

## LinksPlatform's Platform.Collections Class Library

### 1.1 ./csharp/Platform.Collections/Arrays/ArrayFiller[TElement, TReturnConstant].cs

```
1 using System.Collections.Generic;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Arrays
7 {
8     public class ArrayFiller<TElement, TReturnConstant> : ArrayFiller<TElement>
9     {
10         protected readonly TReturnConstant _returnConstant;
11
12         [MethodImpl(MethodImplOptions.AggressiveInlining)]
13         public ArrayFiller(TElement[] array, long offset, TReturnConstant returnConstant) :
14             ↪ base(array, offset) => _returnConstant = returnConstant;
15
16         [MethodImpl(MethodImplOptions.AggressiveInlining)]
17         public ArrayFiller(TElement[] array, TReturnConstant returnConstant) : this(array, 0,
18             ↪ returnConstant) { }
19
20         [MethodImpl(MethodImplOptions.AggressiveInlining)]
21         public TReturnConstant AddAndReturnConstant(TElement element) =>
22             ↪ _array.AddAndReturnConstant(ref _position, element, _returnConstant);
23
24         [MethodImpl(MethodImplOptions.AggressiveInlining)]
25         public TReturnConstant AddFirstAndReturnConstant(ICollection<TElement> elements) =>
26             ↪ _array.AddFirstAndReturnConstant(ref _position, elements, _returnConstant);
27
28         [MethodImpl(MethodImplOptions.AggressiveInlining)]
29         public TReturnConstant AddAllAndReturnConstant(ICollection<TElement> elements) =>
30             ↪ _array.AddAllAndReturnConstant(ref _position, elements, _returnConstant);
31
32         [MethodImpl(MethodImplOptions.AggressiveInlining)]
33         public TReturnConstant AddSkipFirstAndReturnConstant(ICollection<TElement> elements) =>
34             ↪ _array.AddSkipFirstAndReturnConstant(ref _position, elements, _returnConstant);
35     }
36 }
```

### 1.2 ./csharp/Platform.Collections/Arrays/ArrayFiller[TElement].cs

```
1 using System.Collections.Generic;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Arrays
7 {
8     public class ArrayFiller<TElement>
9     {
10         protected readonly TElement[] _array;
11         protected long _position;
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public ArrayFiller(TElement[] array, long offset)
15         {
16             _array = array;
17             _position = offset;
18         }
19
20         [MethodImpl(MethodImplOptions.AggressiveInlining)]
21         public ArrayFiller(TElement[] array) : this(array, 0) { }
22
23         [MethodImpl(MethodImplOptions.AggressiveInlining)]
24         public void Add(TElement element) => _array[_position++] = element;
25
26         [MethodImpl(MethodImplOptions.AggressiveInlining)]
27         public bool AddAndReturnTrue(TElement element) => _array.AddAndReturnConstant(ref
28             ↪ _position, element, true);
29
30         [MethodImpl(MethodImplOptions.AggressiveInlining)]
31         public bool AddFirstAndReturnTrue(ICollection<TElement> elements) =>
32             ↪ _array.AddFirstAndReturnConstant(ref _position, elements, true);
33
34         [MethodImpl(MethodImplOptions.AggressiveInlining)]
35         public bool AddAllAndReturnTrue(ICollection<TElement> elements) =>
36             ↪ _array.AddAllAndReturnConstant(ref _position, elements, true);
37
38         [MethodImpl(MethodImplOptions.AggressiveInlining)]
39         public bool AddSkipFirstAndReturnTrue(ICollection<TElement> elements) =>
40             ↪ _array.AddSkipFirstAndReturnConstant(ref _position, elements, true);
41     }
42 }
```

```

36         public bool AddSkipFirstAndReturnTrue(ICollection<TElement> elements) =>
           ↪ _array.AddSkipFirstAndReturnConstant(ref _position, elements, true);
37     }
38 }

```

### 1.3 ./csharp/Platform.Collections/Arrays/ArrayPool.cs

```

1  using System.Runtime.CompilerServices;
2
3  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4
5  namespace Platform.Collections.Arrays
6  {
7      public static class ArrayPool
8      {
9          public static readonly int DefaultSizesAmount = 512;
10         public static readonly int DefaultMaxArraysPerSize = 32;
11
12         [MethodImpl(MethodImplOptions.AggressiveInlining)]
13         public static T[] Allocate<T>(long size) => ArrayPool<T>.ThreadInstance.Allocate(size);
14
15         [MethodImpl(MethodImplOptions.AggressiveInlining)]
16         public static void Free<T>(T[] array) => ArrayPool<T>.ThreadInstance.Free(array);
17     }
18 }

```

### 1.4 ./csharp/Platform.Collections/Arrays/ArrayPool[T].cs

```

1  using System;
2  using System.Collections.Generic;
3  using System.Runtime.CompilerServices;
4  using Platform.Disposables;
5  using Platform.Collections.Stacks;
6
7  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
8
9  namespace Platform.Collections.Arrays
10 {
11     /// <remarks>
12     /// Original idea from
13     ↪ http://geekswithblogs.net/blackrob/archive/2014/12/18/array-pooling-in-csharp.aspx
14     /// </remarks>
15     public class ArrayPool<T>
16     {
17         // May be use Default class for that later.
18         [ThreadStatic]
19         private static ArrayPool<T> _threadInstance;
20         internal static ArrayPool<T> ThreadInstance => _threadInstance ?? (_threadInstance = new
           ↪ ArrayPool<T>());
21
22         private readonly int _maxArraysPerSize;
23         private readonly Dictionary<long, Stack<T[]>> _pool = new Dictionary<long,
           ↪ Stack<T[]>>(ArrayPool.DefaultSizesAmount);
24
25         [MethodImpl(MethodImplOptions.AggressiveInlining)]
26         public ArrayPool(int maxArraysPerSize) => _maxArraysPerSize = maxArraysPerSize;
27
28         [MethodImpl(MethodImplOptions.AggressiveInlining)]
29         public ArrayPool() : this(ArrayPool.DefaultMaxArraysPerSize) { }
30
31         [MethodImpl(MethodImplOptions.AggressiveInlining)]
32         public Disposable<T[]> AllocateDisposable(long size) => (Allocate(size), Free);
33
34         [MethodImpl(MethodImplOptions.AggressiveInlining)]
35         public Disposable<T[]> Resize(Disposable<T[]> source, long size)
36         {
37             var destination = AllocateDisposable(size);
38             T[] sourceArray = source;
39             if (!sourceArray.IsNullOrEmpty())
40             {
41                 T[] destinationArray = destination;
42                 Array.Copy(sourceArray, destinationArray, size < sourceArray.LongLength ? size :
                   ↪ sourceArray.LongLength);
43                 source.Dispose();
44             }
45             return destination;
46         }
47
48         [MethodImpl(MethodImplOptions.AggressiveInlining)]
49         public virtual void Clear() => _pool.Clear();
50     }
51 }

```

```

50     [MethodImpl(MethodImplOptions.AggressiveInlining)]
51     public virtual T[] Allocate(long size) => size <= 0L ? Array.Empty<T>() :
    ↪     _pool.GetOrDefault(size)?.PopOrDefault() ?? new T[size];
52
53     [MethodImpl(MethodImplOptions.AggressiveInlining)]
54     public virtual void Free(T[] array)
55     {
56         if (array.IsNullOrEmpty())
57         {
58             return;
59         }
60         var stack = _pool.GetOrAdd(array.LongLength, size => new
    ↪         Stack<T[]>(_maxArraysPerSize));
61         if (stack.Count == _maxArraysPerSize) // Stack is full
62         {
63             return;
64         }
65         stack.Push(array);
66     }
67 }
68 }

```

### 1.5 ./csharp/Platform.Collections/Arrays/ArrayString.cs

```

1  using System.Runtime.CompilerServices;
2  using Platform.Collections.Segments;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Collections.Arrays
7  {
8      public class ArrayString<T> : Segment<T>
9      {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         public ArrayString(int length) : base(new T[length], 0, length) { }
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public ArrayString(T[] array) : base(array, 0, array.Length) { }
15
16         [MethodImpl(MethodImplOptions.AggressiveInlining)]
17         public ArrayString(T[] array, int length) : base(array, 0, length) { }
18     }
19 }

```

### 1.6 ./csharp/Platform.Collections/Arrays/CharArrayExtensions.cs

```

1  using System.Runtime.CompilerServices;
2
3  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4
5  namespace Platform.Collections.Arrays
6  {
7      public static unsafe class CharArrayExtensions
8      {
9          /// <remarks>
10         /// Based on https://github.com/Microsoft/referencesource/blob/3b1eaf5203992df69de44c783\_a3eda37d3d4cd10/mscorlib/system/string.cs#L833
11         ↪     ↪ a3eda37d3d4cd10/mscorlib/system/string.cs#L833
12         /// </remarks>
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public static int GenerateHashCode(this char[] array, int offset, int length)
15         {
16             var hashSeed = 5381;
17             var hashAccumulator = hashSeed;
18             fixed (char* arrayPointer = &array[offset])
19             {
20                 for (char* charPointer = arrayPointer, last = charPointer + length; charPointer
21                     ↪     ↪ < last; charPointer++)
22                 {
23                     hashAccumulator = (hashAccumulator << 5) + hashAccumulator ^ *charPointer;
24                 }
25             }
26             return hashAccumulator + (hashSeed * 1566083941);
27         }
28
29         /// <remarks>
30         /// Based on https://github.com/Microsoft/referencesource/blob/3b1eaf5203992df69de44c783\_a3eda37d3d4cd10/mscorlib/system/string.cs#L364
31         ↪     ↪ a3eda37d3d4cd10/mscorlib/system/string.cs#L364
32         /// </remarks>
33         [MethodImpl(MethodImplOptions.AggressiveInlining)]
34         public static bool ContentEqualTo(this char[] left, int leftOffset, int length, char[]
35             ↪     ↪ right, int rightOffset)

```

```

32 {
33     fixed (char* leftPointer = &left[leftOffset])
34     {
35         fixed (char* rightPointer = &right[rightOffset])
36         {
37             char* leftPointerCopy = leftPointer, rightPointerCopy = rightPointer;
38             if (!CheckArraysMainPartForEquality(ref leftPointerCopy, ref
39                 ↪ rightPointerCopy, ref length))
40             {
41                 return false;
42             }
43             CheckArraysRemainderForEquality(ref leftPointerCopy, ref rightPointerCopy,
44                 ↪ ref length);
45             return length <= 0;
46         }
47     }
48 }
49
50 [MethodImpl(MethodImplOptions.AggressiveInlining)]
51 private static bool CheckArraysMainPartForEquality(ref char* left, ref char* right, ref
52     ↪ int length)
53 {
54     while (length >= 10)
55     {
56         if ((* (int*)left != *(int*)right)
57             || (*(int*)(left + 2) != *(int*)(right + 2))
58             || (*(int*)(left + 4) != *(int*)(right + 4))
59             || (*(int*)(left + 6) != *(int*)(right + 6))
60             || (*(int*)(left + 8) != *(int*)(right + 8)))
61         {
62             return false;
63         }
64         left += 10;
65         right += 10;
66         length -= 10;
67     }
68     return true;
69 }
70
71 [MethodImpl(MethodImplOptions.AggressiveInlining)]
72 private static void CheckArraysRemainderForEquality(ref char* left, ref char* right, ref
73     ↪ int length)
74 {
75     // This depends on the fact that the String objects are
76     // always zero terminated and that the terminating zero is not included
77     // in the length. For odd string sizes, the last compare will include
78     // the zero terminator.
79     while (length > 0)
80     {
81         if ((* (int*)left != *(int*)right)
82             {
83             break;
84         }
85         left += 2;
86         right += 2;
87         length -= 2;
88     }
89 }
90 }

```

## 1.7 ./csharp/Platform.Collections/Arrays/GenericArrayExtensions.cs

```

1 using System;
2 using System.Collections.Generic;
3 using System.Runtime.CompilerServices;
4
5 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7 namespace Platform.Collections.Arrays
8 {
9     public static class GenericArrayExtensions
10     {
11         /// <summary>
12         /// <param name="array"><para>Array that will participate in
13         ↪ verification.</para><para>Массив который будет участвовать в
14         ↪ проверке.</para></param>
15         /// <param name="index"><para>Number type int to compare.</para><para>Число типа int для
16         ↪ сравнения.</para></param>

```

```

14  /// <para>We check whether the array exists, if so, we check the array length using the
    → index variable type int, and if the array length is greater than the index, we
    → return array[index], otherwise-default value.</para>
15  /// <para>Мы проверяем, существует ли массив, если да - мы проверяем длину массива с
    → помощью переменной index, и если длина массива больше индекса - возвращаем
    → array[index], иначе - default value.</para>
16  /// </summary>
17  /// <typeparam name="T"><para>Array variable type.</para><para>Тип переменной
    → массива.</para></typeparam>
18  /// <returns><para>Array element or default value.</para><para>Элемент массива или же
    → значение по умолчанию.</para></returns>
19
20  [MethodImpl(MethodImplOptions.AggressiveInlining)]
21  public static T GetElementOrDefault<T>(this T[] array, int index) => array != null &&
    → array.Length > index ? array[index] : default;
22
23  /// <summary>
24  /// <param name="array"><para>Array that will participate in
    → verification.</para><para>Массив который будет участвовать в
    → проверке.</para></param>
25  /// <param name="index"><para>Number type long to compare.</para><para>Число типа long
    → для сравнения.</para></param>
26  /// <para>We check whether the array exists, if so, we check the array length using the
    → index variable type long, and if the array length is greater than the index, we
    → return array[index], otherwise-default value.</para>
27  /// <para>Мы проверяем, существует ли массив, если да - мы проверяем длину массива с
    → помощью переменной index, и если длина массива больше индекса - возвращаем
    → array[index], иначе - значение по умолчанию.</para>
28  /// </summary>
29  /// <typeparam name="T"><para>Array variable type.</para><para>Тип переменной
    → массива.</para></typeparam>
30  /// <returns><para>Array element or default value.</para><para>Элемент массива или же
    → значение по умолчанию.</para></returns>
31
32  [MethodImpl(MethodImplOptions.AggressiveInlining)]
33  public static T GetElementOrDefault<T>(this T[] array, long index) => array != null &&
    → array.LongLength > index ? array[index] : default;
34
35  /// <summary>
36  /// <param name="array"><para>Array that will participate in
    → verification.</para><para>Массив который будет участвовать в
    → проверке.</para></param>
37  /// <param name="index"><para>Number type int to compare.</para><para>Число типа int для
    → сравнения.</para></param>
38  /// <param name="element"><para>Passing the argument by reference, if successful, it
    → will take the value array[index] otherwise default value.</para><para>Передаём
    → аргумент по ссылке, в случае успеха он примет значение array[index] в противном
    → случае значение по умолчанию.</para></param>
39  /// <para>We check whether the array exist, if so, we check the array length using the
    → index variable type int, and if the array length is greater than the index, we set
    → the element variable to array[index] and return true.</para>
40  /// <para>Мы проверяем, существует ли массив, если да, то мы проверяем длину массива с
    → помощью переменной index типа int, и если длина массива больше значения index, мы
    → устанавливаем значение переменной element - array[index] и возвращаем true.</para>
41  /// </summary>
42  /// <typeparam name="T"><para>Array variable type.</para><para>Тип переменной
    → массива.</para></typeparam>
43  /// <returns><para>True if successful otherwise false.</para><para>True в случае успеха,
    → в противном случае false</para></returns>
44
45  [MethodImpl(MethodImplOptions.AggressiveInlining)]
46  public static bool TryGetElement<T>(this T[] array, int index, out T element)
47  {
48      if (array != null && array.Length > index)
49      {
50          element = array[index];
51          return true;
52      }
53      else
54      {
55          element = default;
56          return false;
57      }
58  }
59
60  /// <summary>

