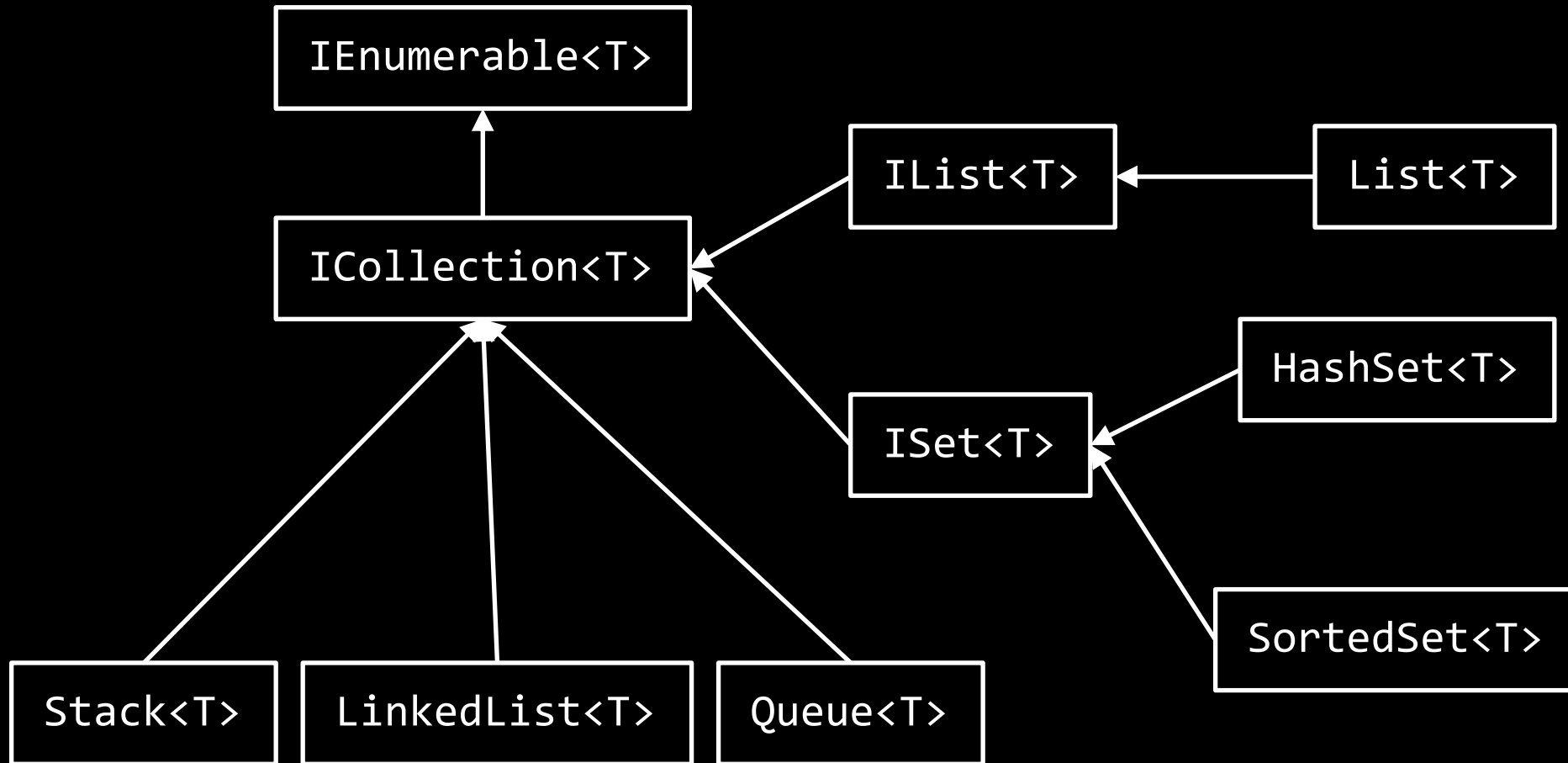
```
yield break;
```

```
foreach (var item in items)
{
}
```

