1.1 ./csharp/Platform.Data.Doublets/CriterionMatchers/TargetMatcher.cs

```
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Interfaces;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.CriterionMatchers
{
    /// <summary>
    /// <para>
    /// Represents the target matcher.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksOperatorBase{TLink}"/>
    /// <seealso cref="ICriterionMatcher{TLink}"/>
    public class TargetMatcher<TLink> : LinksOperatorBase<TLink>, ICriterionMatcher<TLink>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;
        private readonly TLink _targetToMatch;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="TargetMatcher"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="targetToMatch">
        /// <para>A target to match.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TargetMatcher(ILinks<TLink> links, TLink targetToMatch) : base(links) =>
        ↪  _targetToMatch = targetToMatch;

        /// <summary>
        /// <para>
        /// Determines whether this instance is matched.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool IsMatched(TLink link) => _equalityComparer.Equals(_links.GetTarget(link),
        ↪  _targetToMatch);
    }
}
```

1.2 ./csharp/Platform.Data.Doublets/Decorators/LinksCascadeUniquenessAndUsagesResolver.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <summary>
    /// <para>
    /// Represents the links cascade uniqueness and usages resolver.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksUniquenessResolver{TLink}"/>
```

```
    public class LinksCascadeUniquenessAndUsagesResolver<TLink> : LinksUniquenessResolver<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksCascadeUniquenessAndUsagesResolver"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksCascadeUniquenessAndUsagesResolver(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Resolves the address change conflict using the specified old link address.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="oldLinkAddress">
        /// <para>The old link address.</para>
        /// <para></para>
        /// </param>
        /// <param name="newLinkAddress">
        /// <para>The new link address.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink ResolveAddressChangeConflict(TLink oldLinkAddress, TLink
        ↪  newLinkAddress, WriteHandler<TLink>? handler)
        {
            var constants = _links.Constants;
            WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
            ↪  handler);
            // Use Facade (the last decorator) to ensure recursion working correctly
            handlerState.Apply(_facade.MergeUsages(oldLinkAddress, newLinkAddress,
            ↪  handlerState.Handler));
            handlerState.Apply(base.ResolveAddressChangeConflict(oldLinkAddress, newLinkAddress,
            ↪  handlerState.Handler));
            return handlerState.Result;
        }
    }
}
```

1.3 ./csharp/Platform.Data.Doublets/Decorators/LinksCascadeUsagesResolver.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <remarks>
    /// <para>Must be used in conjunction with NonNullContentsLinkDeletionResolver.</para>
    /// <para>Должен использоваться вместе с NonNullContentsLinkDeletionResolver.</para>
    /// </remarks>
    public class LinksCascadeUsagesResolver<TLink> : LinksDecoratorBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksCascadeUsagesResolver"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksCascadeUsagesResolver(ILinks<TLink> links) : base(links) { }
```

```

        /// <summary>
        /// <para>
        /// Deletes the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Delete(IList<TLink>? restriction, WriteHandler<TLink> handler)
        {
            var constants = _links.Constants;
            WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
            ↪  handler);
            var linkIndex = restriction[_constants.IndexPart];
            // Use Facade (the last decorator) to ensure recursion working correctly
            handlerState.Apply(_facade.DeleteAllUsages(linkIndex, handlerState.Handler));
            handlerState.Apply(_links.Delete(restriction, handlerState.Handler));
            return handlerState.Result;
        }
    }
}
```

1.4 ./csharp/Platform.Data.Doublets/Decorators/LinksDecoratorBase.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <summary>
    /// <para>
    /// Represents the links decorator base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksOperatorBase{TLink}"/>
    /// <seealso cref="ILinks{TLink}"/>
    public abstract class LinksDecoratorBase<TLink> : LinksOperatorBase<TLink>, ILinks<TLink>
    {
        /// <summary>
        /// <para>
        /// The constants.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly LinksConstants<TLink> _constants;