```

```

61  /// <param name="array"><para>Array that will participate in
    → verification.</para><para>Массив который будет участвовать в
    → проверке.</para></param>
62  /// <param name="index"><para>Number type long to compare.</para><para>Число типа long
    → для сравнения.</para></param>
63  /// <param name="element"><para>Passing the argument by reference, if successful, it
    → will take the value array[index] otherwise default value.</para><para>Передаём
    → аргумент по ссылке, в случае успеха он примет значение array[index] в противном
    → случае значение по умолчанию.</para></param>
64  /// <para>We check whether the array exist, if so, we check the array length using the
    → index variable type long, and if the array length is greater than the index, we set
    → the element variable to array[index] and return true.</para>
65  /// <para>Мы проверяем, существует ли массив, если да, то мы проверяем длину массива с
    → помощью переменной index типа long, и если длина массива больше значения index, мы
    → устанавливаем значение переменной element - array[index] и возвращаем true.</para>
66  /// </summary>
67  /// <typeparam name="T"><para>Array variable type.</para><para>Тип переменной
    → массива.</para></typeparam>
68  /// <returns><para>True if successful otherwise false.</para><para>True в случае успеха,
    → в противном случае false</para></returns>
69
70  [MethodImpl(MethodImplOptions.AggressiveInlining)]
71  public static bool TryGetElement<T>(this T[] array, long index, out T element)
72  {
73      if (array != null && array.LongLength > index)
74      {
75          element = array[index];
76          return true;
77      }
78      else
79      {
80          element = default;
81          return false;
82      }
83  }
84
85  [MethodImpl(MethodImplOptions.AggressiveInlining)]
86  public static T[] Clone<T>(this T[] array)
87  {
88      var copy = new T[array.LongLength];
89      Array.Copy(array, 0L, copy, 0L, array.LongLength);
90      return copy;
91  }
92
93  [MethodImpl(MethodImplOptions.AggressiveInlining)]
94  public static IList<T> ShiftRight<T>(this T[] array) => array.ShiftRight(1L);
95
96  [MethodImpl(MethodImplOptions.AggressiveInlining)]
97  public static IList<T> ShiftRight<T>(this T[] array, long shift)
98  {
99      if (shift < 0)
100     {
101         throw new NotImplementedException();
102     }
103     if (shift == 0)
104     {
105         return array.Clone<T>();
106     }
107     else
108     {
109         var restrictions = new T[array.LongLength + shift];
110         Array.Copy(array, 0L, restrictions, shift, array.LongLength);
111         return restrictions;
112     }
113  }
114
115  [MethodImpl(MethodImplOptions.AggressiveInlining)]
116  public static void Add<T>(this T[] array, ref int position, T element) =>
    → array[position++] = element;
117
118  [MethodImpl(MethodImplOptions.AggressiveInlining)]
119  public static void Add<T>(this T[] array, ref long position, T element) =>
    → array[position++] = element;
120
121  [MethodImpl(MethodImplOptions.AggressiveInlining)]
122  public static TReturnConstant AddAndReturnConstant<TElement, TReturnConstant>(this
    → TElement[] array, ref long position, TElement element, TReturnConstant
    → returnConstant)

```

```

123     {
124         array.Add(ref position, element);
125         return returnConstant;
126     }
127
128     [MethodImpl(MethodImplOptions.AggressiveInlining)]
129     public static void AddFirst<T>(this T[] array, ref long position, IList<T> elements) =>
130         ↪ array[position++] = elements[0];
131
132     [MethodImpl(MethodImplOptions.AggressiveInlining)]
133     public static TReturnConstant AddFirstAndReturnConstant<TElement, TReturnConstant>(this
134         ↪ TElement[] array, ref long position, IList<TElement> elements, TReturnConstant
135         ↪ returnConstant)
136     {
137         array.AddFirst(ref position, elements);
138         return returnConstant;
139     }
140
141     [MethodImpl(MethodImplOptions.AggressiveInlining)]
142     public static TReturnConstant AddAllAndReturnConstant<TElement, TReturnConstant>(this
143         ↪ TElement[] array, ref long position, IList<TElement> elements, TReturnConstant
144         ↪ returnConstant)
145     {
146         array.AddAll(ref position, elements);
147         return returnConstant;
148     }
149
150     [MethodImpl(MethodImplOptions.AggressiveInlining)]
151     public static void AddAll<T>(this T[] array, ref long position, IList<T> elements)
152     {
153         for (var i = 0; i < elements.Count; i++)
154         {
155             array.Add(ref position, elements[i]);
156         }
157     }
158
159     [MethodImpl(MethodImplOptions.AggressiveInlining)]
160     public static TReturnConstant AddSkipFirstAndReturnConstant<TElement,
161         ↪ TReturnConstant>(this TElement[] array, ref long position, IList<TElement> elements,
162         ↪ TReturnConstant returnConstant)
163     {
164         array.AddSkipFirst(ref position, elements);
165         return returnConstant;
166     }
167
168     [MethodImpl(MethodImplOptions.AggressiveInlining)]
169     public static void AddSkipFirst<T>(this T[] array, ref long position, IList<T> elements)
170         ↪ => array.AddSkipFirst(ref position, elements, 1);
171
172     [MethodImpl(MethodImplOptions.AggressiveInlining)]
173     public static void AddSkipFirst<T>(this T[] array, ref long position, IList<T> elements,
174         ↪ int skip)
175     {
176         for (var i = skip; i < elements.Count; i++)
177         {
178             array.Add(ref position, elements[i]);
179         }
180     }
181 }
182
183 }

```

## 1.8 ./csharp/Platform.Collections/BitString.cs

```

1  using System;
2  using System.Collections.Concurrent;
3  using System.Collections.Generic;
4  using System.Numerics;
5  using System.Runtime.CompilerServices;
6  using System.Threading.Tasks;
7  using Platform.Exceptions;
8  using Platform.Ranges;
9
10 // ReSharper disable ForCanBeConvertedToForeach
11 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
12
13 namespace Platform.Collections
14 {
15     /// <remarks>
16     /// А что если хранить карту значений, где каждый бит будет означать присутствует ли блок в
17     ↪ 64 бит в массиве значений.

```

```

17  /// 64 бита по 0 бит, будут означать отсутствие 64-х блоков по 64 бита. Т.е. упаковка 512
18  ↪ байт в 8 байт.
19  /// Подобный принцип можно применять и к 64-ём блокам и т.п. По сути это карта значений. С
20  ↪ помощью которой можно быстро
21  /// проверять есть ли значения непосредственно далее (ниже по уровню).
22  /// Или как таблица виртуальной памяти где номер блока означает его присутствие и адрес.
23  /// </remarks>
24  public class BitString : IEquatable<BitString>
25  {
26      private static readonly byte[][] _bitsSetIn16Bits;
27      private long[] _array;
28      private long _length;
29      private long _minPositiveWord;
30      private long _maxPositiveWord;
31
32      public bool this[long index]
33      {
34          [MethodImpl(MethodImplOptions.AggressiveInlining)]
35          get => Get(index);
36          [MethodImpl(MethodImplOptions.AggressiveInlining)]
37          set => Set(index, value);
38      }
39
40      public long Length
41      {
42          [MethodImpl(MethodImplOptions.AggressiveInlining)]
43          get => _length;
44          [MethodImpl(MethodImplOptions.AggressiveInlining)]
45          set
46          {
47              if (_length == value)
48              {
49                  return;
50              }
51              Ensure.Always.ArgumentInRange(value, GetValidLengthRange(), nameof(Length));
52              // Currently we never shrink the array
53              if (value > _length)
54              {
55                  var words = GetWordsCountFromIndex(value);
56                  var oldWords = GetWordsCountFromIndex(_length);
57                  if (words > _array.LongLength)
58                  {
59                      var copy = new long[words];
60                      Array.Copy(_array, copy, _array.LongLength);
61                      _array = copy;
62                  }
63                  else
64                  {
65                      // What is going on here?
66                      Array.Clear(_array, (int)oldWords, (int)(words - oldWords));
67                  }
68                  // What is going on here?
69                  var mask = (int)(_length % 64);
70                  if (mask > 0)
71                  {
72                      _array[oldWords - 1] &= (1L << mask) - 1;
73                  }
74              }
75              else
76              {
77                  // Looks like minimum and maximum positive words are not updated
78                  throw new NotImplementedException();
79              }
80              _length = value;
81          }
82      }
83
84      #region Constructors
85
86      [MethodImpl(MethodImplOptions.AggressiveInlining)]
87      static BitString()
88      {
89          _bitsSetIn16Bits = new byte[65536][];
90          int i, c, k;
91          byte bitIndex;
92          for (i = 0; i < 65536; i++)
93          {
94              // Calculating size of array (number of positive bits)
95              for (c = 0, k = 1; k <= 65536; k <= 1)

```



```

94         {
95             if ((i & k) == k)
96             {
97                 c++;
98             }
99         }
100         var array = new byte[c];
101         // Adding positive bits indices into array
102         for (bitIndex = 0, c = 0, k = 1; k <= 65536; k <= 1)
103         {
104             if ((i & k) == k)
105             {
106                 array[c++] = bitIndex;
107             }
108             bitIndex++;
109         }
110         _bitsSetIn16Bits[i] = array;
111     }
112 }
113
114 [MethodImpl(MethodImplOptions.AggressiveInlining)]
115 public BitString(BitString other)
116 {
117     Ensure.Always.ArgumentNotNull(other, nameof(other));
118     _length = other._length;
119     _array = new long[GetWordsCountFromIndex(_length)];
120     _minPositiveWord = other._minPositiveWord;
121     _maxPositiveWord = other._maxPositiveWord;
122     Array.Copy(other._array, _array, _array.LongLength);
123 }
124
125 [MethodImpl(MethodImplOptions.AggressiveInlining)]
126 public BitString(long length)
127 {
128     Ensure.Always.ArgumentInRange(length, GetValidLengthRange(), nameof(length));
129     _length = length;
130     _array = new long[GetWordsCountFromIndex(_length)];
131     MarkBordersAsAllBitsReset();
132 }
133
134 [MethodImpl(MethodImplOptions.AggressiveInlining)]
135 public BitString(long length, bool defaultValue)
136     : this(length)
137 {
138     if (defaultValue)
139     {
140         SetAll();
141     }
142 }
143
144 #endregion
145
146 [MethodImpl(MethodImplOptions.AggressiveInlining)]
147 public BitString Not()
148 {
149     for (var i = 0L; i < _array.LongLength; i++)
150     {
151         _array[i] = ~_array[i];
152         RefreshBordersByWord(i);
153     }
154     return this;
155 }
156
157 [MethodImpl(MethodImplOptions.AggressiveInlining)]
158 public BitString ParallelNot()
159 {
160     var threads = Environment.ProcessorCount / 2;
161     if (threads <= 1)
162     {
163         return Not();
164     }
165     var partitioner = Partitioner.Create(0L, _array.LongLength, _array.LongLength /
166         ↳ threads);
167     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions {
168         ↳ MaxDegreeOfParallelism = threads }, range =>
169     {
170         var maximum = range.Item2;
171         for (var i = range.Item1; i < maximum; i++)
172         {

```

```

171         _array[i] = ~_array[i];
172     }
173 });
174 MarkBordersAsAllBitsSet();
175 TryShrinkBorders();
176 return this;
177 }
178
179 [MethodImpl(MethodImplOptions.AggressiveInlining)]
180 public BitString VectorNot()
181 {
182     if (!Vector.IsHardwareAccelerated || _array.LongLength >= int.MaxValue)
183     {
184         return Not();
185     }
186     var step = Vector<long>.Count;
187     if (_array.Length < step)
188     {
189         return Not();
190     }
191     VectorNotLoop(_array, step, 0, _array.Length);
192     MarkBordersAsAllBitsSet();
193     TryShrinkBorders();
194     return this;
195 }
196
197 [MethodImpl(MethodImplOptions.AggressiveInlining)]
198 public BitString ParallelVectorNot()
199 {
200     var threads = Environment.ProcessorCount / 2;
201     if (threads <= 1)
202     {
203         return VectorNot();
204     }
205     if (!Vector.IsHardwareAccelerated)
206     {
207         return ParallelNot();
208     }
209     var step = Vector<long>.Count;
210     if (_array.Length < (step * threads))
211     {
212         return VectorNot();
213     }
214     var partitioner = Partitioner.Create(0, _array.Length, _array.Length / threads);
215     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions {
216         ↪ MaxDegreeOfParallelism = threads }, range => VectorNotLoop(_array, step,
217         ↪ range.Item1, range.Item2));
218     MarkBordersAsAllBitsSet();
219     TryShrinkBorders();
220     return this;
221 }
222
223 [MethodImpl(MethodImplOptions.AggressiveInlining)]
224 static private void VectorNotLoop(long[] array, int step, int start, int maximum)
225 {
226     var i = start;
227     var range = maximum - start - 1;
228     var stop = range - (range % step);
229     for (; i < stop; i += step)
230     {
231         (~new Vector<long>(array, i)).CopyTo(array, i);
232     }
233     for (; i < maximum; i++)
234     {
235         array[i] = ~array[i];
236     }
237 }
238
239 [MethodImpl(MethodImplOptions.AggressiveInlining)]
240 public BitString And(BitString other)
241 {
242     EnsureBitStringHasTheSameSize(other, nameof(other));
243     GetCommonOuterBorders(this, other, out long from, out long to);
244     var otherArray = other._array;
245     for (var i = from; i <= to; i++)
246     {
247         _array[i] &= otherArray[i];
248         RefreshBordersByWord(i);
249     }
250 }

