

LinksPlatform's Platform.Collections Class Library

1.1 ./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         {
23             _array[_position++] = element;
24             return _returnConstant;
25         }
26
27         [MethodImpl(MethodImplOptions.AggressiveInlining)]
28         public TReturnConstant AddFirstAndReturnConstant(ICollection<TElement> collection)
29         {
30             _array[_position++] = collection[0];
31             return _returnConstant;
32         }
33     }
34 }
```

1.2 ./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)
28         {
29             _array[_position++] = element;
30             return true;
31         }
32
33         [MethodImpl(MethodImplOptions.AggressiveInlining)]
34         public bool AddFirstAndReturnTrue(ICollection<TElement> collection)
35         {
36             _array[_position++] = collection[0];
37             return true;
38         }
39     }
40 }
```

1.3 ./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 ./Platform.Collections/Arrays/ArrayPool[T].cs

```
1 using System;
2 using System.Collections.Generic;
3 using System.Runtime.CompilerServices;
4 using Platform.Exceptions;
5 using Platform.Disposables;
6 using Platform.Ranges;
7 using Platform.Collections.Stacks;
8
9 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
10
11 namespace Platform.Collections.Arrays
12 {
13     /// <remarks>
14     /// Original idea from
15     ↪ http://geekswithblogs.net/blackrob/archive/2014/12/18/array-pooling-in-csharp.aspx
16     /// </remarks>
17     public class ArrayPool<T>
18     {
19         public static readonly T[] Empty = Array.Empty<T>();
20
21         // May be use Default class for that later.
22         [ThreadStatic]
23         internal static ArrayPool<T> _threadInstance;
24         internal static ArrayPool<T> ThreadInstance { get => _threadInstance ?? (_threadInstance
25             ↪ = new ArrayPool<T>()); }
26
27         private readonly int _maxArraysPerSize;
28         private readonly Dictionary<int, Stack<T[]>> _pool = new Dictionary<int,
29             ↪ Stack<T[]>>(ArrayPool.DefaultSizesAmount);
30
31         [MethodImpl(MethodImplOptions.AggressiveInlining)]
32         public ArrayPool(int maxArraysPerSize) => _maxArraysPerSize = maxArraysPerSize;
33
34         [MethodImpl(MethodImplOptions.AggressiveInlining)]
35         public ArrayPool() : this(ArrayPool.DefaultMaxArraysPerSize) { }
36
37         [MethodImpl(MethodImplOptions.AggressiveInlining)]
38         public Disposable<T[]> AllocatedDisposable(long size) => (Allocate(size), Free);
39
40         [MethodImpl(MethodImplOptions.AggressiveInlining)]
41         public Disposable<T[]> Resize(Disposable<T[]> source, long size)
42         {
43             var destination = AllocatedDisposable(size);
44             T[] sourceArray = source;
45             T[] destinationArray = destination;
46             Array.Copy(sourceArray, destinationArray, size < sourceArray.Length ? (int)size :
47                 ↪ sourceArray.Length);
48             source.Dispose();
49             return destination;
50         }
51
52         [MethodImpl(MethodImplOptions.AggressiveInlining)]
53         public virtual void Clear() => _pool.Clear();
54
55         [MethodImpl(MethodImplOptions.AggressiveInlining)]
56         public virtual T[] Allocate(long size)
57         {
58             Ensure.Always.ArgumentInRange(size, (0, int.MaxValue));
59         }
60     }
61 }
```

```

55         return size == 0 ? Empty : _pool.GetOrDefault((int)size)?.PopOrDefault() ?? new
           ↪ T[size];
56     }
57
58     [MethodImpl(MethodImplOptions.AggressiveInlining)]
59     public virtual void Free(T[] array)
60     {
61         Ensure.Always.ArgumentNotNull(array, nameof(array));
62         if (array.Length == 0)
63         {
64             return;
65         }
66         var stack = _pool.GetOrAdd(array.Length, size => new Stack<T[]>(_maxArraysPerSize));
67         if (stack.Count == _maxArraysPerSize) // Stack is full
68         {
69             return;
70         }
71         stack.Push(array);
72     }
73 }
74 }

```

1.5 ./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 ./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         /// </remarks>
12         [MethodImpl(MethodImplOptions.AggressiveInlining)]
13         public static int GenerateHashCode(this char[] array, int offset, int length)
14         {
15             var hashSeed = 5381;
16             var hashAccumulator = hashSeed;
17             fixed (char* pointer = &array[offset])
18             {
19                 for (char* s = pointer, last = s + length; s < last; s++)
20                 {
21                     hashAccumulator = (hashAccumulator << 5) + hashAccumulator ^ *s;
22                 }
23             }
24             return hashAccumulator + (hashSeed * 1566083941);
25         }
26
27         /// <remarks>
28         /// Based on https://github.com/Microsoft/referencesource/blob/3b1eaf5203992df69de44c783\_a3eda37d3d4cd10/mscorlib/system/string.cs#L364
29         /// </remarks>
30         [MethodImpl(MethodImplOptions.AggressiveInlining)]
31         public static bool ContentEqualTo(this char[] left, int leftOffset, int length, char[]
           ↪ 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     [MethodImpl(MethodImplOptions.AggressiveInlining)]
49     private static bool CheckArraysMainPartForEquality(ref char* left, ref char* right, ref
50     ↪ int length)
51     {
52         while (length >= 10)
53         {
54             if ((* (int*)left != * (int*)right)
55                 || (* (int*)(left + 2) != * (int*)(right + 2))
56                 || (* (int*)(left + 4) != * (int*)(right + 4))
57                 || (* (int*)(left + 6) != * (int*)(right + 6))
58                 || (* (int*)(left + 8) != * (int*)(right + 8)))
59             {
60                 return false;
61             }
62             left += 10;
63             right += 10;
64             length -= 10;
65         }
66         return true;
67     }
68     [MethodImpl(MethodImplOptions.AggressiveInlining)]
69     private static void CheckArraysRemainderForEquality(ref char* left, ref char* right, ref
70     ↪ int length)
71     {
72         // This depends on the fact that the String objects are
73         // always zero terminated and that the terminating zero is not included
74         // in the length. For odd string sizes, the last compare will include
75         // the zero terminator.
76         while (length > 0)
77         {
78             if ((* (int*)left != * (int*)right)
79                 {
80                 break;
81             }
82             left += 2;
83             right += 2;
84             length -= 2;
85         }
86     }
87 }

```

1.7 ./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         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         public static T[] Clone<T>(this T[] array)
13         {
14             var copy = new T[array.Length];
15             Array.Copy(array, 0, copy, 0, array.Length);
16             return copy;
17         }
18     }