        /// <summary>
        /// <para>
        /// Gets the constants value.
        /// </para>
        /// <para></para>
        /// </summary>
        public LinksConstants<TLink> Constants
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get => _constants;
        }

        /// <summary>
        /// <para>
        /// The facade.
        /// </para>
        /// <para></para>
        /// </summary>
        protected ILinks<TLink> _facade;

        /// <summary>
        /// <para>
        /// Gets or sets the facade value.
        /// </para>
        /// <para></para>
```

```
        /// </summary>
        public ILinks<TLink> Facade
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get => _facade;
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            set
            {
                _facade = value;
                if (_links is LinksDecoratorBase<TLink> decorator)
                {
                    decorator.Facade = value;
                }
            }
        }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksDecoratorBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected LinksDecoratorBase(ILinks<TLink> links) : base(links)
        {
            _constants = links.Constants;
            Facade = this;
        }

        /// <summary>
        /// <para>
        /// Counts the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public virtual TLink Count(IList<TLink>? restriction) => _links.Count(restriction);

        /// <summary>
        /// <para>
        /// Eaches the handler.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public virtual TLink Each(IList<TLink> restriction, ReadHandler<TLink>? handler) =>
        ↪  _links.Each(restriction, handler);

        /// <summary>
        /// <para>
        /// Creates the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
130         /// <param name="restriction">
131         /// <para>The restriction.</para>
132         /// <para></para>
133         /// </param>
134         /// <returns>
135         /// <para>The link</para>
136         /// <para></para>
137         /// </returns>
138         [MethodImpl(MethodImplOptions.AggressiveInlining)]
139         public virtual TLink Create(IList<TLink> substitution, WriteHandler<TLink> handler) =>
            ↪ _links.Create(substitution, handler);
140
141         /// <summary>
142         /// <para>
143         /// Updates the restriction.
144         /// </para>
145         /// <para></para>
146         /// </summary>
147         /// <param name="restriction">
148         /// <para>The restriction.</para>
149         /// <para></para>
150         /// </param>
151         /// <param name="substitution">
152         /// <para>The substitution.</para>
153         /// <para></para>
154         /// </param>
155         /// <returns>
156         /// <para>The link</para>
157         /// <para></para>
158         /// </returns>
159         [MethodImpl(MethodImplOptions.AggressiveInlining)]
160         public virtual TLink Update(IList<TLink> restriction, IList<TLink> substitution,
            ↪ WriteHandler<TLink> handler) => _links.Update(restriction, substitution, handler);
161
162         /// <summary>
163         /// <para>
164         /// Deletes the restriction.
165         /// </para>
166         /// <para></para>
167         /// </summary>
168         /// <param name="restriction">
169         /// <para>The restriction.</para>
170         /// <para></para>
171         /// </param>
172         [MethodImpl(MethodImplOptions.AggressiveInlining)]
173         public virtual TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler) =>
            ↪ _links.Delete(restriction, handler);
174     }
175 }
```

1.5 ./csharp/Platform.Data.Doublets/Decorators/LinksDisposableDecoratorBase.cs

```
1  using System.Runtime.CompilerServices;
2  using Platform.Disposables;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5  #pragma warning disable CA1063 // Implement IDisposable Correctly
6
7  namespace Platform.Data.Doublets.Decorators
8  {
9      /// <summary>
10     /// <para>
11     /// Represents the links disposable decorator base.
12     /// </para>
13     /// <para></para>
14     /// </summary>
15     /// <seealso cref="LinksDecoratorBase{TLink}"/>
16     /// <seealso cref="ILinks{TLink}"/>
17     /// <seealso cref="System.IDisposable"/>
18     public abstract class LinksDisposableDecoratorBase<TLink> : LinksDecoratorBase<TLink>,
        ↪ ILinks<TLink>, System.IDisposable
19     {
20         /// <summary>
21         /// <para>
22         /// Represents the disposable with multiple calls allowed.
23         /// </para>
24         /// <para></para>
25         /// </summary>
26         /// <seealso cref="Disposable"/>
```