```

```

247     }
248     return this;
249 }
250
251 [MethodImpl(MethodImplOptions.AggressiveInlining)]
252 public BitString ParallelAnd(BitString other)
253 {
254     var threads = Environment.ProcessorCount / 2;
255     if (threads <= 1)
256     {
257         return And(other);
258     }
259     EnsureBitStringHasTheSameSize(other, nameof(other));
260     GetCommonOuterBorders(this, other, out long from, out long to);
261     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
262     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions {
263         ↪ MaxDegreeOfParallelism = threads }, range =>
264     {
265         var maximum = range.Item2;
266         for (var i = range.Item1; i < maximum; i++)
267         {
268             _array[i] &= other._array[i];
269         }
270     });
271     MarkBordersAsAllBitsSet();
272     TryShrinkBorders();
273     return this;
274 }
275
276 [MethodImpl(MethodImplOptions.AggressiveInlining)]
277 public BitString VectorAnd(BitString other)
278 {
279     if (!Vector.IsHardwareAccelerated || _array.LongLength >= int.MaxValue)
280     {
281         return And(other);
282     }
283     var step = Vector<long>.Count;
284     if (_array.Length < step)
285     {
286         return And(other);
287     }
288     EnsureBitStringHasTheSameSize(other, nameof(other));
289     GetCommonOuterBorders(this, other, out int from, out int to);
290     VectorAndLoop(_array, other._array, step, from, to + 1);
291     MarkBordersAsAllBitsSet();
292     TryShrinkBorders();
293     return this;
294 }
295
296 [MethodImpl(MethodImplOptions.AggressiveInlining)]
297 public BitString ParallelVectorAnd(BitString other)
298 {
299     var threads = Environment.ProcessorCount / 2;
300     if (threads <= 1)
301     {
302         return VectorAnd(other);
303     }
304     if (!Vector.IsHardwareAccelerated)
305     {
306         return ParallelAnd(other);
307     }
308     var step = Vector<long>.Count;
309     if (_array.Length < (step * threads))
310     {
311         return VectorAnd(other);
312     }
313     EnsureBitStringHasTheSameSize(other, nameof(other));
314     GetCommonOuterBorders(this, other, out int from, out int to);
315     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
316     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions {
317         ↪ MaxDegreeOfParallelism = threads }, range => VectorAndLoop(_array, other._array,
318         ↪ step, range.Item1, range.Item2));
319     MarkBordersAsAllBitsSet();
320     TryShrinkBorders();
321     return this;
322 }
323
324 [MethodImpl(MethodImplOptions.AggressiveInlining)]

```

```

322 static private void VectorAndLoop(long[] array, long[] otherArray, int step, int start,
323     ↪ int maximum)
324 {
325     var i = start;
326     var range = maximum - start - 1;
327     var stop = range - (range % step);
328     for (; i < stop; i += step)
329     {
330         (new Vector<long>(array, i) & new Vector<long>(otherArray, i)).CopyTo(array, i);
331     }
332     for (; i < maximum; i++)
333     {
334         array[i] &= otherArray[i];
335     }
336 }
337 [MethodImpl(MethodImplOptions.AggressiveInlining)]
338 public BitString Or(BitString other)
339 {
340     EnsureBitStringHasTheSameSize(other, nameof(other));
341     GetCommonOuterBorders(this, other, out long from, out long to);
342     for (var i = from; i <= to; i++)
343     {
344         _array[i] |= other._array[i];
345         RefreshBordersByWord(i);
346     }
347     return this;
348 }
349 [MethodImpl(MethodImplOptions.AggressiveInlining)]
350 public BitString ParallelOr(BitString other)
351 {
352     var threads = Environment.ProcessorCount / 2;
353     if (threads <= 1)
354     {
355         return Or(other);
356     }
357     EnsureBitStringHasTheSameSize(other, nameof(other));
358     GetCommonOuterBorders(this, other, out long from, out long to);
359     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
360     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions {
361         ↪ MaxDegreeOfParallelism = threads }, range =>
362     {
363         var maximum = range.Item2;
364         for (var i = range.Item1; i < maximum; i++)
365         {
366             _array[i] |= other._array[i];
367         }
368     });
369     MarkBordersAsAllBitsSet();
370     TryShrinkBorders();
371     return this;
372 }
373 [MethodImpl(MethodImplOptions.AggressiveInlining)]
374 public BitString VectorOr(BitString other)
375 {
376     if (!Vector.IsHardwareAccelerated || _array.LongLength >= int.MaxValue)
377     {
378         return Or(other);
379     }
380     var step = Vector<long>.Count;
381     if (_array.Length < step)
382     {
383         return Or(other);
384     }
385     EnsureBitStringHasTheSameSize(other, nameof(other));
386     GetCommonOuterBorders(this, other, out int from, out int to);
387     VectorOrLoop(_array, other._array, step, from, to + 1);
388     MarkBordersAsAllBitsSet();
389     TryShrinkBorders();
390     return this;
391 }
392 [MethodImpl(MethodImplOptions.AggressiveInlining)]
393 public BitString ParallelVectorOr(BitString other)
394 {
395     var threads = Environment.ProcessorCount / 2;

```

```

398     if (threads <= 1)
399     {
400         return VectorOr(other);
401     }
402     if (!Vector.IsHardwareAccelerated)
403     {
404         return ParallelOr(other);
405     }
406     var step = Vector<long>.Count;
407     if (_array.Length < (step * threads))
408     {
409         return VectorOr(other);
410     }
411     EnsureBitStringHasTheSameSize(other, nameof(other));
412     GetCommonOuterBorders(this, other, out int from, out int to);
413     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
414     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions {
415         ↪ MaxDegreeOfParallelism = threads }, range => VectorOrLoop(_array, other._array,
416         ↪ step, range.Item1, range.Item2));
417     MarkBordersAsAllBitsSet();
418     TryShrinkBorders();
419     return this;
420 }
421
422 [MethodImpl(MethodImplOptions.AggressiveInlining)]
423 static private void VectorOrLoop(long[] array, long[] otherArray, int step, int start,
424 ↪ int maximum)
425 {
426     var i = start;
427     var range = maximum - start - 1;
428     var stop = range - (range % step);
429     for (; i < stop; i += step)
430     {
431         (new Vector<long>(array, i) | new Vector<long>(otherArray, i)).CopyTo(array, i);
432     }
433     for (; i < maximum; i++)
434     {
435         array[i] |= otherArray[i];
436     }
437 }
438
439 [MethodImpl(MethodImplOptions.AggressiveInlining)]
440 public BitString Xor(BitString other)
441 {
442     EnsureBitStringHasTheSameSize(other, nameof(other));
443     GetCommonOuterBorders(this, other, out long from, out long to);
444     for (var i = from; i <= to; i++)
445     {
446         _array[i] ^= other._array[i];
447         RefreshBordersByWord(i);
448     }
449     return this;
450 }
451
452 [MethodImpl(MethodImplOptions.AggressiveInlining)]
453 public BitString ParallelXor(BitString other)
454 {
455     var threads = Environment.ProcessorCount / 2;
456     if (threads <= 1)
457     {
458         return Xor(other);
459     }
460     EnsureBitStringHasTheSameSize(other, nameof(other));
461     GetCommonOuterBorders(this, other, out long from, out long to);
462     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
463     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions {
464         ↪ MaxDegreeOfParallelism = threads }, range =>
465     {
466         var maximum = range.Item2;
467         for (var i = range.Item1; i < maximum; i++)
468         {
469             _array[i] ^= other._array[i];
470         }
471     });
472     MarkBordersAsAllBitsSet();
473     TryShrinkBorders();
474     return this;
475 }

```

```

472 [MethodImpl(MethodImplOptions.AggressiveInlining)]
473 public BitString VectorXor(BitString other)
474 {
475     if (!Vector.IsHardwareAccelerated || _array.LongLength >= int.MaxValue)
476     {
477         return Xor(other);
478     }
479     var step = Vector<long>.Count;
480     if (_array.Length < step)
481     {
482         return Xor(other);
483     }
484     EnsureBitStringHasTheSameSize(other, nameof(other));
485     GetCommonOuterBorders(this, other, out int from, out int to);
486     VectorXorLoop(_array, other._array, step, from, to + 1);
487     MarkBordersAsAllBitsSet();
488     TryShrinkBorders();
489     return this;
490 }
491
492 [MethodImpl(MethodImplOptions.AggressiveInlining)]
493 public BitString ParallelVectorXor(BitString other)
494 {
495     var threads = Environment.ProcessorCount / 2;
496     if (threads <= 1)
497     {
498         return VectorXor(other);
499     }
500     if (!Vector.IsHardwareAccelerated)
501     {
502         return ParallelXor(other);
503     }
504     var step = Vector<long>.Count;
505     if (_array.Length < (step * threads))
506     {
507         return VectorXor(other);
508     }
509     EnsureBitStringHasTheSameSize(other, nameof(other));
510     GetCommonOuterBorders(this, other, out int from, out int to);
511     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
512     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions {
513         ↪ MaxDegreeOfParallelism = threads }, range => VectorXorLoop(_array, other._array,
514         ↪ step, range.Item1, range.Item2));
515     MarkBordersAsAllBitsSet();
516     TryShrinkBorders();
517     return this;
518 }
519
520 [MethodImpl(MethodImplOptions.AggressiveInlining)]
521 static private void VectorXorLoop(long[] array, long[] otherArray, int step, int start,
522 ↪ int maximum)
523 {
524     var i = start;
525     var range = maximum - start - 1;
526     var stop = range - (range % step);
527     for (; i < stop; i += step)
528     {
529         (new Vector<long>(array, i) ^ new Vector<long>(otherArray, i)).CopyTo(array, i);
530     }
531     for (; i < maximum; i++)
532     {
533         array[i] ^= otherArray[i];
534     }
535 }
536
537 [MethodImpl(MethodImplOptions.AggressiveInlining)]
538 private void RefreshBordersByWord(long wordIndex)
539 {
540     if (_array[wordIndex] == 0)
541     {
542         if (wordIndex == _minPositiveWord && wordIndex != _array.LongLength - 1)
543         {
544             _minPositiveWord++;
545         }
546         if (wordIndex == _maxPositiveWord && wordIndex != 0)
547         {
548             _maxPositiveWord--;
549         }
550     }
551 }

```

```

547     }
548 }
549 else
550 {
551     if (wordIndex < _minPositiveWord)
552     {
553         _minPositiveWord = wordIndex;
554     }
555     if (wordIndex > _maxPositiveWord)
556     {
557         _maxPositiveWord = wordIndex;
558     }
559 }
560 }
561
562 [MethodImpl(MethodImplOptions.AggressiveInlining)]
563 public bool TryShrinkBorders()
564 {
565     GetBorders(out long from, out long to);
566     while (from <= to && _array[from] == 0)
567     {
568         from++;
569     }
570     if (from > to)
571     {
572         MarkBordersAsAllBitsReset();
573         return true;
574     }
575     while (to >= from && _array[to] == 0)
576     {
577         to--;
578     }
579     if (to < from)
580     {
581         MarkBordersAsAllBitsReset();
582         return true;
583     }
584     var bordersUpdated = from != _minPositiveWord || to != _maxPositiveWord;
585     if (bordersUpdated)
586     {
587         SetBorders(from, to);
588     }
589     return bordersUpdated;
590 }
591
592 [MethodImpl(MethodImplOptions.AggressiveInlining)]
593 public bool Get(long index)
594 {
595     Ensure.Always.ArgumentInRange(index, GetValidIndexRange(), nameof(index));
596     return (_array[GetWordIndexFromIndex(index)] & GetBitMaskFromIndex(index)) != 0;
597 }
598
599 [MethodImpl(MethodImplOptions.AggressiveInlining)]
600 public void Set(long index, bool value)
601 {
602     if (value)
603     {
604         Set(index);
605     }
606     else
607     {
608         Reset(index);
609     }
610 }
611
612 [MethodImpl(MethodImplOptions.AggressiveInlining)]
613 public void Set(long index)
614 {
615     Ensure.Always.ArgumentInRange(index, GetValidIndexRange(), nameof(index));
616     var wordIndex = GetWordIndexFromIndex(index);
617     var mask = GetBitMaskFromIndex(index);
618     _array[wordIndex] |= mask;
619     RefreshBordersByWord(wordIndex);
620 }
621
622 [MethodImpl(MethodImplOptions.AggressiveInlining)]
623 public void Reset(long index)
624 {
625     Ensure.Always.ArgumentInRange(index, GetValidIndexRange(), nameof(index));

```

```

626     var wordIndex = GetWordIndexFromIndex(index);
627     var mask = GetBitMaskFromIndex(index);
628     _array[wordIndex] &= ~mask;
629     RefreshBordersByWord(wordIndex);
630 }
631
632 [MethodImpl(MethodImplOptions.AggressiveInlining)]
633 public bool Add(long index)
634 {
635     var wordIndex = GetWordIndexFromIndex(index);
636     var mask = GetBitMaskFromIndex(index);
637     if ((_array[wordIndex] & mask) == 0)
638     {
639         _array[wordIndex] |= mask;
640         RefreshBordersByWord(wordIndex);
641         return true;
642     }
643     else
644     {
645         return false;
646     }
647 }
648
649 [MethodImpl(MethodImplOptions.AggressiveInlining)]
650 public void SetAll(bool value)
651 {
652     if (value)
653     {
654         SetAll();
655     }
656     else
657     {
658         ResetAll();
659     }
660 }
661
662 [MethodImpl(MethodImplOptions.AggressiveInlining)]
663 public void SetAll()
664 {
665     const long fillValue = unchecked((long)0xffffffffffffffff);
666     var words = GetWordsCountFromIndex(_length);
667     for (var i = 0; i < words; i++)
668     {
669         _array[i] = fillValue;
670     }
671     MarkBordersAsAllBitsSet();
672 }
673
674 [MethodImpl(MethodImplOptions.AggressiveInlining)]
675 public void ResetAll()
676 {
677     const long fillValue = 0;
678     GetBorders(out long from, out long to);
679     for (var i = from; i <= to; i++)
680     {
681         _array[i] = fillValue;
682     }
683     MarkBordersAsAllBitsReset();
684 }
685
686 [MethodImpl(MethodImplOptions.AggressiveInlining)]
687 public List<long> GetSetIndices()
688 {
689     var result = new List<long>();
690     GetBorders(out long from, out long to);
691     for (var i = from; i <= to; i++)
692     {
693         var word = _array[i];
694         if (word != 0)
695         {
696             AppendAllSetBitIndices(result, i, word);
697         }
698     }
699     return result;
700 }
701
702 [MethodImpl(MethodImplOptions.AggressiveInlining)]
703 public List<ulong> GetSetUInt64Indices()
704 {