```

```

19     [MethodImpl(MethodImplOptions.AggressiveInlining)]
20     public static IList<T> ShiftRight<T>(this T[] array) => array.ShiftRight(1);
21
22     [MethodImpl(MethodImplOptions.AggressiveInlining)]
23     public static IList<T> ShiftRight<T>(this T[] array, int shift)
24     {
25         var restrictions = new T[array.Length + shift];
26         Array.Copy(array, 0, restrictions, shift, array.Length);
27         return restrictions;
28     }
29 }
30 }

```

1.8 ./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.
18     /// 64 бита по 0 бит, будут означать отсутствие 64-х блоков по 64 бита. Т.е. упаковка 512
19     /// → байт в 8 байт.
20     /// Подобный принцип можно применять и к 64-ём блокам и т.п. По сути это карта значений. С
21     /// → помощью которой можно быстро
22     /// проверять есть ли значения непосредственно далее (ниже по уровню).
23     /// Или как таблица виртуальной памяти где номер блока означает его присутствие и адрес.
24     /// </remarks>
25     public class BitString : IEquatable<BitString>
26     {
27         private static readonly byte[] [] _bitsSetIn16Bits;
28         private long[] _array;
29         private long _length;
30         private long _minPositiveWord;
31         private long _maxPositiveWord;
32
33         public bool this[long index]
34         {
35             [MethodImpl(MethodImplOptions.AggressiveInlining)]
36             get => Get(index);
37             [MethodImpl(MethodImplOptions.AggressiveInlining)]
38             set => Set(index, value);
39         }
40
41         public long Length
42         {
43             [MethodImpl(MethodImplOptions.AggressiveInlining)]
44             get => _length;
45             [MethodImpl(MethodImplOptions.AggressiveInlining)]
46             set
47             {
48                 if (_length == value)
49                 {
50                     return;
51                 }
52                 Ensure.Always.ArgumentInRange(value, GetValidLengthRange(), nameof(Length));
53                 // Currently we never shrink the array
54                 if (value > _length)
55                 {
56                     var words = GetWordsCountFromIndex(value);
57                     var oldWords = GetWordsCountFromIndex(_length);
58                     if (words > _array.LongLength)
59                     {
60                         var copy = new long[words];
61                         Array.Copy(_array, copy, _array.LongLength);
62                         _array = copy;
63                     }
64                     else
65                     {
66                         // What is going on here?
67                     }
68                 }
69             }
70         }
71     }
72 }

```

```

64         Array.Clear(_array, (int)oldWords, (int)(words - oldWords));
65     }
66     // What is going on here?
67     var mask = (int)(_length % 64);
68     if (mask > 0)
69     {
70         _array[oldWords - 1] &= (1L << mask) - 1;
71     }
72 }
73 else
74 {
75     // Looks like minimum and maximum positive words are not updated
76     throw new NotImplementedException();
77 }
78 _length = value;
79 }
80 }
81
82 #region Constructors
83
84 [MethodImpl(MethodImplOptions.AggressiveInlining)]
85 static BitString()
86 {
87     _bitsSetIn16Bits = new byte[65536][];
88     int i, c, k;
89     byte bitIndex;
90     for (i = 0; i < 65536; i++)
91     {
92         // Calculating size of array (number of positive bits)
93         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 #endregion
144
145 [MethodImpl(MethodImplOptions.AggressiveInlining)]
146 public BitString Not()
147 {
148     for (var i = 0L; i < _array.LongLength; i++)
149     {
150         _array[i] = ~_array[i];
151         RefreshBordersByWord(i);
152     }
153     return this;
154 }
155
156 [MethodImpl(MethodImplOptions.AggressiveInlining)]
157 public BitString ParallelNot()
158 {
159     var threads = Environment.ProcessorCount / 2;
160     if (threads <= 1)
161     {
162         return Not();
163     }
164     var partitioner = Partitioner.Create(0L, _array.LongLength, _array.LongLength /
165         ↪ threads);
166     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions() {
167         ↪ MaxDegreeOfParallelism = threads }, range =>
168     {
169         var maximum = range.Item2;
170         for (var i = range.Item1; i < maximum; i++)
171         {
172             _array[i] = ~_array[i];
173         }
174     });
175     MarkBordersAsAllBitsSet();
176     TryShrinkBorders();
177     return this;
178 }
179
180 [MethodImpl(MethodImplOptions.AggressiveInlining)]
181 public BitString VectorNot()
182 {
183     if (!Vector.IsHardwareAccelerated || _array.LongLength >= int.MaxValue)
184     {
185         return Not();
186     }
187     var step = Vector<long>.Count;
188     if (_array.Length < step)
189     {
190         return Not();
191     }
192     VectorNotLoop(_array, step, 0, _array.Length);
193     MarkBordersAsAllBitsSet();
194     TryShrinkBorders();
195     return this;
196 }
197
198 [MethodImpl(MethodImplOptions.AggressiveInlining)]
199 public BitString ParallelVectorNot()
200 {
201     var threads = Environment.ProcessorCount / 2;
202     if (threads <= 1)
203     {
204         return VectorNot();
205     }
206     if (!Vector.IsHardwareAccelerated)
207     {
208         return ParallelNot();
209     }
210     var step = Vector<long>.Count;
211     if (_array.Length < (step * threads))
212     {
213         return VectorNot();
214     }
215     var partitioner = Partitioner.Create(0, _array.Length, _array.Length / threads);
216     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions() {
217         ↪ MaxDegreeOfParallelism = threads }, range => VectorNotLoop(_array, step,
218         ↪ range.Item1, range.Item2));
219     MarkBordersAsAllBitsSet();

```