```
        protected class DisposableWithMultipleCallsAllowed : Disposable
        {
            /// <summary>
            /// <para>
            /// Initializes a new <see cref="DisposableWithMultipleCallsAllowed"/> instance.
            /// </para>
            /// <para></para>
            /// </summary>
            /// <param name="disposal">
            /// <para>A disposal.</para>
            /// <para></para>
            /// </param>
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            public DisposableWithMultipleCallsAllowed(Disposal disposal) : base(disposal) { }

            /// <summary>
            /// <para>
            /// Gets the allow multiple dispose calls value.
            /// </para>
            /// <para></para>
            /// </summary>
            protected override bool AllowMultipleDisposeCalls
            {
                [MethodImpl(MethodImplOptions.AggressiveInlining)]
                get => true;
            }
        }

        /// <summary>
        /// <para>
        /// The disposable.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly DisposableWithMultipleCallsAllowed Disposable;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksDisposableDecoratorBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected LinksDisposableDecoratorBase(ILinks<TLink> links) : base(links) => Disposable
        ↪  = new DisposableWithMultipleCallsAllowed(Dispose);

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        ~LinksDisposableDecoratorBase() => Disposable.Destruct();

        /// <summary>
        /// <para>
        /// Disposes this instance.
        /// </para>
        /// <para></para>
        /// </summary>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void Dispose() => Disposable.Dispose();

        /// <summary>
        /// <para>
        /// Disposes the manual.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="manual">
        /// <para>The manual.</para>
        /// <para></para>
        /// </param>
        /// <param name="wasDisposed">
        /// <para>The was disposed.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual void Dispose(bool manual, bool wasDisposed)
```

```
        {
            if (!wasDisposed)
            {
                _links.DisposeIfPossible();
            }
        }
    }
}
```

1.6 ./csharp/Platform.Data.Doublets/Decorators/LinksInnerReferenceExistenceValidator.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    // TODO: Make LinksExternalReferenceValidator. A layer that checks each link to exist or to be external (hybrid link's raw number).
    /// <summary>
    /// <para>
    /// Represents the links inner reference existence validator.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksDecoratorBase{TLink}"/>
    public class LinksInnerReferenceExistenceValidator<TLink> : LinksDecoratorBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksInnerReferenceExistenceValidator"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksInnerReferenceExistenceValidator(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Eaches the handler.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Each(IList<TLink>? restriction, ReadHandler<TLink>? handler)
        {
            var links = _links;
            links.EnsureInnerReferenceExists(restriction, nameof(restriction));
            return links.Each(restriction, handler);
        }

        /// <summary>
        /// <para>
        /// Updates the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
```

```
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Update(IList<TLink> restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler)
        {
            // TODO: Possible values: null, ExistentLink or NonExistentHybrid(ExternalReference)
            var links = _links;
            links.EnsureInnerReferenceExists(restriction, nameof(restriction));
            links.EnsureInnerReferenceExists(substitution, nameof(substitution));
            return links.Update(restriction, substitution, handler);
        }

        /// <summary>
        /// <para>
        /// Deletes the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
        {
            var link = restriction[_constants.IndexPart];
            var links = _links;
            links.EnsureLinkExists(link, nameof(link));
            return links.Delete(restriction, handler);
        }
    }
}
```

1.7 ./csharp/Platform.Data.Doublets/Decorators/LinksItselfConstantToSelfReferenceResolver.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <summary>
    /// <para>
    /// Represents the links itself constant to self reference resolver.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksDecoratorBase{TLink}"/>
    public class LinksItselfConstantToSelfReferenceResolver<TLink> : LinksDecoratorBase<TLink>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksItselfConstantToSelfReferenceResolver"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksItselfConstantToSelfReferenceResolver(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Eaches the handler.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Each(IList<TLink>? restriction, ReadHandler<TLink>? handler)
        {
            var constants = _constants;
            var itselfConstant = constants.Itself;
            if (!_equalityComparer.Equals(constants.Any, itselfConstant) &&
            ↪  restriction.Contains(itselfConstant))
            {
                // Itself constant is not supported for Each method right now, skipping execution
                return constants.Continue;
            }
            return _links.Each(restriction, handler);
        }