```



```

705     var result = new List<ulong>();
706     GetBorders(out ulong from, out ulong to);
707     for (var i = from; i <= to; i++)
708     {
709         var word = _array[i];
710         if (word != 0)
711         {
712             AppendAllSetBitIndices(result, i, word);
713         }
714     }
715     return result;
716 }
717
718 [MethodImpl(MethodImplOptions.AggressiveInlining)]
719 public long GetFirstSetBitIndex()
720 {
721     var i = _minPositiveWord;
722     var word = _array[i];
723     if (word != 0)
724     {
725         return GetFirstSetBitForWord(i, word);
726     }
727     return -1;
728 }
729
730 [MethodImpl(MethodImplOptions.AggressiveInlining)]
731 public long GetLastSetBitIndex()
732 {
733     var i = _maxPositiveWord;
734     var word = _array[i];
735     if (word != 0)
736     {
737         return GetLastSetBitForWord(i, word);
738     }
739     return -1;
740 }
741
742 [MethodImpl(MethodImplOptions.AggressiveInlining)]
743 public long CountSetBits()
744 {
745     var total = 0L;
746     GetBorders(out long from, out long to);
747     for (var i = from; i <= to; i++)
748     {
749         var word = _array[i];
750         if (word != 0)
751         {
752             total += CountSetBitsForWord(word);
753         }
754     }
755     return total;
756 }
757
758 [MethodImpl(MethodImplOptions.AggressiveInlining)]
759 public bool HaveCommonBits(BitString other)
760 {
761     EnsureBitStringHasTheSameSize(other, nameof(other));
762     GetCommonInnerBorders(this, other, out long from, out long to);
763     var otherArray = other._array;
764     for (var i = from; i <= to; i++)
765     {
766         var left = _array[i];
767         var right = otherArray[i];
768         if (left != 0 && right != 0 && (left & right) != 0)
769         {
770             return true;
771         }
772     }
773     return false;
774 }
775
776 [MethodImpl(MethodImplOptions.AggressiveInlining)]
777 public long CountCommonBits(BitString other)
778 {
779     EnsureBitStringHasTheSameSize(other, nameof(other));
780     GetCommonInnerBorders(this, other, out long from, out long to);
781     var total = 0L;
782     var otherArray = other._array;
783     for (var i = from; i <= to; i++)

```

```

784     {
785         var left = _array[i];
786         var right = otherArray[i];
787         var combined = left & right;
788         if (combined != 0)
789         {
790             total += CountSetBitsForWord(combined);
791         }
792     }
793     return total;
794 }
795
796 [MethodImpl(MethodImplOptions.AggressiveInlining)]
797 public List<long> GetCommonIndices(BitString other)
798 {
799     EnsureBitStringHasTheSameSize(other, nameof(other));
800     GetCommonInnerBorders(this, other, out long from, out long to);
801     var result = new List<long>();
802     var otherArray = other._array;
803     for (var i = from; i <= to; i++)
804     {
805         var left = _array[i];
806         var right = otherArray[i];
807         var combined = left & right;
808         if (combined != 0)
809         {
810             AppendAllSetBitIndices(result, i, combined);
811         }
812     }
813     return result;
814 }
815
816 [MethodImpl(MethodImplOptions.AggressiveInlining)]
817 public List<ulong> GetCommonUInt64Indices(BitString other)
818 {
819     EnsureBitStringHasTheSameSize(other, nameof(other));
820     GetCommonBorders(this, other, out ulong from, out ulong to);
821     var result = new List<ulong>();
822     var otherArray = other._array;
823     for (var i = from; i <= to; i++)
824     {
825         var left = _array[i];
826         var right = otherArray[i];
827         var combined = left & right;
828         if (combined != 0)
829         {
830             AppendAllSetBitIndices(result, i, combined);
831         }
832     }
833     return result;
834 }
835
836 [MethodImpl(MethodImplOptions.AggressiveInlining)]
837 public long GetFirstCommonBitIndex(BitString other)
838 {
839     EnsureBitStringHasTheSameSize(other, nameof(other));
840     GetCommonInnerBorders(this, other, out long from, out long to);
841     var otherArray = other._array;
842     for (var i = from; i <= to; i++)
843     {
844         var left = _array[i];
845         var right = otherArray[i];
846         var combined = left & right;
847         if (combined != 0)
848         {
849             return GetFirstSetBitForWord(i, combined);
850         }
851     }
852     return -1;
853 }
854
855 [MethodImpl(MethodImplOptions.AggressiveInlining)]
856 public long GetLastCommonBitIndex(BitString other)
857 {
858     EnsureBitStringHasTheSameSize(other, nameof(other));
859     GetCommonInnerBorders(this, other, out long from, out long to);
860     var otherArray = other._array;
861     for (var i = to; i >= from; i--)
862     {

```

```

863         var left = _array[i];
864         var right = otherArray[i];
865         var combined = left & right;
866         if (combined != 0)
867         {
868             return GetLastSetBitForWord(i, combined);
869         }
870     }
871     return -1;
872 }
873
874 [MethodImpl(MethodImplOptions.AggressiveInlining)]
875 public override bool Equals(object obj) => obj is BitString @string ? Equals(@string) :
    => false;
876
877 [MethodImpl(MethodImplOptions.AggressiveInlining)]
878 public bool Equals(BitString other)
879 {
880     if (_length != other._length)
881     {
882         return false;
883     }
884     var otherArray = other._array;
885     if (_array.Length != otherArray.Length)
886     {
887         return false;
888     }
889     if (_minPositiveWord != other._minPositiveWord)
890     {
891         return false;
892     }
893     if (_maxPositiveWord != other._maxPositiveWord)
894     {
895         return false;
896     }
897     GetCommonBorders(this, other, out ulong from, out ulong to);
898     for (var i = from; i <= to; i++)
899     {
900         if (_array[i] != otherArray[i])
901         {
902             return false;
903         }
904     }
905     return true;
906 }
907
908 [MethodImpl(MethodImplOptions.AggressiveInlining)]
909 private void EnsureBitStringHasTheSameSize(BitString other, string argumentName)
910 {
911     Ensure.Always.ArgumentNotNull(other, argumentName);
912     if (_length != other._length)
913     {
914         throw new ArgumentException("Bit string must be the same size.", argumentName);
915     }
916 }
917
918 [MethodImpl(MethodImplOptions.AggressiveInlining)]
919 private void MarkBordersAsAllBitsReset() => SetBorders(_array.LongLength - 1, 0);
920
921 [MethodImpl(MethodImplOptions.AggressiveInlining)]
922 private void MarkBordersAsAllBitsSet() => SetBorders(0, _array.LongLength - 1);
923
924 [MethodImpl(MethodImplOptions.AggressiveInlining)]
925 private void GetBorders(out long from, out long to)
926 {
927     from = _minPositiveWord;
928     to = _maxPositiveWord;
929 }
930
931 [MethodImpl(MethodImplOptions.AggressiveInlining)]
932 private void GetBorders(out ulong from, out ulong to)
933 {
934     from = (ulong)_minPositiveWord;
935     to = (ulong)_maxPositiveWord;
936 }
937
938 [MethodImpl(MethodImplOptions.AggressiveInlining)]
939 private void SetBorders(long from, long to)
940 {

```

```

941     _minPositiveWord = from;
942     _maxPositiveWord = to;
943 }
944
945 [MethodImpl(MethodImplOptions.AggressiveInlining)]
946 private Range<long> GetValidIndexRange() => (0, _length - 1);
947
948 [MethodImpl(MethodImplOptions.AggressiveInlining)]
949 private static Range<long> GetValidLengthRange() => (0, long.MaxValue);
950
951 [MethodImpl(MethodImplOptions.AggressiveInlining)]
952 private static void AppendAllSetBitIndices(List<ulong> result, ulong wordIndex, long
    ↳ wordValue)
953 {
954     GetBits(wordValue, out byte[] bits00to15, out byte[] bits16to31, out byte[]
    ↳ bits32to47, out byte[] bits48to63);
955     AppendAllSetIndices(result, wordIndex, bits00to15, bits16to31, bits32to47,
    ↳ bits48to63);
956 }
957
958 [MethodImpl(MethodImplOptions.AggressiveInlining)]
959 private static void AppendAllSetBitIndices(List<long> result, long wordIndex, long
    ↳ wordValue)
960 {
961     GetBits(wordValue, out byte[] bits00to15, out byte[] bits16to31, out byte[]
    ↳ bits32to47, out byte[] bits48to63);
962     AppendAllSetBitIndices(result, wordIndex, bits00to15, bits16to31, bits32to47,
    ↳ bits48to63);
963 }
964
965 [MethodImpl(MethodImplOptions.AggressiveInlining)]
966 private static long CountSetBitsForWord(long word)
967 {
968     GetBits(word, out byte[] bits00to15, out byte[] bits16to31, out byte[] bits32to47,
    ↳ out byte[] bits48to63);
969     return bits00to15.LongLength + bits16to31.LongLength + bits32to47.LongLength +
    ↳ bits48to63.LongLength;
970 }
971
972 [MethodImpl(MethodImplOptions.AggressiveInlining)]
973 private static long GetFirstSetBitForWord(long wordIndex, long wordValue)
974 {
975     GetBits(wordValue, out byte[] bits00to15, out byte[] bits16to31, out byte[]
    ↳ bits32to47, out byte[] bits48to63);
976     return GetFirstSetBit(wordIndex, bits00to15, bits16to31, bits32to47, bits48to63);
977 }
978
979 [MethodImpl(MethodImplOptions.AggressiveInlining)]
980 private static long GetLastSetBitForWord(long wordIndex, long wordValue)
981 {
982     GetBits(wordValue, out byte[] bits00to15, out byte[] bits16to31, out byte[]
    ↳ bits32to47, out byte[] bits48to63);
983     return GetLastSetBit(wordIndex, bits00to15, bits16to31, bits32to47, bits48to63);
984 }
985
986 [MethodImpl(MethodImplOptions.AggressiveInlining)]
987 private static void AppendAllSetBitIndices(List<long> result, long i, byte[] bits00to15,
    ↳ byte[] bits16to31, byte[] bits32to47, byte[] bits48to63)
988 {
989     for (var j = 0; j < bits00to15.Length; j++)
990     {
991         result.Add(bits00to15[j] + (i * 64));
992     }
993     for (var j = 0; j < bits16to31.Length; j++)
994     {
995         result.Add(bits16to31[j] + 16 + (i * 64));
996     }
997     for (var j = 0; j < bits32to47.Length; j++)
998     {
999         result.Add(bits32to47[j] + 32 + (i * 64));
1000     }
1001     for (var j = 0; j < bits48to63.Length; j++)
1002     {
1003         result.Add(bits48to63[j] + 48 + (i * 64));
1004     }
1005 }
1006
1007 [MethodImpl(MethodImplOptions.AggressiveInlining)]

```

```

private static void AppendAllSetIndices(List<ulong> result, ulong i, byte[] bits00to15,
    ↪ byte[] bits16to31, byte[] bits32to47, byte[] bits48to63)
{
    for (var j = 0; j < bits00to15.Length; j++)
    {
        result.Add(bits00to15[j] + (i * 64));
    }
    for (var j = 0; j < bits16to31.Length; j++)
    {
        result.Add(bits16to31[j] + 16UL + (i * 64));
    }
    for (var j = 0; j < bits32to47.Length; j++)
    {
        result.Add(bits32to47[j] + 32UL + (i * 64));
    }
    for (var j = 0; j < bits48to63.Length; j++)
    {
        result.Add(bits48to63[j] + 48UL + (i * 64));
    }
}

[MethodImpl(MethodImplOptions.AggressiveInlining)]
private static long GetFirstSetBit(long i, byte[] bits00to15, byte[] bits16to31, byte[]
    ↪ bits32to47, byte[] bits48to63)
{
    if (bits00to15.Length > 0)
    {
        return bits00to15[0] + (i * 64);
    }
    if (bits16to31.Length > 0)
    {
        return bits16to31[0] + 16 + (i * 64);
    }
    if (bits32to47.Length > 0)
    {
        return bits32to47[0] + 32 + (i * 64);
    }
    return bits48to63[0] + 48 + (i * 64);
}

[MethodImpl(MethodImplOptions.AggressiveInlining)]
private static long GetLastSetBit(long i, byte[] bits00to15, byte[] bits16to31, byte[]
    ↪ bits32to47, byte[] bits48to63)
{
    if (bits48to63.Length > 0)
    {
        return bits48to63[bits48to63.Length - 1] + 48 + (i * 64);
    }
    if (bits32to47.Length > 0)
    {
        return bits32to47[bits32to47.Length - 1] + 32 + (i * 64);
    }
    if (bits16to31.Length > 0)
    {
        return bits16to31[bits16to31.Length - 1] + 16 + (i * 64);
    }
    return bits00to15[bits00to15.Length - 1] + (i * 64);
}

[MethodImpl(MethodImplOptions.AggressiveInlining)]
private static void GetBits(long word, out byte[] bits00to15, out byte[] bits16to31, out
    ↪ byte[] bits32to47, out byte[] bits48to63)
{
    bits00to15 = _bitsSetIn16Bits[word & 0xffffu];
    bits16to31 = _bitsSetIn16Bits[(word >> 16) & 0xffffu];
    bits32to47 = _bitsSetIn16Bits[(word >> 32) & 0xffffu];
    bits48to63 = _bitsSetIn16Bits[(word >> 48) & 0xffffu];
}

[MethodImpl(MethodImplOptions.AggressiveInlining)]
public static void GetCommonInnerBorders(BitString left, BitString right, out long from,
    ↪ out long to)
{
    from = Math.Max(left._minPositiveWord, right._minPositiveWord);
    to = Math.Min(left._maxPositiveWord, right._maxPositiveWord);
}

```

```

1080     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1081     public static void GetCommonOuterBorders(BitString left, BitString right, out long from,
        ↪ out long to)
1082     {
1083         from = Math.Min(left._minPositiveWord, right._minPositiveWord);
1084         to = Math.Max(left._maxPositiveWord, right._maxPositiveWord);
1085     }
1086
1087     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1088     public static void GetCommonOuterBorders(BitString left, BitString right, out int from,
        ↪ out int to)
1089     {
1090         from = (int)Math.Min(left._minPositiveWord, right._minPositiveWord);
1091         to = (int)Math.Max(left._maxPositiveWord, right._maxPositiveWord);
1092     }
1093
1094     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1095     public static void GetCommonBorders(BitString left, BitString right, out ulong from, out
        ↪ ulong to)
1096     {
1097         from = (ulong)Math.Max(left._minPositiveWord, right._minPositiveWord);
1098         to = (ulong)Math.Min(left._maxPositiveWord, right._maxPositiveWord);
1099     }
1100
1101     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1102     public static long GetWordsCountFromIndex(long index) => (index + 63) / 64;
1103
1104     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1105     public static long GetWordIndexFromIndex(long index) => index >> 6;
1106
1107     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1108     public static long GetBitMaskFromIndex(long index) => 1L << (int)(index & 63);
1109
1110     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1111     public override int GetHashCode() => base.GetHashCode();
1112
1113     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1114     public override string ToString() => base.ToString();
1115 }
1116 }