```

217     TryShrinkBorders();
218     return this;
219 }
220
221 [MethodImpl(MethodImplOptions.AggressiveInlining)]
222 static private void VectorNotLoop(long[] array, int step, int start, int maximum)
223 {
224     var i = start;
225     var range = maximum - start - 1;
226     var stop = range - (range % step);
227     for (; i < stop; i += step)
228     {
229         (~new Vector<long>(array, i)).CopyTo(array, i);
230     }
231     for (; i < maximum; i++)
232     {
233         array[i] = ~array[i];
234     }
235 }
236
237 [MethodImpl(MethodImplOptions.AggressiveInlining)]
238 public BitString And(BitString other)
239 {
240     EnsureBitStringHasTheSameSize(other, nameof(other));
241     GetCommonOuterBorders(this, other, out long from, out long to);
242     var otherArray = other._array;
243     for (var i = from; i <= to; i++)
244     {
245         _array[i] &= otherArray[i];
246         RefreshBordersByWord(i);
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 [MethodImpl(MethodImplOptions.AggressiveInlining)]
296 public BitString ParallelVectorAnd(BitString other)
297 {
298     var threads = Environment.ProcessorCount / 2;
299     if (threads <= 1)
300     {
301         return VectorAnd(other);
302     }
303     if (!Vector.IsHardwareAccelerated)
304     {
305         return ParallelAnd(other);
306     }
307     var step = Vector<long>.Count;
308     if (_array.Length < (step * threads))
309     {
310         return VectorAnd(other);
311     }
312     EnsureBitStringHasTheSameSize(other, nameof(other));
313     GetCommonOuterBorders(this, other, out int from, out int to);
314     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
315     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions() {
316         ↪ MaxDegreeOfParallelism = threads }, range => VectorAndLoop(_array, other._array,
317         ↪ step, range.Item1, range.Item2));
318     MarkBordersAsAllBitsSet();
319     TryShrinkBorders();
320     return this;
321 }
322
323 [MethodImpl(MethodImplOptions.AggressiveInlining)]
324 static private void VectorAndLoop(long[] array, long[] otherArray, int step, int start,
325     ↪ int maximum)
326 {
327     var i = start;
328     var range = maximum - start - 1;
329     var stop = range - (range % step);
330     for (; i < stop; i += step)
331     {
332         (new Vector<long>(array, i) & new Vector<long>(otherArray, i)).CopyTo(array, i);
333     }
334     for (; i < maximum; i++)
335     {
336         array[i] &= otherArray[i];
337     }
338 }
339
340 [MethodImpl(MethodImplOptions.AggressiveInlining)]
341 public BitString Or(BitString other)
342 {
343     EnsureBitStringHasTheSameSize(other, nameof(other));
344     GetCommonOuterBorders(this, other, out long from, out long to);
345     for (var i = from; i <= to; i++)
346     {
347         _array[i] |= other._array[i];
348         RefreshBordersByWord(i);
349     }
350     return this;
351 }
352
353 [MethodImpl(MethodImplOptions.AggressiveInlining)]
354 public BitString ParallelOr(BitString other)
355 {
356     var threads = Environment.ProcessorCount / 2;
357     if (threads <= 1)
358     {
359         return Or(other);
360     }
361     EnsureBitStringHasTheSameSize(other, nameof(other));
362     GetCommonOuterBorders(this, other, out long from, out long to);
363     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
364     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions() {
365         ↪ MaxDegreeOfParallelism = threads }, range =>
366     {
367         var maximum = range.Item2;
368         for (var i = range.Item1; i < maximum; i++)
369         {
370             _array[i] |= other._array[i];
371         }
372     });
373 }

```

```

369     MarkBordersAsAllBitsSet();
370     TryShrinkBorders();
371     return this;
372 }
373
374 [MethodImpl(MethodImplOptions.AggressiveInlining)]
375 public BitString VectorOr(BitString other)
376 {
377     if (!Vector.IsHardwareAccelerated || _array.LongLength >= int.MaxValue)
378     {
379         return Or(other);
380     }
381     var step = Vector<long>.Count;
382     if (_array.Length < step)
383     {
384         return Or(other);
385     }
386     EnsureBitStringHasTheSameSize(other, nameof(other));
387     GetCommonOuterBorders(this, other, out int from, out int to);
388     VectorOrLoop(_array, other._array, step, from, to + 1);
389     MarkBordersAsAllBitsSet();
390     TryShrinkBorders();
391     return this;
392 }
393
394 [MethodImpl(MethodImplOptions.AggressiveInlining)]
395 public BitString ParallelVectorOr(BitString other)
396 {
397     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     }
448 }

```

```

444         RefreshBordersByWord(i);
445     }
446     return this;
447 }
448
449 [MethodImpl(MethodImplOptions.AggressiveInlining)]
450 public BitString ParallelXor(BitString other)
451 {
452     var threads = Environment.ProcessorCount / 2;
453     if (threads <= 1)
454     {
455         return Xor(other);
456     }
457     EnsureBitStringHasTheSameSize(other, nameof(other));
458     GetCommonOuterBorders(this, other, out long from, out long to);
459     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
460     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions() {
461         ↪ MaxDegreeOfParallelism = threads }, range =>
462     {
463         var maximum = range.Item2;
464         for (var i = range.Item1; i < maximum; i++)
465         {
466             _array[i] ^= other._array[i];
467         }
468     });
469     MarkBordersAsAllBitsSet();
470     TryShrinkBorders();
471     return this;
472 }
473
474 [MethodImpl(MethodImplOptions.AggressiveInlining)]
475 public BitString VectorXor(BitString other)
476 {
477     if (!Vector.IsHardwareAccelerated || _array.LongLength >= int.MaxValue)
478     {
479         return Xor(other);
480     }
481     var step = Vector<long>.Count;
482     if (_array.Length < step)
483     {
484         return Xor(other);
485     }
486     EnsureBitStringHasTheSameSize(other, nameof(other));
487     GetCommonOuterBorders(this, other, out int from, out int to);
488     VectorXorLoop(_array, other._array, step, from, to + 1);
489     MarkBordersAsAllBitsSet();
490     TryShrinkBorders();
491     return this;
492 }
493
494 [MethodImpl(MethodImplOptions.AggressiveInlining)]
495 public BitString ParallelVectorXor(BitString other)
496 {
497     var threads = Environment.ProcessorCount / 2;
498     if (threads <= 1)
499     {
500         return VectorXor(other);
501     }
502     if (!Vector.IsHardwareAccelerated)
503     {
504         return ParallelXor(other);
505     }
506     var step = Vector<long>.Count;
507     if (_array.Length < (step * threads))
508     {
509         return VectorXor(other);
510     }
511     EnsureBitStringHasTheSameSize(other, nameof(other));
512     GetCommonOuterBorders(this, other, out int from, out int to);
513     var partitioner = Partitioner.Create(from, to + 1, (to - from) / threads);
514     Parallel.ForEach(partitioner.GetDynamicPartitions(), new ParallelOptions() {
515         ↪ MaxDegreeOfParallelism = threads }, range => VectorXorLoop(_array, other._array,
516         ↪ step, range.Item1, range.Item2));
517     MarkBordersAsAllBitsSet();
518     TryShrinkBorders();
519     return this;
520 }

```