        /// <summary>
        /// <para>
        /// Updates the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Update(IList<TLink> restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler) => _links.Update(restriction,
        ↪  _links.ResolveConstantAsSelfReference(_constants.Itself, restriction, substitution),
        ↪  handler);
    }
}
```

1.8 ./csharp/Platform.Data.Doublets/Decorators/LinksNonExistentDependenciesCreator.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <remarks>
    /// Not practical if newSource and newTarget are too big.
    /// To be able to use practical version we should allow to create link at any specific
    ↪  location inside ResizableDirectMemoryLinks.
    /// This in turn will require to implement not a list of empty links, but a list of ranges
    ↪  to store it more efficiently.
    /// </remarks>
    public class LinksNonExistentDependenciesCreator<TLink> : LinksDecoratorBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksNonExistentDependenciesCreator"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksNonExistentDependenciesCreator(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Updates the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Update(IList<TLink>? restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler)
        {
            var constants = _constants;
            var links = _links;
            links.EnsureCreated(substitution[constants.SourcePart],
            ↪  substitution[constants.TargetPart]);
            return links.Update(restriction, substitution, handler);
        }
    }
}
```

1.9 ./csharp/Platform.Data.Doublets/Decorators/LinksNullConstantToSelfReferenceResolver.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <summary>
    /// <para>
    /// Represents the links null constant to self reference resolver.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksDecoratorBase{TLink}"/>
    public class LinksNullConstantToSelfReferenceResolver<TLink> : LinksDecoratorBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksNullConstantToSelfReferenceResolver"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksNullConstantToSelfReferenceResolver(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Creates the substitution.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
```

```
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Create(IList<TLink>? substitution, WriteHandler<TLink> handler)
        {
            return _links.CreatePoint(handler);
        }

        /// <summary>
        /// <para>
        /// Updates the substitution.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Update(IList<TLink> restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler) => _links.Update(restriction,
        ↪  _links.ResolveConstantAsSelfReference(_constants.Null, restriction, substitution),
        ↪  handler);
    }
}
```

1.10 ./csharp/Platform.Data.Doublets/Decorators/LinksUniquenessResolver.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <summary>
    /// <para>
    /// Represents the links uniqueness resolver.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksDecoratorBase{TLink}"/>
    public class LinksUniquenessResolver<TLink> : LinksDecoratorBase<TLink>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksUniquenessResolver"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksUniquenessResolver(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Updates the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
```

```
41          /// <para>The restriction.</para>
42          /// <para></para>
43          /// </param>
44          /// <param name="substitution">
45          /// <para>The substitution.</para>
46          /// <para></para>
47          /// </param>
48          /// <returns>
49          /// <para>The link</para>
50          /// <para></para>
51          /// </returns>
52          [MethodImpl(MethodImplOptions.AggressiveInlining)]
53          public override TLink Update(IList<TLink>? restriction, IList<TLink> substitution,
            ↪ WriteHandler<TLink> handler)
54          {
55              var constants = _constants;
56              var links = _links;
57              var newLinkAddress = links.SearchOrDefault(substitution[constants.SourcePart],
                ↪ substitution[constants.TargetPart]);
58              if (_equalityComparer.Equals(newLinkAddress, default))
59              {
60                  return links.Update(restriction, substitution, handler);
61              }
62              return ResolveAddressChangeConflict(restriction[constants.IndexPart],
                ↪ newLinkAddress, handler);
63          }
64
65          /// <summary>
66          /// <para>
67          /// Resolves the address change conflict using the specified old link address.
68          /// </para>
69          /// <para></para>
70          /// </summary>
71          /// <param name="oldLinkAddress">
72          /// <para>The old link address.</para>
73          /// <para></para>
74          /// </param>
75          /// <param name="newLinkAddress">
76          /// <para>The new link address.</para>
77          /// <para></para>
78          /// </param>
79          /// <returns>
80          /// <para>The new link address.</para>
81          /// <para></para>
82          /// </returns>
83          [MethodImpl(MethodImplOptions.AggressiveInlining)]
84          protected virtual TLink ResolveAddressChangeConflict(TLink oldLinkAddress, TLink
            ↪ newLinkAddress, WriteHandler<TLink> handler)
85          {
86              if (!_equalityComparer.Equals(oldLinkAddress, newLinkAddress) &&
                ↪ _links.Exists(oldLinkAddress))
87              {
88                  return _facade.Delete(oldLinkAddress, handler);
89              }
90              return _links.Constants.Continue;
91          }
92      }
93  }
```