```

## 1.9 ./csharp/Platform.Collections/BitStringExtensions.cs

```

1 using System.Runtime.CompilerServices;
2 using Platform.Random;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections
7 {
8     public static class BitStringExtensions
9     {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         public static void SetRandomBits(this BitString @string)
12         {
13             for (var i = 0; i < @string.Length; i++)
14             {
15                 var value = RandomHelpers.Default.NextBoolean();
16                 @string.Set(i, value);
17             }
18         }
19     }
20 }

```

## 1.10 ./csharp/Platform.Collections/Concurrent/ConcurrentQueueExtensions.cs

```

1 using System.Collections.Concurrent;
2 using System.Collections.Generic;
3 using System.Runtime.CompilerServices;
4
5 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7 namespace Platform.Collections.Concurrent
8 {
9     public static class ConcurrentQueueExtensions
10     {
11         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         public static IEnumerable<T> DequeueAll<T>(this ConcurrentQueue<T> queue)
13         {
14             while (queue.TryDequeue(out T item))
15             {

```

```

16         yield return item;
17     }
18 }
19 }
20 }

```

### 1.11 ./csharp/Platform.Collections/Concurrent/ConcurrentStackExtensions.cs

```

1 using System.Collections.Concurrent;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Concurrent
7 {
8     public static class ConcurrentStackExtensions
9     {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         public static T PopOrDefault<T>(this ConcurrentStack<T> stack) => stack.TryPop(out T
            ↪ value) ? value : default;
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public static T PeekOrDefault<T>(this ConcurrentStack<T> stack) => stack.TryPeek(out T
            ↪ value) ? value : default;
15     }
16 }

```

### 1.12 ./csharp/Platform.Collections/EnsureExtensions.cs

```

1 using System;
2 using System.Collections.Generic;
3 using System.Diagnostics;
4 using System.Runtime.CompilerServices;
5 using Platform.Exceptions;
6 using Platform.Exceptions.ExtensionRoots;
7
8 #pragma warning disable IDE0060 // Remove unused parameter
9 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
10
11 namespace Platform.Collections
12 {
13     public static class EnsureExtensions
14     {
15         #region Always
16
17         [MethodImpl(MethodImplOptions.AggressiveInlining)]
18         public static void ArgumentNotEmpty<T>(this EnsureAlwaysExtensionRoot root,
            ↪ ICollection<T> argument, string argumentName, string message)
19         {
20             if (argument.IsNullOrEmpty())
21             {
22                 throw new ArgumentException(message, argumentName);
23             }
24         }
25
26         [MethodImpl(MethodImplOptions.AggressiveInlining)]
27         public static void ArgumentNotEmpty<T>(this EnsureAlwaysExtensionRoot root,
            ↪ ICollection<T> argument, string argumentName) => ArgumentNotEmpty(root, argument,
            ↪ argumentName, null);
28
29         [MethodImpl(MethodImplOptions.AggressiveInlining)]
30         public static void ArgumentNotEmpty<T>(this EnsureAlwaysExtensionRoot root,
            ↪ ICollection<T> argument) => ArgumentNotEmpty(root, argument, null, null);
31
32         [MethodImpl(MethodImplOptions.AggressiveInlining)]
33         public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureAlwaysExtensionRoot root,
            ↪ string argument, string argumentName, string message)
34         {
35             if (string.IsNullOrEmpty(argument))
36             {
37                 throw new ArgumentException(message, argumentName);
38             }
39         }
40
41         [MethodImpl(MethodImplOptions.AggressiveInlining)]
42         public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureAlwaysExtensionRoot root,
            ↪ string argument, string argumentName) => ArgumentNotEmptyAndNotWhiteSpace(root,
            ↪ argument, argumentName, null);
43
44         [MethodImpl(MethodImplOptions.AggressiveInlining)]

```

```

45     public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureAlwaysExtensionRoot root,
46         ↪ string argument) => ArgumentNotEmptyAndNotWhiteSpace(root, argument, null, null);
47
48     #endregion
49
50     #region OnDebug
51
52     [Conditional("DEBUG")]
53     public static void ArgumentNotEmpty<T>(this EnsureOnDebugExtensionRoot root,
54         ↪ ICollection<T> argument, string argumentName, string message) =>
55         ↪ Ensure.Always.ArgumentNotEmpty(argument, argumentName, message);
56
57     [Conditional("DEBUG")]
58     public static void ArgumentNotEmpty<T>(this EnsureOnDebugExtensionRoot root,
59         ↪ ICollection<T> argument, string argumentName) =>
60         ↪ Ensure.Always.ArgumentNotEmpty(argument, argumentName, null);
61
62     [Conditional("DEBUG")]
63     public static void ArgumentNotEmpty<T>(this EnsureOnDebugExtensionRoot root,
64         ↪ ICollection<T> argument) => Ensure.Always.ArgumentNotEmpty(argument, null, null);
65
66     [Conditional("DEBUG")]
67     public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureOnDebugExtensionRoot
68         ↪ root, string argument, string argumentName, string message) =>
69         ↪ Ensure.Always.ArgumentNotEmptyAndNotWhiteSpace(argument, argumentName, message);
70
71     [Conditional("DEBUG")]
72     public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureOnDebugExtensionRoot
73         ↪ root, string argument, string argumentName) =>
74         ↪ Ensure.Always.ArgumentNotEmptyAndNotWhiteSpace(argument, argumentName, null);
75
76     [Conditional("DEBUG")]
77     public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureOnDebugExtensionRoot
78         ↪ root, string argument) => Ensure.Always.ArgumentNotEmptyAndNotWhiteSpace(argument,
79         ↪ null, null);
80
81     #endregion
82 }
83 }

```

### 1.13 ./csharp/Platform.Collections/ICollectionExtensions.cs

```

1  using System.Collections.Generic;
2  using System.Linq;
3  using System.Runtime.CompilerServices;
4
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7  namespace Platform.Collections
8  {
9      public static class ICollectionExtensions
10     {
11         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         public static bool IsNullOrEmpty<T>(this ICollection<T> collection) => collection ==
13             ↪ null || collection.Count == 0;
14
15         [MethodImpl(MethodImplOptions.AggressiveInlining)]
16         public static bool AllEqualToDefault<T>(this ICollection<T> collection)
17         {
18             var equalityComparer = EqualityComparer<T>.Default;
19             return collection.All(item => equalityComparer.Equals(item, default));
20         }
21     }
22 }

```

### 1.14 ./csharp/Platform.Collections/IDictionaryExtensions.cs

```

1  using System;
2  using System.Collections.Generic;
3  using System.Runtime.CompilerServices;
4
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7  namespace Platform.Collections
8  {
9      public static class IDictionaryExtensions
10     {
11         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         public static TValue GetOrDefault<TKey, TValue>(this IDictionary<TKey, TValue>
13             ↪ dictionary, TKey key)
14         {

```



```

14         dictionary.TryGetValue(key, out TValue value);
15         return value;
16     }
17
18     [MethodImpl(MethodImplOptions.AggressiveInlining)]
19     public static TValue GetOrAdd<TKey, TValue>(this IDictionary<TKey, TValue> dictionary,
20     ↪ TKey key, Func<TKey, TValue> valueFactory)
21     {
22         if (!dictionary.TryGetValue(key, out TValue value))
23         {
24             value = valueFactory(key);
25             dictionary.Add(key, value);
26             return value;
27         }
28         return value;
29     }
30 }

```

### 1.15 ./csharp/Platform.Collections/Lists/CharIListExtensions.cs

```

1 using System.Collections.Generic;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Lists
7 {
8     public static class CharIListExtensions
9     {
10         /// <remarks>
11         /// Based on https://github.com/Microsoft/referencesource/blob/3b1eaf5203992df69de44c783\_
12         ↪ a3eda37d3d4cd10/mscorlib/system/string.cs#L833
13         /// </remarks>
14         [MethodImpl(MethodImplOptions.AggressiveInlining)]
15         public static int GenerateHashCode(this IList<char> list)
16         {
17             var hashSeed = 5381;
18             var hashAccumulator = hashSeed;
19             for (var i = 0; i < list.Count; i++)
20             {
21                 hashAccumulator = (hashAccumulator << 5) + hashAccumulator ^ list[i];
22             }
23             return hashAccumulator + (hashSeed * 1566083941);
24         }
25
26         [MethodImpl(MethodImplOptions.AggressiveInlining)]
27         public static bool EqualTo(this IList<char> left, IList<char> right) =>
28         ↪ left.EqualTo(right, ContentEqualTo);
29
30         [MethodImpl(MethodImplOptions.AggressiveInlining)]
31         public static bool ContentEqualTo(this IList<char> left, IList<char> right)
32         {
33             for (var i = left.Count - 1; i >= 0; --i)
34             {
35                 if (left[i] != right[i])
36                 {
37                     return false;
38                 }
39             }
40             return true;
41         }
42     }
43 }

```

### 1.16 ./csharp/Platform.Collections/Lists/IListComparer.cs

```

1 using System.Collections.Generic;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Lists
7 {
8     public class IListComparer<T> : IComparer<IList<T>>
9     {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         public int Compare(IList<T> left, IList<T> right) => left.CompareTo(right);
12     }
13 }

```

### 1.17 ./csharp/Platform.Collections/Lists/IEqualityComparer.cs

```
1 using System.Collections.Generic;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Lists
7 {
8     public class IEqualityComparer<T> : IEqualityComparer<IList<T>>
9     {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         public bool Equals(IList<T> left, IList<T> right) => left.EqualTo(right);
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public int GetHashCode(IList<T> list) => list.GenerateHashCode();
15     }
16 }
```

### 1.18 ./csharp/Platform.Collections/Lists/IListExtensions.cs

```
1 using System;
2 using System.Collections.Generic;
3 using System.Runtime.CompilerServices;
4
5 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7 namespace Platform.Collections.Lists
8 {
9     public static class IListExtensions
10     {
11         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         public static T GetElementOrDefault<T>(this IList<T> list, int index) => list != null &&
13             ↪ list.Count > index ? list[index] : default;
14
15         [MethodImpl(MethodImplOptions.AggressiveInlining)]
16         public static bool TryGetElement<T>(this IList<T> list, int index, out T element)
17         {
18             if (list != null && list.Count > index)
19             {
20                 element = list[index];
21                 return true;
22             }
23             else
24             {
25                 element = default;
26                 return false;
27             }
28
29             [MethodImpl(MethodImplOptions.AggressiveInlining)]
30             public static bool AddAndReturnTrue<T>(this IList<T> list, T element)
31             {
32                 list.Add(element);
33                 return true;
34             }
35
36             [MethodImpl(MethodImplOptions.AggressiveInlining)]
37             public static bool AddFirstAndReturnTrue<T>(this IList<T> list, IList<T> elements)
38             {
39                 list.AddFirst(elements);
40                 return true;
41             }
42
43             [MethodImpl(MethodImplOptions.AggressiveInlining)]
44             public static void AddFirst<T>(this IList<T> list, IList<T> elements) =>
45                 ↪ list.Add(elements[0]);
46
47             [MethodImpl(MethodImplOptions.AggressiveInlining)]
48             public static bool AddAllAndReturnTrue<T>(this IList<T> list, IList<T> elements)
49             {
50                 list.AddAll(elements);
51                 return true;
52             }
53
54             [MethodImpl(MethodImplOptions.AggressiveInlining)]
55             public static void AddAll<T>(this IList<T> list, IList<T> elements)
56             {
57                 for (var i = 0; i < elements.Count; i++)
58                 {
59                     list.Add(elements[i]);
60                 }
61             }
62         }
63     }
64 }
```

```

60     }
61
62     [MethodImpl(MethodImplOptions.AggressiveInlining)]
63     public static bool AddSkipFirstAndReturnTrue<T>(this IList<T> list, IList<T> elements)
64     {
65         list.AddSkipFirst(elements);
66         return true;
67     }
68
69     [MethodImpl(MethodImplOptions.AggressiveInlining)]
70     public static void AddSkipFirst<T>(this IList<T> list, IList<T> elements) =>
71     ↪ list.AddSkipFirst(elements, 1);
72
73     [MethodImpl(MethodImplOptions.AggressiveInlining)]
74     public static void AddSkipFirst<T>(this IList<T> list, IList<T> elements, int skip)
75     {
76         for (var i = skip; i < elements.Count; i++)
77         {
78             list.Add(elements[i]);
79         }
80
81     [MethodImpl(MethodImplOptions.AggressiveInlining)]
82     public static int GetCountOrZero<T>(this IList<T> list) => list?.Count ?? 0;
83
84     [MethodImpl(MethodImplOptions.AggressiveInlining)]
85     public static bool EqualTo<T>(this IList<T> left, IList<T> right) => EqualTo(left,
86     ↪ right, ContentEqualTo);
87
88     [MethodImpl(MethodImplOptions.AggressiveInlining)]
89     public static bool EqualTo<T>(this IList<T> left, IList<T> right, Func<IList<T>,
90     ↪ IList<T>, bool> contentEqualityComparer)
91     {
92         if (ReferenceEquals(left, right))
93         {
94             return true;
95         }
96         var leftCount = left.GetCountOrZero();
97         var rightCount = right.GetCountOrZero();
98         if (leftCount == 0 && rightCount == 0)
99         {
100             return true;
101         }
102         if (leftCount == 0 || rightCount == 0 || leftCount != rightCount)
103         {
104             return false;
105         }
106         return contentEqualityComparer(left, right);
107     }
108
109     [MethodImpl(MethodImplOptions.AggressiveInlining)]
110     public static bool ContentEqualTo<T>(this IList<T> left, IList<T> right)
111     {
112         var equalityComparer = EqualityComparer<T>.Default;
113         for (var i = left.Count - 1; i >= 0; --i)
114         {
115             if (!equalityComparer.Equals(left[i], right[i]))
116             {
117                 return false;
118             }
119         }
120         return true;
121     }
122
123     [MethodImpl(MethodImplOptions.AggressiveInlining)]
124     public static T[] ToArray<T>(this IList<T> list, Func<T, bool> predicate)
125     {
126         if (list == null)
127         {
128             return null;
129         }
130         var result = new List<T>(list.Count);
131         for (var i = 0; i < list.Count; i++)
132         {
133             if (predicate(list[i]))
134             {
135                 result.Add(list[i]);
136             }
137         }
138     }