```

519 [MethodImpl(MethodImplOptions.AggressiveInlining)]
520 static private void VectorXorLoop(long[] array, long[] otherArray, int step, int start,
    ↪ int maximum)
521 {
522     var i = start;
523     var range = maximum - start - 1;
524     var stop = range - (range % step);
525     for (; i < stop; i += step)
526     {
527         (new Vector<long>(array, i) ^ new Vector<long>(otherArray, i)).CopyTo(array, i);
528     }
529     for (; i < maximum; i++)
530     {
531         array[i] ^= otherArray[i];
532     }
533 }
534
535 [MethodImpl(MethodImplOptions.AggressiveInlining)]
536 private void RefreshBordersByWord(long wordIndex)
537 {
538     if (_array[wordIndex] == 0)
539     {
540         if (wordIndex == _minPositiveWord && wordIndex != _array.LongLength - 1)
541         {
542             _minPositiveWord++;
543         }
544         if (wordIndex == _maxPositiveWord && wordIndex != 0)
545         {
546             _maxPositiveWord--;
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)]
1008 private static void AppendAllSetIndices(List<ulong> result, ulong i, byte[] bits00to15,
        ↳ byte[] bits16to31, byte[] bits32to47, byte[] bits48to63)
1009 {
1010     for (var j = 0; j < bits00to15.Length; j++)
1011     {
1012         result.Add(bits00to15[j] + (i * 64));
1013     }
1014     for (var j = 0; j < bits16to31.Length; j++)
1015     {
1016         result.Add(bits16to31[j] + 16UL + (i * 64));
1017     }
1018     for (var j = 0; j < bits32to47.Length; j++)
1019     {
1020         result.Add(bits32to47[j] + 32UL + (i * 64));
1021     }
1022     for (var j = 0; j < bits48to63.Length; j++)
1023     {
1024         result.Add(bits48to63[j] + 48UL + (i * 64));
1025     }
1026 }
1027
1028 [MethodImpl(MethodImplOptions.AggressiveInlining)]
1029 private static long GetFirstSetBit(long i, byte[] bits00to15, byte[] bits16to31, byte[]
        ↳ bits32to47, byte[] bits48to63)
1030 {
1031     if (bits00to15.Length > 0)
1032     {
1033         return bits00to15[0] + (i * 64);
1034     }
1035     if (bits16to31.Length > 0)
1036     {
1037         return bits16to31[0] + 16 + (i * 64);
1038     }
1039     if (bits32to47.Length > 0)
1040     {
1041         return bits32to47[0] + 32 + (i * 64);
1042     }
1043     return bits48to63[0] + 48 + (i * 64);
1044 }
1045
1046 [MethodImpl(MethodImplOptions.AggressiveInlining)]
1047 private static long GetLastSetBit(long i, byte[] bits00to15, byte[] bits16to31, byte[]
        ↳ bits32to47, byte[] bits48to63)
1048 {
1049     if (bits48to63.Length > 0)
1050     {
1051         return bits48to63[bits48to63.Length - 1] + 48 + (i * 64);
1052     }

```

```

1053         if (bits32to47.Length > 0)
1054         {
1055             return bits32to47[bits32to47.Length - 1] + 32 + (i * 64);
1056         }
1057         if (bits16to31.Length > 0)
1058         {
1059             return bits16to31[bits16to31.Length - 1] + 16 + (i * 64);
1060         }
1061         return bits00to15[bits00to15.Length - 1] + (i * 64);
1062     }
1063
1064     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1065     private static void GetBits(long word, out byte[] bits00to15, out byte[] bits16to31, out
1066     ↪ byte[] bits32to47, out byte[] bits48to63)
1067     {
1068         bits00to15 = _bitsSetIn16Bits[word & 0xffffu];
1069         bits16to31 = _bitsSetIn16Bits[(word >> 16) & 0xffffu];
1070         bits32to47 = _bitsSetIn16Bits[(word >> 32) & 0xffffu];
1071         bits48to63 = _bitsSetIn16Bits[(word >> 48) & 0xffffu];
1072     }
1073
1074     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1075     public static void GetCommonInnerBorders(BitString left, BitString right, out long from,
1076     ↪ out long to)
1077     {
1078         from = Math.Max(left._minPositiveWord, right._minPositiveWord);
1079         to = Math.Min(left._maxPositiveWord, right._maxPositiveWord);
1080     }
1081
1082     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1083     public static void GetCommonOuterBorders(BitString left, BitString right, out long from,
1084     ↪ out long to)
1085     {
1086         from = Math.Min(left._minPositiveWord, right._minPositiveWord);
1087         to = Math.Max(left._maxPositiveWord, right._maxPositiveWord);
1088     }
1089
1090     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1091     public static void GetCommonOuterBorders(BitString left, BitString right, out int from,
1092     ↪ out int to)
1093     {
1094         from = (int)Math.Min(left._minPositiveWord, right._minPositiveWord);
1095         to = (int)Math.Max(left._maxPositiveWord, right._maxPositiveWord);
1096     }
1097
1098     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1099     public static void GetCommonOuterBorders(BitString left, BitString right, out int from,
1100     ↪ out int to)
1101     {
1102         from = (int)Math.Min(left._minPositiveWord, right._minPositiveWord);
1103         to = (int)Math.Max(left._maxPositiveWord, right._maxPositiveWord);
1104     }
1105
1106     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1107     public static void GetCommonOuterBorders(BitString left, BitString right, out int from,
1108     ↪ out int to)
1109     {
1110         from = (int)Math.Min(left._minPositiveWord, right._minPositiveWord);
1111         to = (int)Math.Max(left._maxPositiveWord, right._maxPositiveWord);
1112     }
1113
1114     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1115     public static void GetCommonOuterBorders(BitString left, BitString right, out int from,
1116     ↪ out int to)
1117     {
1118         from = (int)Math.Min(left._minPositiveWord, right._minPositiveWord);
1119         to = (int)Math.Max(left._maxPositiveWord, right._maxPositiveWord);
1120     }
1121
1122     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1123     public static long GetWordsCountFromIndex(long index) => (index + 63) / 64;
1124
1125     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1126     public static long GetWordIndexFromIndex(long index) => index >> 6;
1127
1128     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1129     public static long GetBitMaskFromIndex(long index) => 1L << (int)(index & 63);
1130
1131     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1132     public override int GetHashCode() => base.GetHashCode();
1133
1134     [MethodImpl(MethodImplOptions.AggressiveInlining)]
1135     public override string ToString() => base.ToString();
1136 }

```

1.9 ./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 ./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 ./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
12         ↪ value) ? value : default;
13
14         [MethodImpl(MethodImplOptions.AggressiveInlining)]
15         public static T PeekOrDefault<T>(this ConcurrentStack<T> stack) => stack.TryPeek(out T
16         ↪ value) ? value : default;
17     }
18 }

```

1.12 ./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,
19         ↪ ICollection<T> argument, string argumentName, string message)
20         {
21             if (argument.IsNullOrEmpty())
22             {
23                 throw new ArgumentException(message, argumentName);
24             }
25         }
26     }
27 }

```