1.11 ./csharp/Platform.Data.Doublets/Decorators/LinksUniquenessValidator.cs

```
1   using System;
2   using System.Collections.Generic;
3   using System.Runtime.CompilerServices;
4   using Platform.Delegates;
5
6   #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
7
8   namespace Platform.Data.Doublets.Decorators
9   {
10      /// <summary>
11      /// <para>
12      /// Represents the links uniqueness validator.
13      /// </para>
14      /// <para></para>
15      /// </summary>
16      /// <seealso cref="LinksDecoratorBase{TLink}"/>
17      public class LinksUniquenessValidator<TLink> : LinksDecoratorBase<TLink>
18      {
```

```
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksUniquenessValidator"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksUniquenessValidator(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Updates the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Update(IList<TLink>? restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler)
        {
            var links = _links;
            var constants = _constants;
            links.EnsureDoesNotExists(substitution[constants.SourcePart],
            ↪  substitution[constants.TargetPart]);
            return links.Update(restriction, substitution, handler);
        }
    }
}
```

1.12 ./csharp/Platform.Data.Doublets/Decorators/LinksUsagesValidator.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <summary>
    /// <para>
    /// Represents the links usages validator.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksDecoratorBase{TLink}"/>
    public class LinksUsagesValidator<TLink> : LinksDecoratorBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksUsagesValidator"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksUsagesValidator(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Updates the restriction.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Update(IList<TLink>? restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler)
        {
            var links = _links;
            links.EnsureNoUsages(restriction[_constants.IndexPart]);
            return links.Update(restriction, substitution, handler);
        }

        /// <summary>
        /// <para>
        /// Deletes the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
        {
            var link = restriction[_constants.IndexPart];
            var links = _links;
            links.EnsureNoUsages(link);
            return links.Delete(restriction, handler);
        }
    }
}
```

1.13 ./csharp/Platform.Data.Doublets/Decorators/LoggingDecorator.cs

```
using System.Collections.Generic;
using System.IO;
using Platform.Delegates;

namespace Platform.Data.Doublets.Decorators
{
    public class LoggingDecorator<TLink> : LinksDecoratorBase<TLink>
    {
        private readonly Stream _logStream;
        private readonly StreamWriter _logStreamWriter;
        public LoggingDecorator(ILinks<TLink> links, Stream logStream) : base(links)
        {
            _logStream = logStream;
            _logStreamWriter = new StreamWriter(_logStream);
            _logStreamWriter.AutoFlush = true;
        }

        public override TLink Create(IList<TLink>? substitution, WriteHandler<TLink> handler)
        {
            WriteHandlerState<TLink> handlerState = new(_constants.Continue, _constants.Break,
            ↪  handler);
            return base.Create(substitution, (before, after) =>
            {
                if (handlerState.Handler != null)
                {
                    handlerState.Apply(handlerState.Handler(before, after));
                }
                _logStreamWriter.WriteLine($"Create. Before: {new Link<TLink>(before)}. After:
                ↪  {new Link<TLink>(after)}");
                return _constants.Continue;
            });
        }

```