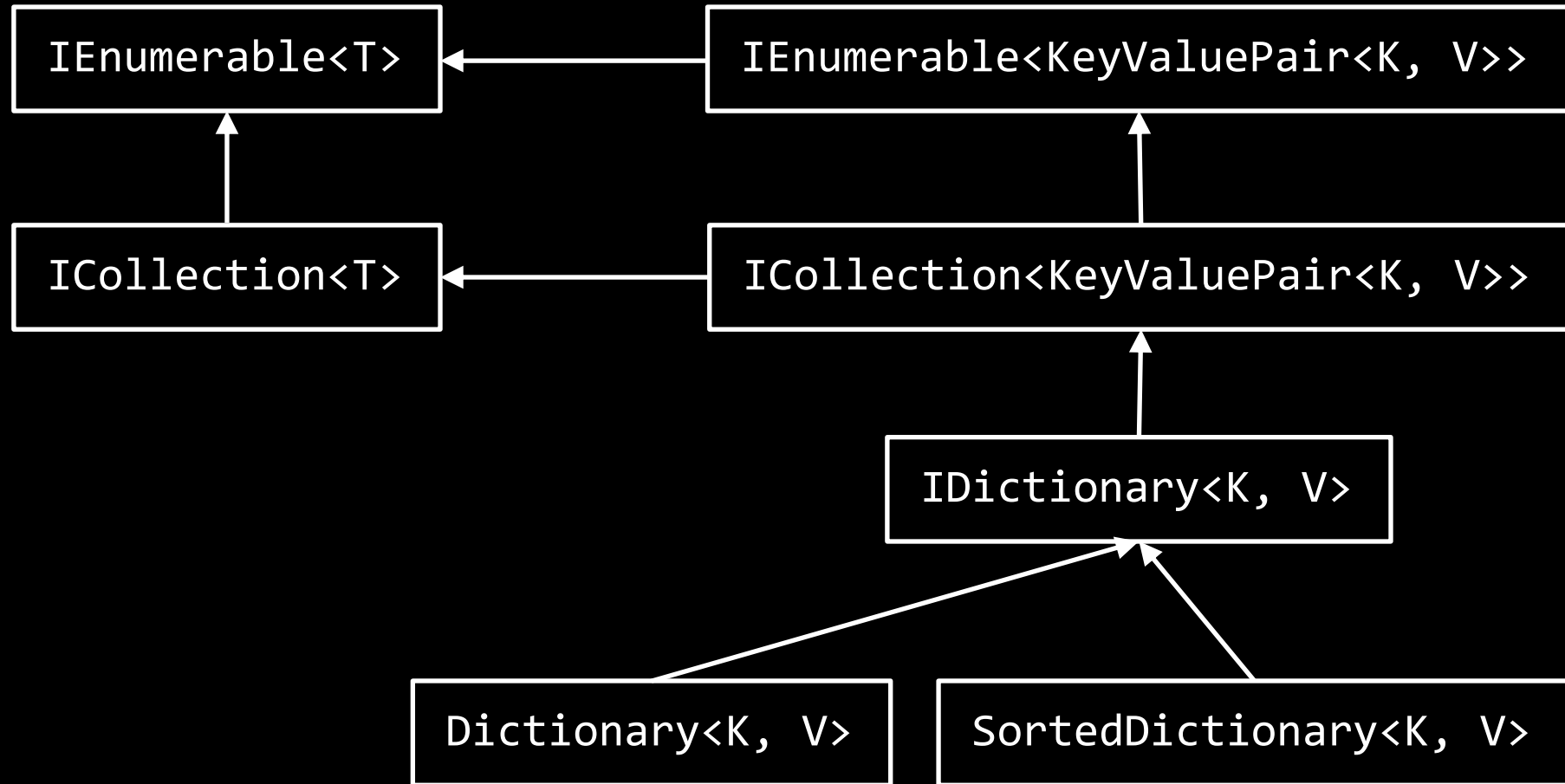
System.Collections



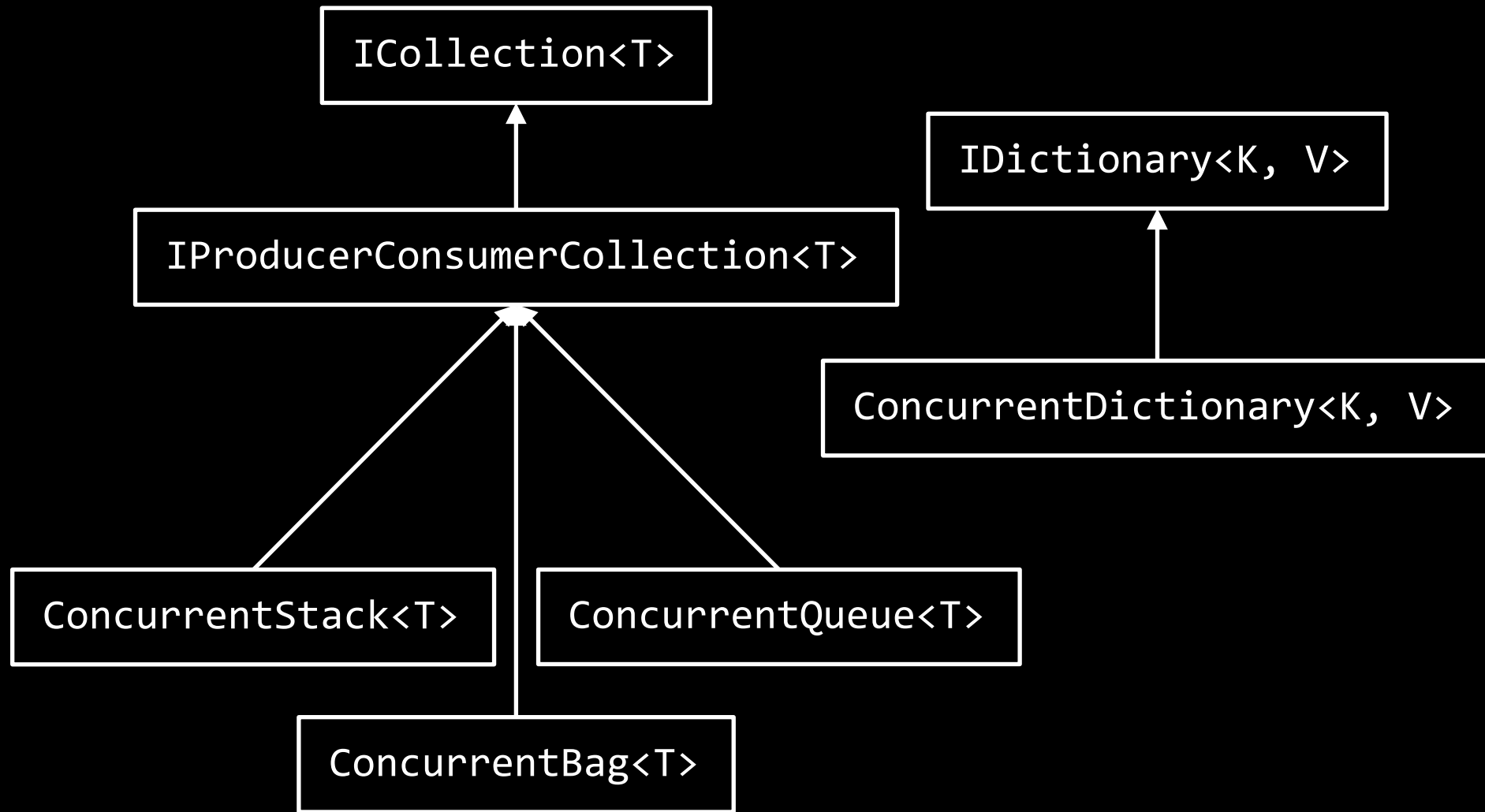
System.Collections.Generic



System.Collections.Generic 2



System.Collections.Concurrent



Regular expressions 1

*	Zero or more times the previous character
+	Once or more times the previous character
?	Zero or one time the previous character
.	Any single character (not \n)
\s	Any whitespace character (e.g. tab)
\S	Any non-whitespace character
\b	Word boundary
\B	Any non-word boundary position
\w	Any word character (a-z, A-Z, 0-9)
\W	Any non-word character
^	Start of the input text
\$	End of the input text

Regular expressions 2

<code>[1c]</code>	matches character '1' or 'c'
<code>[a-z]</code>	matches all lower-case letters
<code>[a-zA-Z]</code>	matches all letters
<code>[0-9]+</code>	matches integer numbers
<code>[0-9]+\.[0-9]+</code>	matches a floating point
<code>[0-2][0-9]:[0-5][0-9]</code>	matches a time e.g. 12:34

Regular expressions 3

<code>[^abc]</code>	matches character not in 'a', 'b', or 'c'
<code>[a-z]+(\d{5})</code>	matches a standard Danish license plate where the numeric part is a capturing group
<code>(?<given_name>\w+) (?<surname>\w+)</code>	matching a given name followed by a surname (named capturing groups)
<code>(?:Jane John) (\w+) (?:Doe)</code>	matching the middle name of Jane or John Doe