```

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,
    ↳ string argument) => ArgumentNotEmptyAndNotWhiteSpace(root, argument, null, null);
46
47 #endregion
48
49 #region OnDebug
50
51 [Conditional("DEBUG")]
52 public static void ArgumentNotEmpty<T>(this EnsureOnDebugExtensionRoot root,
    ↳ ICollection<T> argument, string argumentName, string message) =>
    ↳ Ensure.Always.ArgumentNotEmpty(argument, argumentName, message);
53
54 [Conditional("DEBUG")]
55 public static void ArgumentNotEmpty<T>(this EnsureOnDebugExtensionRoot root,
    ↳ ICollection<T> argument, string argumentName) =>
    ↳ Ensure.Always.ArgumentNotEmpty(argument, argumentName, null);
56
57 [Conditional("DEBUG")]
58 public static void ArgumentNotEmpty<T>(this EnsureOnDebugExtensionRoot root,
    ↳ ICollection<T> argument) => Ensure.Always.ArgumentNotEmpty(argument, null, null);
59
60 [Conditional("DEBUG")]
61 public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureOnDebugExtensionRoot
    ↳ root, string argument, string argumentName, string message) =>
    ↳ Ensure.Always.ArgumentNotEmptyAndNotWhiteSpace(argument, argumentName, message);
62
63 [Conditional("DEBUG")]
64 public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureOnDebugExtensionRoot
    ↳ root, string argument, string argumentName) =>
    ↳ Ensure.Always.ArgumentNotEmptyAndNotWhiteSpace(argument, argumentName, null);
65
66 [Conditional("DEBUG")]
67 public static void ArgumentNotEmptyAndNotWhiteSpace(this EnsureOnDebugExtensionRoot
    ↳ root, string argument) => Ensure.Always.ArgumentNotEmptyAndNotWhiteSpace(argument,
    ↳ null, null);
68
69 #endregion
70 }
71 }

```

1.13 ./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 ==
        ↳ null || collection.Count == 0;
13
14     [MethodImpl(MethodImplOptions.AggressiveInlining)]
15     public static bool AllEqualToDefault<T>(this ICollection<T> collection)
16     {
17         var equalityComparer = EqualityComparer<T>.Default;
18         return collection.All(item => equalityComparer.Equals(item, default));
19     }
20 }
21 }

```

1.14 ./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>
            ↳ dictionary, TKey key)
13         {
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,
            ↳ TKey key, Func<TKey, TValue> valueFactory)
20         {
21             if (!dictionary.TryGetValue(key, out TValue value))
22             {
23                 value = valueFactory(key);
24                 dictionary.Add(key, value);
25                 return value;
26             }
27             return value;
28         }
29     }
30 }

```

1.15 ./Platform.Collections/Lists/CharListExtensions.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 CharListExtensions
9     {
10         /// <remarks>
11         /// Based on https://github.com/Microsoft/referencesource/blob/3b1eaf5203992df69de44c783a3eda37d3d4cd10/mscorlib/system/string.cs#L833
12         /// </remarks>
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public static unsafe int GenerateHashCode(this IList<char> list)
15         {
16             var hashSeed = 5381;
17             var hashAccumulator = hashSeed;
18             for (var i = 0; i < list.Count; i++)
19             {
20                 hashAccumulator = (hashAccumulator << 5) + hashAccumulator ^ list[i];
21             }
22             return hashAccumulator + (hashSeed * 1566083941);
23         }
24
25         [MethodImpl(MethodImplOptions.AggressiveInlining)]
26         public static bool EqualTo(this IList<char> left, IList<char> right) =>
            ↳ left.EqualTo(right, ContentEqualTo);
27
28         [MethodImpl(MethodImplOptions.AggressiveInlining)]

```

```

29     public static bool ContentEqualTo(this IList<char> left, IList<char> right)
30     {
31         for (var i = left.Count - 1; i >= 0; --i)
32         {
33             if (left[i] != right[i])
34             {
35                 return false;
36             }
37         }
38         return true;
39     }
40 }
41 }

```

1.16 ./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 ./Platform.Collections/Lists/IListEqualityComparer.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 IListEqualityComparer<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 ./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 bool AddAndReturnTrue<T>(this IList<T> list, T element)
13         {
14             list.Add(element);
15             return true;
16         }
17
18         [MethodImpl(MethodImplOptions.AggressiveInlining)]
19         public static int GetCountOrZero<T>(this IList<T> list) => list?.Count ?? 0;
20
21         [MethodImpl(MethodImplOptions.AggressiveInlining)]
22         public static bool EqualTo<T>(this IList<T> left, IList<T> right) => EqualTo(left,
23             ↪ right, ContentEqualTo);
24
25         [MethodImpl(MethodImplOptions.AggressiveInlining)]
26         public static bool EqualTo<T>(this IList<T> left, IList<T> right, Func<IList<T>,
27             ↪ IList<T>, bool> contentEqualityComparer)
28         {
29             if (ReferenceEquals(left, right))
30             {
31                 return true;
32             }
33
34             if (left.Count != right.Count)
35             {
36                 return false;
37             }
38
39             for (var i = 0; i < left.Count; i++)
40             {
41                 if (!contentEqualityComparer(left[i], right[i]))
42                 {
43                     return false;
44                 }
45             }
46
47             return true;
48         }
49     }
50 }

```

```

30     }
31     var leftCount = left.GetCountOrZero();
32     var rightCount = right.GetCountOrZero();
33     if (leftCount == 0 && rightCount == 0)
34     {
35         return true;
36     }
37     if (leftCount == 0 || rightCount == 0 || leftCount != rightCount)
38     {
39         return false;
40     }
41     return contentEqualityComparer(left, right);
42 }
43
44 [MethodImpl(MethodImplOptions.AggressiveInlining)]
45 public static bool ContentEqualTo<T>(this IList<T> left, IList<T> right)
46 {
47     var equalityComparer = EqualityComparer<T>.Default;
48     for (var i = left.Count - 1; i >= 0; --i)
49     {
50         if (!equalityComparer.Equals(left[i], right[i]))
51         {
52             return false;
53         }
54     }
55     return true;
56 }
57
58 [MethodImpl(MethodImplOptions.AggressiveInlining)]
59 public static T[] ToArray<T>(this IList<T> list, Func<T, bool> predicate)
60 {
61     if (list == null)
62     {
63         return null;
64     }
65     var result = new List<T>(list.Count);
66     for (var i = 0; i < list.Count; i++)
67     {
68         if (predicate(list[i]))
69         {
70             result.Add(list[i]);
71         }
72     }
73     return result.ToArray();
74 }
75
76 [MethodImpl(MethodImplOptions.AggressiveInlining)]
77 public static T[] ToArray<T>(this IList<T> list)
78 {
79     var array = new T[list.Count];
80     list.CopyTo(array, 0);
81     return array;
82 }
83
84 [MethodImpl(MethodImplOptions.AggressiveInlining)]
85 public static void ForEach<T>(this IList<T> list, Action<T> action)
86 {
87     for (var i = 0; i < list.Count; i++)
88     {
89         action(list[i]);
90     }
91 }
92
93 /// <remarks>
94 /// Based on http://stackoverflow.com/questions/263400/what-is-the-best-algorithm-for-an
95 /// ↪ -overridden-system-object-gethashcode
96 /// </remarks>
97 [MethodImpl(MethodImplOptions.AggressiveInlining)]
98 public static int GenerateHashCode<T>(this IList<T> list)
99 {
100     var result = 17;
101     for (var i = 0; i < list.Count; i++)
102     {
103         result = unchecked((result * 23) + list[i].GetHashCode());
104     }
105     return result;
106 }
107
108 [MethodImpl(MethodImplOptions.AggressiveInlining)]

```