```

```

136         return result.ToArray();
137     }
138
139     [MethodImpl(MethodImplOptions.AggressiveInlining)]
140     public static T[] ToArray<T>(this IList<T> list)
141     {
142         var array = new T[list.Count];
143         list.CopyTo(array, 0);
144         return array;
145     }
146
147     [MethodImpl(MethodImplOptions.AggressiveInlining)]
148     public static void ForEach<T>(this IList<T> list, Action<T> action)
149     {
150         for (var i = 0; i < list.Count; i++)
151         {
152             action(list[i]);
153         }
154     }
155
156     /// <remarks>
157     /// Based on http://stackoverflow.com/questions/263400/what-is-the-best-algorithm-for-an-override-system-object-gethashcode
158     /// </remarks>
159     [MethodImpl(MethodImplOptions.AggressiveInlining)]
160     public static int GenerateHashCode<T>(this IList<T> list)
161     {
162         var hashAccumulator = 17;
163         for (var i = 0; i < list.Count; i++)
164         {
165             hashAccumulator = unchecked((hashAccumulator * 23) + list[i].GetHashCode());
166         }
167         return hashAccumulator;
168     }
169
170     [MethodImpl(MethodImplOptions.AggressiveInlining)]
171     public static int CompareTo<T>(this IList<T> left, IList<T> right)
172     {
173         var comparer = Comparer<T>.Default;
174         var leftCount = left.GetCountOrZero();
175         var rightCount = right.GetCountOrZero();
176         var intermediateResult = leftCount.CompareTo(rightCount);
177         for (var i = 0; intermediateResult == 0 && i < leftCount; i++)
178         {
179             intermediateResult = comparer.Compare(left[i], right[i]);
180         }
181         return intermediateResult;
182     }
183
184     [MethodImpl(MethodImplOptions.AggressiveInlining)]
185     public static T[] SkipFirst<T>(this IList<T> list) => list.SkipFirst(1);
186
187     [MethodImpl(MethodImplOptions.AggressiveInlining)]
188     public static T[] SkipFirst<T>(this IList<T> list, int skip)
189     {
190         if (list.IsNullOrEmpty() || list.Count <= skip)
191         {
192             return Array.Empty<T>();
193         }
194         var result = new T[list.Count - skip];
195         for (int r = skip, w = 0; r < list.Count; r++, w++)
196         {
197             result[w] = list[r];
198         }
199         return result;
200     }
201
202     [MethodImpl(MethodImplOptions.AggressiveInlining)]
203     public static IList<T> ShiftRight<T>(this IList<T> list) => list.ShiftRight(1);
204
205     [MethodImpl(MethodImplOptions.AggressiveInlining)]
206     public static IList<T> ShiftRight<T>(this IList<T> list, int shift)
207     {
208         if (shift < 0)
209         {
210             throw new NotImplementedException();
211         }
212         if (shift == 0)
213         {

```

```

214         return list.ToArray();
215     }
216     else
217     {
218         var result = new T[list.Count + shift];
219         for (int r = 0, w = shift; r < list.Count; r++, w++)
220         {
221             result[w] = list[r];
222         }
223         return result;
224     }
225 }
226 }
227 }

```

## 1.19 ./csharp/Platform.Collections/Lists/ListFiller.cs

```

1  using System.Collections.Generic;
2  using System.Runtime.CompilerServices;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Collections.Lists
7  {
8      public class ListFiller<TElement, TReturnConstant>
9      {
10         protected readonly List<TElement> _list;
11         protected readonly TReturnConstant _returnConstant;
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public ListFiller(List<TElement> list, TReturnConstant returnConstant)
15         {
16             _list = list;
17             _returnConstant = returnConstant;
18         }
19
20         [MethodImpl(MethodImplOptions.AggressiveInlining)]
21         public ListFiller(List<TElement> list) : this(list, default) { }
22
23         [MethodImpl(MethodImplOptions.AggressiveInlining)]
24         public void Add(TElement element) => _list.Add(element);
25
26         [MethodImpl(MethodImplOptions.AggressiveInlining)]
27         public bool AddAndReturnTrue(TElement element) => _list.AddAndReturnTrue(element);
28
29         [MethodImpl(MethodImplOptions.AggressiveInlining)]
30         public bool AddFirstAndReturnTrue(IList<TElement> elements) =>
31             ↪ _list.AddFirstAndReturnTrue(elements);
32
33         [MethodImpl(MethodImplOptions.AggressiveInlining)]
34         public bool AddAllAndReturnTrue(IList<TElement> elements) =>
35             ↪ _list.AddAllAndReturnTrue(elements);
36
37         [MethodImpl(MethodImplOptions.AggressiveInlining)]
38         public bool AddSkipFirstAndReturnTrue(IList<TElement> elements) =>
39             ↪ _list.AddSkipFirstAndReturnTrue(elements);
40
41         [MethodImpl(MethodImplOptions.AggressiveInlining)]
42         public TReturnConstant AddAndReturnConstant(TElement element)
43         {
44             _list.Add(element);
45             return _returnConstant;
46         }
47
48         [MethodImpl(MethodImplOptions.AggressiveInlining)]
49         public TReturnConstant AddFirstAndReturnConstant(IList<TElement> elements)
50         {
51             _list.AddFirst(elements);
52             return _returnConstant;
53         }
54
55         [MethodImpl(MethodImplOptions.AggressiveInlining)]
56         public TReturnConstant AddAllAndReturnConstant(IList<TElement> elements)
57         {
58             _list.AddAll(elements);
59             return _returnConstant;
60         }
61
62         [MethodImpl(MethodImplOptions.AggressiveInlining)]
63         public TReturnConstant AddSkipFirstAndReturnConstant(IList<TElement> elements)
64         {

```

```

62         _list.AddSkipFirst(elements);
63         return _returnConstant;
64     }
65 }
66 }

```

## 1.20 ./csharp/Platform.Collections/Segments/CharSegment.cs

```

1  using System.Linq;
2  using System.Collections.Generic;
3  using System.Runtime.CompilerServices;
4  using Platform.Collections.Arrays;
5  using Platform.Collections.Lists;
6
7  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
8
9  namespace Platform.Collections.Segments
10 {
11     public class CharSegment : Segment<char>
12     {
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public CharSegment(IList<char> @base, int offset, int length) : base(@base, offset,
15             ↪ length) { }
16
17         [MethodImpl(MethodImplOptions.AggressiveInlining)]
18         public override int GetHashCode()
19         {
20             // Base can be not an array, but still IList<char>
21             if (Base is char[] baseArray)
22             {
23                 return baseArray.GenerateHashCode(Offset, Length);
24             }
25             else
26             {
27                 return this.GenerateHashCode();
28             }
29         }
30
31         [MethodImpl(MethodImplOptions.AggressiveInlining)]
32         public override bool Equals(Segment<char> other)
33         {
34             bool contentEqualityComparer(IList<char> left, IList<char> right)
35             {
36                 // Base can be not an array, but still IList<char>
37                 if (Base is char[] baseArray && other.Base is char[] otherArray)
38                 {
39                     return baseArray.ContentEqualTo(Offset, Length, otherArray, other.Offset);
40                 }
41                 else
42                 {
43                     return left.ContentEqualTo(right);
44                 }
45             }
46             return this.EqualTo(other, contentEqualityComparer);
47         }
48
49         public override bool Equals(object obj) => obj is Segment<char> charSegment ?
50             ↪ Equals(charSegment) : false;
51
52         [MethodImpl(MethodImplOptions.AggressiveInlining)]
53         public static implicit operator string(CharSegment segment)
54         {
55             if (!(segment.Base is char[] array))
56             {
57                 array = segment.Base.ToArray();
58             }
59             return new string(array, segment.Offset, segment.Length);
60         }
61
62         [MethodImpl(MethodImplOptions.AggressiveInlining)]
63         public override string ToString() => this;
64     }
65 }

```

## 1.21 ./csharp/Platform.Collections/Segments/Segment.cs

```

1  using System;
2  using System.Collections;
3  using System.Collections.Generic;
4  using System.Runtime.CompilerServices;
5  using Platform.Collections.Arrays;

```

```

6 using Platform.Collections.Lists;
7
8 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
9
10 namespace Platform.Collections.Segments
11 {
12     public class Segment<T> : IEquatable<Segment<T>>, IList<T>
13     {
14         public IList<T> Base
15         {
16             [MethodImpl(MethodImplOptions.AggressiveInlining)]
17             get;
18         }
19         public int Offset
20         {
21             [MethodImpl(MethodImplOptions.AggressiveInlining)]
22             get;
23         }
24         public int Length
25         {
26             [MethodImpl(MethodImplOptions.AggressiveInlining)]
27             get;
28         }
29
30         [MethodImpl(MethodImplOptions.AggressiveInlining)]
31         public Segment(IList<T> @base, int offset, int length)
32         {
33             Base = @base;
34             Offset = offset;
35             Length = length;
36         }
37
38         [MethodImpl(MethodImplOptions.AggressiveInlining)]
39         public override int GetHashCode() => this.GenerateHashCode();
40
41         [MethodImpl(MethodImplOptions.AggressiveInlining)]
42         public virtual bool Equals(Segment<T> other) => this.EqualTo(other);
43
44         [MethodImpl(MethodImplOptions.AggressiveInlining)]
45         public override bool Equals(object obj) => obj is Segment<T> other ? Equals(other) :
46             ↪ false;
47
48         #region IList
49         public T this[int i]
50         {
51             [MethodImpl(MethodImplOptions.AggressiveInlining)]
52             get => Base[Offset + i];
53             [MethodImpl(MethodImplOptions.AggressiveInlining)]
54             set => Base[Offset + i] = value;
55         }
56
57         public int Count
58         {
59             [MethodImpl(MethodImplOptions.AggressiveInlining)]
60             get => Length;
61         }
62
63         public bool IsReadOnly
64         {
65             [MethodImpl(MethodImplOptions.AggressiveInlining)]
66             get => true;
67         }
68
69         [MethodImpl(MethodImplOptions.AggressiveInlining)]
70         public int IndexOf(T item)
71         {
72             var index = Base.IndexOf(item);
73             if (index >= Offset)
74             {
75                 var actualIndex = index - Offset;
76                 if (actualIndex < Length)
77                 {
78                     return actualIndex;
79                 }
80             }
81             return -1;
82         }
83
84         [MethodImpl(MethodImplOptions.AggressiveInlining)]

```

```

85     public void Insert(int index, T item) => throw new NotSupportedException();
86
87     [MethodImpl(MethodImplOptions.AggressiveInlining)]
88     public void RemoveAt(int index) => throw new NotSupportedException();
89
90     [MethodImpl(MethodImplOptions.AggressiveInlining)]
91     public void Add(T item) => throw new NotSupportedException();
92
93     [MethodImpl(MethodImplOptions.AggressiveInlining)]
94     public void Clear() => throw new NotSupportedException();
95
96     [MethodImpl(MethodImplOptions.AggressiveInlining)]
97     public bool Contains(T item) => IndexOf(item) >= 0;
98
99     [MethodImpl(MethodImplOptions.AggressiveInlining)]
100    public void CopyTo(T[] array, int arrayIndex)
101    {
102        for (var i = 0; i < Length; i++)
103        {
104            array.Add(ref arrayIndex, this[i]);
105        }
106    }
107
108    [MethodImpl(MethodImplOptions.AggressiveInlining)]
109    public bool Remove(T item) => throw new NotSupportedException();
110
111    [MethodImpl(MethodImplOptions.AggressiveInlining)]
112    public IEnumerator<T> GetEnumerator()
113    {
114        for (var i = 0; i < Length; i++)
115        {
116            yield return this[i];
117        }
118    }
119
120    [MethodImpl(MethodImplOptions.AggressiveInlining)]
121    IEnumerator IEnumerable.GetEnumerator() => GetEnumerator();
122
123    #endregion
124 }
125 }

```

## 1.22 ./csharp/Platform.Collections.Segments.Walkers.AllSegmentsWalkerBase.cs

```

1  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
2
3  namespace Platform.Collections.Segments.Walkers
4  {
5      public abstract class AllSegmentsWalkerBase
6      {
7          public static readonly int DefaultMinimumStringSegmentLength = 2;
8      }
9  }

```

## 1.23 ./csharp/Platform.Collections.Segments.Walkers.AllSegmentsWalkerBase[T, TSegment].cs

```

1  using System.Collections.Generic;
2  using System.Runtime.CompilerServices;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Collections.Segments.Walkers
7  {
8      public abstract class AllSegmentsWalkerBase<T, TSegment> : AllSegmentsWalkerBase
9      where TSegment : Segment<T>
10     {
11         private readonly int _minimumStringSegmentLength;
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         protected AllSegmentsWalkerBase(int minimumStringSegmentLength) =>
15             ↪ _minimumStringSegmentLength = minimumStringSegmentLength;
16
17         [MethodImpl(MethodImplOptions.AggressiveInlining)]
18         protected AllSegmentsWalkerBase() : this(DefaultMinimumStringSegmentLength) { }
19
20         [MethodImpl(MethodImplOptions.AggressiveInlining)]
21         public virtual void WalkAll(ICollection<T> elements)
22         {
23             for (int offset = 0, maxOffset = elements.Count - _minimumStringSegmentLength;
24                 ↪ offset <= maxOffset; offset++)
25             {

```



```

24         for (int length = _minimumStringSegmentLength, maxLength = elements.Count -
25             ↪ offset; length <= maxLength; length++)
26         {
27             Iteration(CreateSegment(elements, offset, length));
28         }
29     }
30 }
31 [MethodImpl(MethodImplOptions.AggressiveInlining)]
32 protected abstract TSegment CreateSegment(IList<T> elements, int offset, int length);
33
34 [MethodImpl(MethodImplOptions.AggressiveInlining)]
35 protected abstract void Iteration(TSegment segment);
36 }
37 }

```

#### 1.24 ./csharp/Platform.Collections.Segments.Walkers.AllSegmentsWalkerBase[T].cs

```

1 using System.Collections.Generic;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Segments.Walkers
7 {
8     public abstract class AllSegmentsWalkerBase<T> : AllSegmentsWalkerBase<T, Segment<T>>
9     {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         protected override Segment<T> CreateSegment(IList<T> elements, int offset, int length)
12             ↪ => new Segment<T>(elements, offset, length);
13     }
14 }

```

#### 1.25 ./csharp/Platform.Collections.Segments.Walkers.AllSegmentsWalkerExtensions.cs

```

1 using System.Runtime.CompilerServices;
2
3 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4
5 namespace Platform.Collections.Segments.Walkers
6 {
7     public static class AllSegmentsWalkerExtensions
8     {
9         [MethodImpl(MethodImplOptions.AggressiveInlining)]
10         public static void WalkAll(this AllSegmentsWalkerBase<char> walker, string @string) =>
11             ↪ walker.WalkAll(@string.ToCharArray());
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public static void WalkAll<TSegment>(this AllSegmentsWalkerBase<char>, TSegment walker,
15             ↪ string @string) where TSegment : Segment<char> =>
16             ↪ walker.WalkAll(@string.ToCharArray());
17     }
18 }