```

108 public static int CompareTo<T>(this IList<T> left, IList<T> right)
109 {
110     var comparer = Comparer<T>.Default;
111     var leftCount = left.GetCountOrZero();
112     var rightCount = right.GetCountOrZero();
113     var intermediateResult = leftCount.CompareTo(rightCount);
114     for (var i = 0; intermediateResult == 0 && i < leftCount; i++)
115     {
116         intermediateResult = comparer.Compare(left[i], right[i]);
117     }
118     return intermediateResult;
119 }
120
121 [MethodImpl(MethodImplOptions.AggressiveInlining)]
122 public static T[] SkipFirst<T>(this IList<T> list) => list.SkipFirst(1);
123
124 [MethodImpl(MethodImplOptions.AggressiveInlining)]
125 public static T[] SkipFirst<T>(this IList<T> list, int skip)
126 {
127     if (list.IsNullOrEmpty() || list.Count <= skip)
128     {
129         return Array.Empty<T>();
130     }
131     var result = new T[list.Count - skip];
132     for (int r = skip, w = 0; r < list.Count; r++, w++)
133     {
134         result[w] = list[r];
135     }
136     return result;
137 }
138
139 [MethodImpl(MethodImplOptions.AggressiveInlining)]
140 public static IList<T> ShiftRight<T>(this IList<T> list) => list.ShiftRight(1);
141
142 [MethodImpl(MethodImplOptions.AggressiveInlining)]
143 public static IList<T> ShiftRight<T>(this IList<T> list, int shift)
144 {
145     var result = new T[list.Count + shift];
146     for (int r = 0, w = shift; r < list.Count; r++, w++)
147     {
148         result[w] = list[r];
149     }
150     return result;
151 }
152 }
153 }

```

1.19 ./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)
28         {
29             _list.Add(element);
30             return true;
31         }
32     }
33 }

```

```

33     [MethodImpl(MethodImplOptions.AggressiveInlining)]
34     public bool AddFirstAndReturnTrue(IList<TElement> list)
35     {
36         _list.Add(list[0]);
37         return true;
38     }
39
40     [MethodImpl(MethodImplOptions.AggressiveInlining)]
41     public TReturnConstant AddAndReturnConstant(TElement element)
42     {
43         _list.Add(element);
44         return _returnConstant;
45     }
46
47     [MethodImpl(MethodImplOptions.AggressiveInlining)]
48     public TReturnConstant AddFirstAndReturnConstant(IList<TElement> list)
49     {
50         _list.Add(list[0]);
51         return _returnConstant;
52     }
53
54     [MethodImpl(MethodImplOptions.AggressiveInlining)]
55     public TReturnConstant AddAllValuesAndReturnConstant(IList<TElement> list)
56     {
57         for (int i = 1; i < list.Count; i++)
58         {
59             _list.Add(list[i]);
60         }
61         return _returnConstant;
62     }
63 }
64 }

```

1.20 ./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         }
47     }
48 }

```

```

45         return this.EqualTo(other, contentEqualityComparer);
46     }
47
48     [MethodImpl(MethodImplOptions.AggressiveInlining)]
49     public static implicit operator string(CharSegment segment)
50     {
51         if (!(segment.Base is char[] array))
52         {
53             array = segment.Base.ToArray();
54         }
55         return new string(array, segment.Offset, segment.Length);
56     }
57
58     [MethodImpl(MethodImplOptions.AggressiveInlining)]
59     public override string ToString() => this;
60 }
61 }

```

1.21 ./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.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 Segment<T> : IEquatable<Segment<T>>, IList<T>
12     {
13         public IList<T> Base
14         {
15             [MethodImpl(MethodImplOptions.AggressiveInlining)]
16             get;
17         }
18         public int Offset
19         {
20             [MethodImpl(MethodImplOptions.AggressiveInlining)]
21             get;
22         }
23         public int Length
24         {
25             [MethodImpl(MethodImplOptions.AggressiveInlining)]
26             get;
27         }
28
29         [MethodImpl(MethodImplOptions.AggressiveInlining)]
30         public Segment(IList<T> @base, int offset, int length)
31         {
32             Base = @base;
33             Offset = offset;
34             Length = length;
35         }
36
37         [MethodImpl(MethodImplOptions.AggressiveInlining)]
38         public override int GetHashCode() => this.GenerateHashCode();
39
40         [MethodImpl(MethodImplOptions.AggressiveInlining)]
41         public virtual bool Equals(Segment<T> other) => this.EqualTo(other);
42
43         [MethodImpl(MethodImplOptions.AggressiveInlining)]
44         public override bool Equals(object obj) => obj is Segment<T> other ? Equals(other) :
45             ↪ false;
46
47         #region IList
48         public T this[int i]
49         {
50             [MethodImpl(MethodImplOptions.AggressiveInlining)]
51             get => Base[Offset + i];
52             [MethodImpl(MethodImplOptions.AggressiveInlining)]
53             set => Base[Offset + i] = value;
54         }
55
56         public int Count
57         {
58             [MethodImpl(MethodImplOptions.AggressiveInlining)]
59             get => Length;
60         }
61     }
62 }

```

```

61
62     public bool IsReadOnly
63     {
64         [MethodImpl(MethodImplOptions.AggressiveInlining)]
65         get => true;
66     }
67
68     [MethodImpl(MethodImplOptions.AggressiveInlining)]
69     public int IndexOf(T item)
70     {
71         var index = Base.IndexOf(item);
72         if (index >= Offset)
73         {
74             var actualIndex = index - Offset;
75             if (actualIndex < Length)
76             {
77                 return actualIndex;
78             }
79         }
80         return -1;
81     }
82
83     [MethodImpl(MethodImplOptions.AggressiveInlining)]
84     public void Insert(int index, T item) => throw new NotSupportedException();
85
86     [MethodImpl(MethodImplOptions.AggressiveInlining)]
87     public void RemoveAt(int index) => throw new NotSupportedException();
88
89     [MethodImpl(MethodImplOptions.AggressiveInlining)]
90     public void Add(T item) => throw new NotSupportedException();
91
92     [MethodImpl(MethodImplOptions.AggressiveInlining)]
93     public void Clear() => throw new NotSupportedException();
94
95     [MethodImpl(MethodImplOptions.AggressiveInlining)]
96     public bool Contains(T item) => IndexOf(item) >= 0;
97
98     [MethodImpl(MethodImplOptions.AggressiveInlining)]
99     public void CopyTo(T[] array, int arrayIndex)
100     {
101         for (var i = 0; i < Length; i++)
102         {
103             array[arrayIndex++] = this[i];
104         }
105     }
106
107     [MethodImpl(MethodImplOptions.AggressiveInlining)]
108     public bool Remove(T item) => throw new NotSupportedException();
109
110     [MethodImpl(MethodImplOptions.AggressiveInlining)]
111     public IEnumerator<T> GetEnumerator()
112     {
113         for (var i = 0; i < Length; i++)
114         {
115             yield return this[i];
116         }
117     }
118
119     [MethodImpl(MethodImplOptions.AggressiveInlining)]
120     IEnumerator IEnumerable.GetEnumerator() => GetEnumerator();
121
122     #endregion
123 }
124 }

```

1.22 ./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 ./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             {
26                 for (int length = _minimumStringSegmentLength, maxLength = elements.Count -
27                     ↪ offset; length <= maxLength; length++)
28                 {
29                     Iteration(CreateSegment(elements, offset, length));
30                 }
31             }
32
33             [MethodImpl(MethodImplOptions.AggressiveInlining)]
34             protected abstract TSegment CreateSegment(ICollection<T> elements, int offset, int length);
35
36             [MethodImpl(MethodImplOptions.AggressiveInlining)]
37             protected abstract void Iteration(TSegment segment);
38         }
39     }
40 }

```

1.24 ./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(ICollection<T> elements, int offset, int length)
12             ↪ => new Segment<T>(elements, offset, length);
13     }
14 }

```

1.25 ./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 ./Platform.Collections.Segments.Walkers/DictionaryBasedDuplicateSegmentsWalkerBase[T, Segment].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         [MethodImpl(MethodImplOptions.AggressiveInlining)]
28         protected DictionaryBasedDuplicateSegmentsWalkerBase(IDictionary<TSegment, long>
29             ↳ dictionary, int minimumStringSegmentLength) : this(dictionary,
30             ↳ minimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }
31
32         [MethodImpl(MethodImplOptions.AggressiveInlining)]
33         protected DictionaryBasedDuplicateSegmentsWalkerBase(IDictionary<TSegment, long>
34             ↳ dictionary) : this(dictionary, DefaultMinimumStringSegmentLength,
35             ↳ DefaultResetDictionaryOnEachWalk) { }
36
37         [MethodImpl(MethodImplOptions.AggressiveInlining)]
38         protected DictionaryBasedDuplicateSegmentsWalkerBase(int minimumStringSegmentLength,
39             ↳ bool resetDictionaryOnEachWalk) : this(resetDictionaryOnEachWalk ? null : new
40             ↳ Dictionary<TSegment, long>(), minimumStringSegmentLength, resetDictionaryOnEachWalk)
41             ↳ { }
42
43         [MethodImpl(MethodImplOptions.AggressiveInlining)]
44         protected DictionaryBasedDuplicateSegmentsWalkerBase(int minimumStringSegmentLength) :
45             ↳ this(minimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }
46
47         [MethodImpl(MethodImplOptions.AggressiveInlining)]
48         protected DictionaryBasedDuplicateSegmentsWalkerBase() :
49             ↳ this(DefaultMinimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }
50
51         [MethodImpl(MethodImplOptions.AggressiveInlining)]
52         public override void WalkAll(ICollection<T> elements)
53         {
54             if (_resetDictionaryOnEachWalk)
55             {
56                 var capacity = Math.Ceiling(Math.Pow(elements.Count, 2) / 2);
57                 Dictionary = new Dictionary<TSegment, long>((int)capacity);
58             }
59             base.WalkAll(elements);
60         }
61
62         [MethodImpl(MethodImplOptions.AggressiveInlining)]
63         protected override long GetSegmentFrequency(TSegment segment) =>
64             ↳ Dictionary.GetOrDefault(segment);
65
66         [MethodImpl(MethodImplOptions.AggressiveInlining)]
67         protected override void SetSegmentFrequency(TSegment segment, long frequency) =>
68             ↳ Dictionary[segment] = frequency;
69     }
70 }

```

1.27 ./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> :
9         ↳ 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) :
        ↪ base(minimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }
24
25     [MethodImpl(MethodImplOptions.AggressiveInlining)]
26     protected DictionaryBasedDuplicateSegmentsWalkerBase() :
        ↪ base(DefaultMinimumStringSegmentLength, DefaultResetDictionaryOnEachWalk) { }
27 }
28 }

```

1.28 ./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,
        ↪ TSegment>
8     where TSegment : Segment<T>
9     {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         protected DuplicateSegmentsWalkerBase(int minimumStringSegmentLength) :
            ↪ base(minimumStringSegmentLength) { }
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         protected DuplicateSegmentsWalkerBase() : base(DefaultMinimumStringSegmentLength) { }
15
16         [MethodImpl(MethodImplOptions.AggressiveInlining)]
17         protected override void Iteration(TSegment segment)
18         {
19             var frequency = GetSegmentFrequency(segment);
20             if (frequency == 1)
21             {
22                 OnDuplicateFound(segment);
23             }
24             SetSegmentFrequency(segment, frequency + 1);
25         }
26
27         [MethodImpl(MethodImplOptions.AggressiveInlining)]
28         protected abstract void OnDuplicateFound(TSegment segment);
29
30         [MethodImpl(MethodImplOptions.AggressiveInlining)]
31         protected abstract long GetSegmentFrequency(TSegment segment);
32
33         [MethodImpl(MethodImplOptions.AggressiveInlining)]
34         protected abstract void SetSegmentFrequency(TSegment segment, long frequency);
35     }
36 }

```

1.29 ./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,
        ↪ Segment<T>>

```

```

6     {
7     }
8 }

```

1.30 ./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)]
18         public static bool DoNotContains<T>(this ISet<T> set, T element) =>
19             ↪ !set.Contains(element);
20     }
21 }

```

1.31 ./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)
28         {
29             _set.Add(element);
30             return true;
31         }
32
33         [MethodImpl(MethodImplOptions.AggressiveInlining)]
34         public bool AddFirstAndReturnTrue(IList<TElement> list)
35         {
36             _set.Add(list[0]);
37             return true;
38         }
39
40         [MethodImpl(MethodImplOptions.AggressiveInlining)]
41         public TReturnConstant AddAndReturnConstant(TElement element)
42         {
43             _set.Add(element);
44             return _returnConstant;
45         }
46
47         [MethodImpl(MethodImplOptions.AggressiveInlining)]
48         public TReturnConstant AddFirstAndReturnConstant(IList<TElement> list)
49         {
50             _set.Add(list[0]);
51             return _returnConstant;
52         }
53     }
54 }

```



```

53     }
54 }

```

1.32 ./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 ./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 ./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 ./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 ./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() :
            ↪ default;
12
13         [MethodImpl(MethodImplOptions.AggressiveInlining)]
14         public static T PeekOrDefault<T>(this Stack<T> stack) => stack.Count > 0 ? stack.Peek()
            ↪ : default;
15     }
16 }

```

1.37 ./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) =>
            ↪ string.IsNullOrEmpty(@string) ? @string : @string.Substring(0,
            ↪ Math.Min(@string.Length, maxLength));
37
38        [MethodImpl(MethodImplOptions.AggressiveInlining)]
39        public static string TrimSingle(this string @string, char charToTrim)
40        {
41            if (!string.IsNullOrEmpty(@string))
42            {
43                if (@string.Length == 1)
44                {
45                    if (@string[0] == charToTrim)
46                    {
47                        return "";
48                    }
49                }
50            }
51            return @string;
52        }
53    }
54 }