```

#### 1.26 ./csharp/Platform.Collections.Segments.Walkers.DictionaryBasedDuplicateSegmentsWalkerBase[T, Segment<T>].cs

```

1 using System;
2 using System.Collections.Generic;
3 using System.Runtime.CompilerServices;
4
5 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7 namespace Platform.Collections.Segments.Walkers
8 {
9     public abstract class DictionaryBasedDuplicateSegmentsWalkerBase<T, TSegment> :
10         ↪ DuplicateSegmentsWalkerBase<T, TSegment>
11         where TSegment : Segment<T>
12     {
13         public static readonly bool DefaultResetDictionaryOnEachWalk;
14
15         private readonly bool _resetDictionaryOnEachWalk;
16         protected IDictionary<TSegment, long> Dictionary;
17
18         [MethodImpl(MethodImplOptions.AggressiveInlining)]
19         protected DictionaryBasedDuplicateSegmentsWalkerBase(IDictionary<TSegment, long>
20             ↪ dictionary, int minimumStringSegmentLength, bool resetDictionaryOnEachWalk)
21             : base(minimumStringSegmentLength)
22         {
23             Dictionary = dictionary;
24             _resetDictionaryOnEachWalk = resetDictionaryOnEachWalk;
25         }
26     }
27 }

```

```

25     [MethodImpl(MethodImplOptions.AggressiveInlining)]
26     protected DictionaryBasedDuplicateSegmentsWalkerBase(IDictionary<TSegment, long>
    ↪ dictionary, int minimumStringSegmentLength) : this(dictionary,
    ↪ minimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }

27
28     [MethodImpl(MethodImplOptions.AggressiveInlining)]
29     protected DictionaryBasedDuplicateSegmentsWalkerBase(IDictionary<TSegment, long>
    ↪ dictionary) : this(dictionary, DefaultMinimumStringSegmentLength,
    ↪ DefaultResetDictionaryOnEachWalk) { }

30
31     [MethodImpl(MethodImplOptions.AggressiveInlining)]
32     protected DictionaryBasedDuplicateSegmentsWalkerBase(int minimumStringSegmentLength,
    ↪ bool resetDictionaryOnEachWalk) : this(resetDictionaryOnEachWalk ? null : new
    ↪ Dictionary<TSegment, long>(), minimumStringSegmentLength, resetDictionaryOnEachWalk)
    ↪ { }

33
34     [MethodImpl(MethodImplOptions.AggressiveInlining)]
35     protected DictionaryBasedDuplicateSegmentsWalkerBase(int minimumStringSegmentLength) :
    ↪ this(minimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }

36
37     [MethodImpl(MethodImplOptions.AggressiveInlining)]
38     protected DictionaryBasedDuplicateSegmentsWalkerBase() :
    ↪ this(DefaultMinimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }

39
40     [MethodImpl(MethodImplOptions.AggressiveInlining)]
41     public override void WalkAll(ICollection<T> elements)
42     {
43         if (_resetDictionaryOnEachWalk)
44         {
45             var capacity = Math.Ceiling(Math.Pow(elements.Count, 2) / 2);
46             Dictionary = new Dictionary<TSegment, long>((int)capacity);
47         }
48         base.WalkAll(elements);
49     }

50
51     [MethodImpl(MethodImplOptions.AggressiveInlining)]
52     protected override long GetSegmentFrequency(TSegment segment) =>
    ↪ Dictionary.GetOrDefault(segment);

53
54     [MethodImpl(MethodImplOptions.AggressiveInlining)]
55     protected override void SetSegmentFrequency(TSegment segment, long frequency) =>
    ↪ Dictionary[segment] = frequency;

56 }
57 }

```

## 1.27 ./csharp/Platform.Collections.Segments.Walkers/DictionaryBasedDuplicateSegmentsWalkerBase[T].cs

```

1 using System.Collections.Generic;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Segments.Walkers
7 {
8     public abstract class DictionaryBasedDuplicateSegmentsWalkerBase<T> :
    ↪ DictionaryBasedDuplicateSegmentsWalkerBase<T, Segment<T>>
9     {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         protected DictionaryBasedDuplicateSegmentsWalkerBase(IDictionary<Segment<T>, long>
    ↪ dictionary, int minimumStringSegmentLength, bool resetDictionaryOnEachWalk) :
    ↪ base(dictionary, minimumStringSegmentLength, resetDictionaryOnEachWalk) { }

12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         protected DictionaryBasedDuplicateSegmentsWalkerBase(IDictionary<Segment<T>, long>
    ↪ dictionary, int minimumStringSegmentLength) : base(dictionary,
    ↪ minimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }

15
16         [MethodImpl(MethodImplOptions.AggressiveInlining)]
17         protected DictionaryBasedDuplicateSegmentsWalkerBase(IDictionary<Segment<T>, long>
    ↪ dictionary) : base(dictionary, DefaultMinimumStringSegmentLength,
    ↪ DefaultResetDictionaryOnEachWalk) { }

18
19         [MethodImpl(MethodImplOptions.AggressiveInlining)]
20         protected DictionaryBasedDuplicateSegmentsWalkerBase(int minimumStringSegmentLength,
    ↪ bool resetDictionaryOnEachWalk) : base(minimumStringSegmentLength,
    ↪ resetDictionaryOnEachWalk) { }

21
22         [MethodImpl(MethodImplOptions.AggressiveInlining)]

```

```

23         protected DictionaryBasedDuplicateSegmentsWalkerBase(int minimumStringSegmentLength) :
24             ↪ base(minimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }
25
26         [MethodImpl(MethodImplOptions.AggressiveInlining)]
27         protected DictionaryBasedDuplicateSegmentsWalkerBase() :
28             ↪ base(DefaultMinimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }
29     }
30 }

```

## 1.28 ./csharp/Platform.Collections.Segments.Walkers/DuplicateSegmentsWalkerBase[T, TSegment].cs

```

1  using System.Runtime.CompilerServices;
2
3  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4
5  namespace Platform.Collections.Segments.Walkers
6  {
7      public abstract class DuplicateSegmentsWalkerBase<T, TSegment> : AllSegmentsWalkerBase<T,
8          ↪ TSegment>
9          where TSegment : Segment<T>
10     {
11         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         protected DuplicateSegmentsWalkerBase(int minimumStringSegmentLength) :
13             ↪ base(minimumStringSegmentLength) { }
14
15         [MethodImpl(MethodImplOptions.AggressiveInlining)]
16         protected DuplicateSegmentsWalkerBase() : base(DefaultMinimumStringSegmentLength) { }
17
18         [MethodImpl(MethodImplOptions.AggressiveInlining)]
19         protected override void Iteration(TSegment segment)
20         {
21             var frequency = GetSegmentFrequency(segment);
22             if (frequency == 1)
23             {
24                 OnDuplicateFound(segment);
25             }
26             SetSegmentFrequency(segment, frequency + 1);
27         }
28
29         [MethodImpl(MethodImplOptions.AggressiveInlining)]
30         protected abstract void OnDuplicateFound(TSegment segment);
31
32         [MethodImpl(MethodImplOptions.AggressiveInlining)]
33         protected abstract long GetSegmentFrequency(TSegment segment);
34
35         [MethodImpl(MethodImplOptions.AggressiveInlining)]
36         protected abstract void SetSegmentFrequency(TSegment segment, long frequency);
37     }
38 }

```

## 1.29 ./csharp/Platform.Collections.Segments.Walkers/DuplicateSegmentsWalkerBase[T].cs

```

1  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
2
3  namespace Platform.Collections.Segments.Walkers
4  {
5      public abstract class DuplicateSegmentsWalkerBase<T> : DuplicateSegmentsWalkerBase<T,
6          ↪ Segment<T>>
7      {
8      }
9  }

```

## 1.30 ./csharp/Platform.Collections.Sets/ISetExtensions.cs

```

1  using System.Collections.Generic;
2  using System.Runtime.CompilerServices;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Collections.Sets
7  {
8      public static class ISetExtensions
9      {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         public static void AddAndReturnVoid<T>(this ISet<T> set, T element) => set.Add(element);
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public static void RemoveAndReturnVoid<T>(this ISet<T> set, T element) =>
15             ↪ set.Remove(element);
16
17         [MethodImpl(MethodImplOptions.AggressiveInlining)]

```

```

17     public static bool AddAndReturnTrue<T>(this ISet<T> set, T element)
18     {
19         set.Add(element);
20         return true;
21     }
22
23     [MethodImpl(MethodImplOptions.AggressiveInlining)]
24     public static bool AddFirstAndReturnTrue<T>(this ISet<T> set, IList<T> elements)
25     {
26         AddFirst(set, elements);
27         return true;
28     }
29
30     [MethodImpl(MethodImplOptions.AggressiveInlining)]
31     public static void AddFirst<T>(this ISet<T> set, IList<T> elements) =>
32         => set.Add(elements[0]);
33
34     [MethodImpl(MethodImplOptions.AggressiveInlining)]
35     public static bool AddAllAndReturnTrue<T>(this ISet<T> set, IList<T> elements)
36     {
37         set.AddAll(elements);
38         return true;
39     }
40
41     [MethodImpl(MethodImplOptions.AggressiveInlining)]
42     public static void AddAll<T>(this ISet<T> set, IList<T> elements)
43     {
44         for (var i = 0; i < elements.Count; i++)
45         {
46             set.Add(elements[i]);
47         }
48     }
49
50     [MethodImpl(MethodImplOptions.AggressiveInlining)]
51     public static bool AddSkipFirstAndReturnTrue<T>(this ISet<T> set, IList<T> elements)
52     {
53         set.AddSkipFirst(elements);
54         return true;
55     }
56
57     [MethodImpl(MethodImplOptions.AggressiveInlining)]
58     public static void AddSkipFirst<T>(this ISet<T> set, IList<T> elements) =>
59         => set.AddSkipFirst(elements, 1);
60
61     [MethodImpl(MethodImplOptions.AggressiveInlining)]
62     public static void AddSkipFirst<T>(this ISet<T> set, IList<T> elements, int skip)
63     {
64         for (var i = skip; i < elements.Count; i++)
65         {
66             set.Add(elements[i]);
67         }
68     }
69
70     [MethodImpl(MethodImplOptions.AggressiveInlining)]
71     public static bool DoNotContains<T>(this ISet<T> set, T element) =>
72         => !set.Contains(element);
73 }

```

### 1.31 ./csharp/Platform.Collections/Sets/SetFiller.cs

```

1  using System.Collections.Generic;
2  using System.Runtime.CompilerServices;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Collections.Sets
7  {
8      public class SetFiller<TElement, TReturnConstant>
9      {
10         protected readonly ISet<TElement> _set;
11         protected readonly TReturnConstant _returnConstant;
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public SetFiller(ISet<TElement> set, TReturnConstant returnConstant)
15         {
16             _set = set;
17             _returnConstant = returnConstant;
18         }
19     }

```

```

20     [MethodImpl(MethodImplOptions.AggressiveInlining)]
21     public SetFiller(ISet<TElement> set) : this(set, default) { }
22
23     [MethodImpl(MethodImplOptions.AggressiveInlining)]
24     public void Add(TElement element) => _set.Add(element);
25
26     [MethodImpl(MethodImplOptions.AggressiveInlining)]
27     public bool AddAndReturnTrue(TElement element) => _set.AddAndReturnTrue(element);
28
29     [MethodImpl(MethodImplOptions.AggressiveInlining)]
30     public bool AddFirstAndReturnTrue(ICollection<TElement> elements) =>
31     => _set.AddFirstAndReturnTrue(elements);
32
33     [MethodImpl(MethodImplOptions.AggressiveInlining)]
34     public bool AddAllAndReturnTrue(ICollection<TElement> elements) =>
35     => _set.AddAllAndReturnTrue(elements);
36
37     [MethodImpl(MethodImplOptions.AggressiveInlining)]
38     public bool AddSkipFirstAndReturnTrue(ICollection<TElement> elements) =>
39     => _set.AddSkipFirstAndReturnTrue(elements);
40
41     [MethodImpl(MethodImplOptions.AggressiveInlining)]
42     public TReturnConstant AddAndReturnConstant(TElement element)
43     {
44         _set.Add(element);
45         return _returnConstant;
46     }
47
48     [MethodImpl(MethodImplOptions.AggressiveInlining)]
49     public TReturnConstant AddFirstAndReturnConstant(ICollection<TElement> elements)
50     {
51         _set.AddFirst(elements);
52         return _returnConstant;
53     }
54
55     [MethodImpl(MethodImplOptions.AggressiveInlining)]
56     public TReturnConstant AddAllAndReturnConstant(ICollection<TElement> elements)
57     {
58         _set.AddAll(elements);
59         return _returnConstant;
60     }
61
62     [MethodImpl(MethodImplOptions.AggressiveInlining)]
63     public TReturnConstant AddSkipFirstAndReturnConstant(ICollection<TElement> elements)
64     {
65         _set.AddSkipFirst(elements);
66         return _returnConstant;
67     }
68 }

```

### 1.32 ./csharp/Platform.Collections.Stacks.DefaultStack.cs

```

1  using System.Collections.Generic;
2  using System.Runtime.CompilerServices;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Collections.Stacks
7  {
8      public class DefaultStack<TElement> : Stack<TElement>, IStack<TElement>
9      {
10         public bool IsEmpty
11         {
12             [MethodImpl(MethodImplOptions.AggressiveInlining)]
13             get => Count <= 0;
14         }
15     }
16 }

```

### 1.33 ./csharp/Platform.Collections.Stacks.IStack.cs

```

1  using System.Runtime.CompilerServices;
2
3  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4
5  namespace Platform.Collections.Stacks
6  {
7      public interface IStack<TElement>
8      {
9         bool IsEmpty

```

```

10     {
11         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         get;
13     }
14
15     [MethodImpl(MethodImplOptions.AggressiveInlining)]
16     void Push(TElement element);
17
18     [MethodImpl(MethodImplOptions.AggressiveInlining)]
19     TElement Pop();
20
21     [MethodImpl(MethodImplOptions.AggressiveInlining)]
22     TElement Peek();
23 }
24 }

```

#### 1.34 ./csharp/Platform.Collections.Stacks/IStackExtensions.cs

```

1 using System.Runtime.CompilerServices;
2
3 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4
5 namespace Platform.Collections.Stacks
6 {
7     public static class IStackExtensions
8     {
9         [MethodImpl(MethodImplOptions.AggressiveInlining)]
10        public static void Clear<T>(this IStack<T> stack)
11        {
12            while (!stack.IsEmpty)
13            {
14                _ = stack.Pop();
15            }
16        }
17
18        [MethodImpl(MethodImplOptions.AggressiveInlining)]
19        public static T PopOrDefault<T>(this IStack<T> stack) => stack.IsEmpty ? default :
20            ↪ stack.Pop();
21
22        [MethodImpl(MethodImplOptions.AggressiveInlining)]
23        public static T PeekOrDefault<T>(this IStack<T> stack) => stack.IsEmpty ? default :
24            ↪ stack.Peek();
25    }
26 }