```

```

49         else
50         {
51             return @string;
52         }
53     }
54     else
55     {
56         var left = 0;
57         var right = @string.Length - 1;
58         if (@string[left] == charToTrim)
59         {
60             left++;
61         }
62         if (@string[right] == charToTrim)
63         {
64             right--;
65         }
66         return @string.Substring(left, right - left + 1);
67     }
68 }
69 else
70 {
71     return @string;
72 }
73 }
74 }
75 }

```

1.38 ./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
31             {
32                 var child = GetChild(key);
33                 if (child == null)
34                 {
35                     child = AddChild(key);
36                 }
37                 return child;
38             }
39             [MethodImpl(MethodImplOptions.AggressiveInlining)]
40             set => SetChildValue(value, key);
41         }
42
43         [MethodImpl(MethodImplOptions.AggressiveInlining)]
44         public Node(object value) => Value = value;
45
46         [MethodImpl(MethodImplOptions.AggressiveInlining)]
47         public Node() : this(null) { }
48
49         [MethodImpl(MethodImplOptions.AggressiveInlining)]
50         public bool ContainsChild(params object[] keys) => GetChild(keys) != null;
51

```

```

52 [MethodImpl(MethodImplOptions.AggressiveInlining)]
53 public Node GetChild(params object[] keys)
54 {
55     var node = this;
56     for (var i = 0; i < keys.Length; i++)
57     {
58         node.ChildNodes.TryGetValue(keys[i], out node);
59         if (node == null)
60         {
61             return null;
62         }
63     }
64     return node;
65 }
66
67 [MethodImpl(MethodImplOptions.AggressiveInlining)]
68 public object GetChildValue(params object[] keys) => GetChild(keys)?.Value;
69
70 [MethodImpl(MethodImplOptions.AggressiveInlining)]
71 public Node AddChild(object key) => AddChild(key, new Node(null));
72
73 [MethodImpl(MethodImplOptions.AggressiveInlining)]
74 public Node AddChild(object key, object value) => AddChild(key, new Node(value));
75
76 [MethodImpl(MethodImplOptions.AggressiveInlining)]
77 public Node AddChild(object key, Node child)
78 {
79     ChildNodes.Add(key, child);
80     return child;
81 }
82
83 [MethodImpl(MethodImplOptions.AggressiveInlining)]
84 public Node SetChild(params object[] keys) => SetChildValue(null, keys);
85
86 [MethodImpl(MethodImplOptions.AggressiveInlining)]
87 public Node SetChild(object key) => SetChildValue(null, key);
88
89 [MethodImpl(MethodImplOptions.AggressiveInlining)]
90 public Node SetChildValue(object value, params object[] keys)
91 {
92     var node = this;
93     for (var i = 0; i < keys.Length; i++)
94     {
95         node = SetChildValue(value, keys[i]);
96     }
97     node.Value = value;
98     return node;
99 }
100
101 [MethodImpl(MethodImplOptions.AggressiveInlining)]
102 public Node SetChildValue(object value, object key)
103 {
104     if (!ChildNodes.TryGetValue(key, out Node child))
105     {
106         child = AddChild(key, value);
107     }
108     child.Value = value;
109     return child;
110 }
111 }
112 }

```

1.39 ./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
106     [Fact]
107     public static void BitParallelVectorOrTest()
108     {
109         TestToOperationsWithSameMeaning((x, y, w, v) =>
110         {
111             x.ParallelVectorOr(y);
112             w.Or(v);
113         });
114     }
115
116     [Fact]
117     public static void BitVectorXorTest()
118     {
119         TestToOperationsWithSameMeaning((x, y, w, v) =>
120         {
121             x.VectorXor(y);
122             w.Xor(v);
123         });
124     }
125
126     [Fact]
127     public static void BitParallelXorTest()
128     {
129         TestToOperationsWithSameMeaning((x, y, w, v) =>
130         {
131             x.ParallelXor(y);
132             w.Xor(v);
133         });
134     }
135
136     [Fact]
137     public static void BitParallelVectorXorTest()
138     {
139         TestToOperationsWithSameMeaning((x, y, w, v) =>
140         {
141             x.ParallelVectorXor(y);
142             w.Xor(v);
143         });
144     }
145
146     private static void TestToOperationsWithSameMeaning(Action<BitString, BitString,
147     ↪ BitString, BitString> test)
148     {
149         const int n = 5654;
150         var x = new BitString(n);
151         var y = new BitString(n);
152         while (x.Equals(y))
153         {
154             x.SetRandomBits();
155             y.SetRandomBits();
156         }
157         var w = new BitString(x);
158         var v = new BitString(y);
159         Assert.False(x.Equals(y));
160         Assert.False(w.Equals(v));
161         Assert.True(x.Equals(w));
162         Assert.True(y.Equals(v));
163         test(x, y, w, v);
164         Assert.True(x.Equals(w));
165     }
166 }

```

1.40 ./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 first = new CharSegment(testArray, 0, 4);
14             var firstHashCode = first.GetHashCode();
15             var second = new CharSegment(testArray, 5, 4);
16             var secondHashCode = second.GetHashCode();
17             Assert.Equal(firstHashCode, secondHashCode);
18         }
19
20         [Fact]
21         public static void EqualsTest()
22         {
23             const string testString = "test test";
24             var testArray = testString.ToCharArray();
25             var first = new CharSegment(testArray, 0, 4);
26             var second = new CharSegment(testArray, 5, 4);
27             Assert.True(first.Equals(second));
28         }
29     }
30 }

```

1.41 ./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             var source1 = "hello";
11             var result1 = source1.CapitalizeFirstLetter();
12             Assert.Equal("Hello", result1);
13             var source2 = "Hello";
14             var result2 = source2.CapitalizeFirstLetter();
15             Assert.Equal("Hello", result2);
16             var source3 = " hello";
17             var result3 = source3.CapitalizeFirstLetter();
18             Assert.Equal(" Hello", result3);
19         }
20
21         [Fact]
22         public static void TrimSingleTest()
23         {
24             var source1 = "";
25             var result1 = source1.TrimSingle('\\');
26             Assert.Equal("", result1);
27             var source2 = " ";
28             var result2 = source2.TrimSingle('\\');
29             Assert.Equal("", result2);
30             var source3 = "'hello'";
31             var result3 = source3.TrimSingle('\\');
32             Assert.Equal("hello", result3);
33             var source4 = "hello'";
34             var result4 = source4.TrimSingle('\\');
35             Assert.Equal("hello", result4);
36             var source5 = "'hello";
37             var result5 = source5.TrimSingle('\\');
38             Assert.Equal("hello", result5);
39         }
40     }
41 }

```

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