```

#### 1.35 ./csharp/Platform.Collections.Stacks/IStackFactory.cs

```

1 using Platform.Interfaces;
2
3 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4
5 namespace Platform.Collections.Stacks
6 {
7     public interface IStackFactory<TElement> : IFactory<IStack<TElement>>
8     {
9     }
10 }

```

#### 1.36 ./csharp/Platform.Collections.Stacks/StackExtensions.cs

```

1 using System.Collections.Generic;
2 using System.Runtime.CompilerServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Collections.Stacks
7 {
8     public static class StackExtensions
9     {
10        [MethodImpl(MethodImplOptions.AggressiveInlining)]
11        public static T PopOrDefault<T>(this Stack<T> stack) => stack.Count > 0 ? stack.Pop() :
12            ↪ default;
13
14        [MethodImpl(MethodImplOptions.AggressiveInlining)]
15        public static T PeekOrDefault<T>(this Stack<T> stack) => stack.Count > 0 ? stack.Peek()
16            ↪ : default;
17    }
18 }

```

## 1.37 ./csharp/Platform.Collections/StringExtensions.cs

```

1  using System;
2  using System.Globalization;
3  using System.Runtime.CompilerServices;
4
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7  namespace Platform.Collections
8  {
9      public static class StringExtensions
10     {
11         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         public static string CapitalizeFirstLetter(this string @string)
13         {
14             if (@string.IsNullOrEmpty(@string))
15             {
16                 return @string;
17             }
18             var chars = @string.ToCharArray();
19             for (var i = 0; i < chars.Length; i++)
20             {
21                 var category = char.GetUnicodeCategory(chars[i]);
22                 if (category == UnicodeCategory.UppercaseLetter)
23                 {
24                     return @string;
25                 }
26                 if (category == UnicodeCategory.LowercaseLetter)
27                 {
28                     chars[i] = char.ToUpper(chars[i]);
29                     return new string(chars);
30                 }
31             }
32             return @string;
33         }
34
35         [MethodImpl(MethodImplOptions.AggressiveInlining)]
36         public static string Truncate(this string @string, int maxLength) =>
37             ↪ @string.IsNullOrEmpty(@string) ? @string : @string.Substring(0,
38             ↪ Math.Min(@string.Length, maxLength));
39
40         [MethodImpl(MethodImplOptions.AggressiveInlining)]
41         public static string TrimSingle(this string @string, char charToTrim)
42         {
43             if (!@string.IsNullOrEmpty(@string))
44             {
45                 if (@string.Length == 1)
46                 {
47                     if (@string[0] == charToTrim)
48                     {
49                         return "";
50                     }
51                     else
52                     {
53                         return @string;
54                     }
55                 }
56                 else
57                 {
58                     var left = 0;
59                     var right = @string.Length - 1;
60                     if (@string[left] == charToTrim)
61                     {
62                         left++;
63                     }
64                     if (@string[right] == charToTrim)
65                     {
66                         right--;
67                     }
68                     return @string.Substring(left, right - left + 1);
69                 }
70             }
71             else
72             {
73                 return @string;
74             }
75         }
76     }
77 }

```

## 1.38 ./csharp/Platform.Collections/Trees/Node.cs

```

1  using System.Collections.Generic;
2  using System.Runtime.CompilerServices;
3
4  // ReSharper disable ForCanBeConvertedToForeach
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7  namespace Platform.Collections.Trees
8  {
9      public class Node
10     {
11         private Dictionary<object, Node> _childNodes;
12
13         public object Value
14         {
15             [MethodImpl(MethodImplOptions.AggressiveInlining)]
16             get;
17             [MethodImpl(MethodImplOptions.AggressiveInlining)]
18             set;
19         }
20
21         public Dictionary<object, Node> ChildNodes
22         {
23             [MethodImpl(MethodImplOptions.AggressiveInlining)]
24             get => _childNodes ?? (_childNodes = new Dictionary<object, Node>());
25         }
26
27         public Node this[object key]
28         {
29             [MethodImpl(MethodImplOptions.AggressiveInlining)]
30             get => GetChild(key) ?? AddChild(key);
31             [MethodImpl(MethodImplOptions.AggressiveInlining)]
32             set => SetChildValue(value, key);
33         }
34
35         [MethodImpl(MethodImplOptions.AggressiveInlining)]
36         public Node(object value) => Value = value;
37
38         [MethodImpl(MethodImplOptions.AggressiveInlining)]
39         public Node() : this(null) { }
40
41         [MethodImpl(MethodImplOptions.AggressiveInlining)]
42         public bool ContainsChild(params object[] keys) => GetChild(keys) != null;
43
44         [MethodImpl(MethodImplOptions.AggressiveInlining)]
45         public Node GetChild(params object[] keys)
46         {
47             var node = this;
48             for (var i = 0; i < keys.Length; i++)
49             {
50                 node.ChildNodes.TryGetValue(keys[i], out node);
51                 if (node == null)
52                 {
53                     return null;
54                 }
55             }
56             return node;
57         }
58
59         [MethodImpl(MethodImplOptions.AggressiveInlining)]
60         public object GetChildValue(params object[] keys) => GetChild(keys)?.Value;
61
62         [MethodImpl(MethodImplOptions.AggressiveInlining)]
63         public Node AddChild(object key) => AddChild(key, new Node(null));
64
65         [MethodImpl(MethodImplOptions.AggressiveInlining)]
66         public Node AddChild(object key, object value) => AddChild(key, new Node(value));
67
68         [MethodImpl(MethodImplOptions.AggressiveInlining)]
69         public Node AddChild(object key, Node child)
70         {
71             ChildNodes.Add(key, child);
72             return child;
73         }
74
75         [MethodImpl(MethodImplOptions.AggressiveInlining)]
76         public Node SetChild(params object[] keys) => SetChildValue(null, keys);
77
78         [MethodImpl(MethodImplOptions.AggressiveInlining)]
79         public Node SetChild(object key) => SetChildValue(null, key);

```



```

80
81     [MethodImpl(MethodImplOptions.AggressiveInlining)]
82     public Node SetChildValue(object value, params object[] keys)
83     {
84         var node = this;
85         for (var i = 0; i < keys.Length; i++)
86         {
87             node = SetChildValue(value, keys[i]);
88         }
89         node.Value = value;
90         return node;
91     }
92
93     [MethodImpl(MethodImplOptions.AggressiveInlining)]
94     public Node SetChildValue(object value, object key)
95     {
96         if (!ChildNodes.TryGetValue(key, out Node child))
97         {
98             child = AddChild(key, value);
99         }
100         child.Value = value;
101         return child;
102     }
103 }
104 }

```

### 1.39 ./csharp/Platform.Collections.Tests/ArrayTests.cs

```

1  using Xunit;
2  using Platform.Collections.Arrays;
3
4  namespace Platform.Collections.Tests
5  {
6      public class ArrayTests
7      {
8          [Fact]
9          public void GetElementTest()
10         {
11             var nullArray = (int[])null;
12             Assert.Equal(0, nullArray.GetElementOrDefault(1));
13             Assert.False(nullArray.TryGetElement(1, out int element));
14             Assert.Equal(0, element);
15             var array = new int[] { 1, 2, 3 };
16             Assert.Equal(3, array.GetElementOrDefault(2));
17             Assert.True(array.TryGetElement(2, out element));
18             Assert.Equal(3, element);
19             Assert.Equal(0, array.GetElementOrDefault(10));
20             Assert.False(array.TryGetElement(10, out element));
21             Assert.Equal(0, element);
22         }
23     }
24 }

```

### 1.40 ./csharp/Platform.Collections.Tests/BitStringTests.cs

```

1  using System;
2  using System.Collections;
3  using Xunit;
4  using Platform.Random;
5
6  namespace Platform.Collections.Tests
7  {
8      public static class BitStringTests
9      {
10         [Fact]
11         public static void BitGetSetTest()
12         {
13             const int n = 250;
14             var bitArray = new BitArray(n);
15             var bitString = new BitString(n);
16             for (var i = 0; i < n; i++)
17             {
18                 var value = RandomHelpers.Default.NextBoolean();
19                 bitArray.Set(i, value);
20                 bitString.Set(i, value);
21                 Assert.Equal(value, bitArray.Get(i));
22                 Assert.Equal(value, bitString.Get(i));
23             }
24         }
25
26         [Fact]

```

```

27 public static void BitVectorNotTest()
28 {
29     TestToOperationsWithSameMeaning((x, y, w, v) =>
30     {
31         x.VectorNot();
32         w.Not();
33     });
34 }
35
36 [Fact]
37 public static void BitParallelNotTest()
38 {
39     TestToOperationsWithSameMeaning((x, y, w, v) =>
40     {
41         x.ParallelNot();
42         w.Not();
43     });
44 }
45
46 [Fact]
47 public static void BitParallelVectorNotTest()
48 {
49     TestToOperationsWithSameMeaning((x, y, w, v) =>
50     {
51         x.ParallelVectorNot();
52         w.Not();
53     });
54 }
55
56 [Fact]
57 public static void BitVectorAndTest()
58 {
59     TestToOperationsWithSameMeaning((x, y, w, v) =>
60     {
61         x.VectorAnd(y);
62         w.And(v);
63     });
64 }
65
66 [Fact]
67 public static void BitParallelAndTest()
68 {
69     TestToOperationsWithSameMeaning((x, y, w, v) =>
70     {
71         x.ParallelAnd(y);
72         w.And(v);
73     });
74 }
75
76 [Fact]
77 public static void BitParallelVectorAndTest()
78 {
79     TestToOperationsWithSameMeaning((x, y, w, v) =>
80     {
81         x.ParallelVectorAnd(y);
82         w.And(v);
83     });
84 }
85
86 [Fact]
87 public static void BitVectorOrTest()
88 {
89     TestToOperationsWithSameMeaning((x, y, w, v) =>
90     {
91         x.VectorOr(y);
92         w.Or(v);
93     });
94 }
95
96 [Fact]
97 public static void BitParallelOrTest()
98 {
99     TestToOperationsWithSameMeaning((x, y, w, v) =>
100    {
101        x.ParallelOr(y);
102        w.Or(v);
103    });
104 }

```

```

105 [Fact]
106 public static void BitParallelVectorOrTest()
107 {
108     TestToOperationsWithSameMeaning((x, y, w, v) =>
109     {
110         x.ParallelVectorOr(y);
111         w.Or(v);
112     });
113 }
114
115 [Fact]
116 public static void BitVectorXorTest()
117 {
118     TestToOperationsWithSameMeaning((x, y, w, v) =>
119     {
120         x.VectorXor(y);
121         w.Xor(v);
122     });
123 }
124
125 [Fact]
126 public static void BitParallelXorTest()
127 {
128     TestToOperationsWithSameMeaning((x, y, w, v) =>
129     {
130         x.ParallelXor(y);
131         w.Xor(v);
132     });
133 }
134
135 [Fact]
136 public static void BitParallelVectorXorTest()
137 {
138     TestToOperationsWithSameMeaning((x, y, w, v) =>
139     {
140         x.ParallelVectorXor(y);
141         w.Xor(v);
142     });
143 }
144
145 private static void TestToOperationsWithSameMeaning(Action<BitString, BitString,
146 ↪ BitString, BitString> test)
147 {
148     const int n = 5654;
149     var x = new BitString(n);
150     var y = new BitString(n);
151     while (x.Equals(y))
152     {
153         x.SetRandomBits();
154         y.SetRandomBits();
155     }
156     var w = new BitString(x);
157     var v = new BitString(y);
158     Assert.False(x.Equals(y));
159     Assert.False(w.Equals(v));
160     Assert.True(x.Equals(w));
161     Assert.True(y.Equals(v));
162     test(x, y, w, v);
163     Assert.True(x.Equals(w));
164 }
165 }
166 }

```

#### 1.41 ./csharp/Platform.Collections.Tests/CharsSegmentTests.cs

```

1 using Xunit;
2 using Platform.Collections.Segments;
3
4 namespace Platform.Collections.Tests
5 {
6     public static class CharsSegmentTests
7     {
8         [Fact]
9         public static void GetHashCodeEqualsTest()
10        {
11            const string testString = "test test";
12            var testArray = testString.ToCharArray();
13            var firstHashCode = new CharSegment(testArray, 0, 4).GetHashCode();
14            var secondHashCode = new CharSegment(testArray, 5, 4).GetHashCode();

```

```

15         Assert.Equal(firstHashCode, secondHashCode);
16     }
17
18     [Fact]
19     public static void EqualsTest()
20     {
21         const string testString = "test test";
22         var testArray = testString.ToCharArray();
23         var first = new CharSegment(testArray, 0, 4);
24         var second = new CharSegment(testArray, 5, 4);
25         Assert.True(first.Equals(second));
26     }
27 }
28 }

```

#### 1.42 ./csharp/Platform.Collections.Tests/ListTests.cs

```

1  using System.Collections.Generic;
2  using Xunit;
3  using Platform.Collections.Lists;
4
5
6  namespace Platform.Collections.Tests
7  {
8      public class ListTests
9      {
10         [Fact]
11         public void GetElementTest()
12         {
13             var nullList = (IList<int>)null;
14             Assert.Equal(0, nullList.GetElementOrDefault(1));
15             Assert.False(nullList.TryGetElement(1, out int element));
16             Assert.Equal(0, element);
17             var list = new List<int>() { 1, 2, 3 };
18             Assert.Equal(3, list.GetElementOrDefault(2));
19             Assert.True(list.TryGetElement(2, out element));
20             Assert.Equal(3, element);
21             Assert.Equal(0, list.GetElementOrDefault(10));
22             Assert.False(list.TryGetElement(10, out element));
23             Assert.Equal(0, element);
24         }
25     }
26 }

```

#### 1.43 ./csharp/Platform.Collections.Tests/StringTests.cs

```

1  using Xunit;
2
3  namespace Platform.Collections.Tests
4  {
5      public static class StringTests
6      {
7         [Fact]
8         public static void CapitalizeFirstLetterTest()
9         {
10             Assert.Equal("Hello", "hello".CapitalizeFirstLetter());
11             Assert.Equal("Hello", "Hello".CapitalizeFirstLetter());
12             Assert.Equal(" Hello", " hello".CapitalizeFirstLetter());
13         }
14
15         [Fact]
16         public static void TrimSingleTest()
17         {
18             Assert.Equal("", "".TrimSingle('\'));
19             Assert.Equal("", "''.TrimSingle('\'));
20             Assert.Equal("hello", "'hello'".TrimSingle('\'));
21             Assert.Equal("hello", "hello'".TrimSingle('\'));
22             Assert.Equal("hello", "'hello".TrimSingle('\'));
23         }
24     }
25 }

```

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