```
        public override TLink Update(IList<TLink> restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler)
        {
            WriteHandlerState<TLink> handlerState = new(_constants.Continue, _constants.Break,
            ↪  handler);
            return base.Update(restriction, substitution, (before, after) =>
            {
                if (handlerState.Handler != null)
                {
                    handlerState.Apply(handlerState.Handler(before, after));
                }
                _logStreamWriter.WriteLine($"Update. Before: {new Link<TLink>(before)}. After:
                ↪  {new Link<TLink>(after)}");
                return _constants.Continue;
            });
        }

        public override TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
        {
            WriteHandlerState<TLink> handlerState = new(_constants.Continue, _constants.Break,
            ↪  handler);
            return base.Delete(restriction, (before, after) =>
            {
                if (handlerState.Handler != null)
                {
                    handlerState.Apply(handlerState.Handler(before, after));
                }
                _logStreamWriter.WriteLine($"Delete. Before: {new Link<TLink>(before)}. After:
                ↪  {new Link<TLink>(after)}");
                return _constants.Continue;
            });
        }
    }
}
```

1.14 ./csharp/Platform.Data.Doublets/Decorators/NonNullContentsLinkDeletionResolver.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <summary>
    /// <para>
    /// Represents the non null contents link deletion resolver.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksDecoratorBase{TLink}"/>
    public class NonNullContentsLinkDeletionResolver<TLink> : LinksDecoratorBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="NonNullContentsLinkDeletionResolver"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public NonNullContentsLinkDeletionResolver(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Deletes the restriction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
43          public override TLink Delete(IList<TLink>? restriction, WriteHandler<TLink> handler)
44          {
45              var linkIndex = restriction[_constants.IndexPart];
46              var constants = _links.Constants;
47              WriteHandlerState<TLink> handlerResult = new(constants.Continue, constants.Break,
                ↪  handler);
48              handlerResult.Apply(_links.EnforceResetValues(linkIndex, handlerResult.Handler));
49              handlerResult.Apply(_links.Delete(restriction, handlerResult.Handler));
50              return handlerResult.Result;
51          }
52      }
53  }
```

1.15 ./csharp/Platform.Data.Doublets/Decorators/UInt32Links.cs

```
1   using System;
2   using System.Collections.Generic;
3   using System.Runtime.CompilerServices;
4   using Platform.Delegates;
5   using TLink = System.UInt32;
6
7   #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
8
9   namespace Platform.Data.Doublets.Decorators
10  {
11      /// <summary>
12      /// <para>
13      /// Represents the int 32 links.
14      /// </para>
15      /// <para></para>
16      /// </summary>
17      /// <seealso cref="LinksDisposableDecoratorBase{TLink}"/>
18      public class UInt32Links : LinksDisposableDecoratorBase<TLink>
19      {
20          /// <summary>
21          /// <para>
22          /// Initializes a new <see cref="UInt32Links"/> instance.
23          /// </para>
24          /// <para></para>
25          /// </summary>
26          /// <param name="links">
27          /// <para>A links.</para>
28          /// <para></para>
29          /// </param>
30          [MethodImpl(MethodImplOptions.AggressiveInlining)]
31          public UInt32Links(ILinks<TLink> links) : base(links) { }
32
33          /// <summary>
34          /// <para>
35          /// Creates the substitution.
36          /// </para>
37          /// <para></para>
38          /// </summary>
39          /// <param name="substitution">
40          /// <para>The substitution.</para>
41          /// <para></para>
42          /// </param>
43          /// <returns>
44          /// <para>The link</para>
45          /// <para></para>
46          /// </returns>
47          [MethodImpl(MethodImplOptions.AggressiveInlining)]
48          public override TLink Create(IList<TLink>? substitution, WriteHandler<TLink> handler) =>
            ↪  _links.CreatePoint(handler);
49
50          /// <summary>
51          /// <para>
52          /// Updates the substitution.
53          /// </para>
54          /// <para></para>
55          /// </summary>
56          /// <param name="restriction">
57          /// <para>The substitution.</para>
58          /// <para></para>
59          /// </param>
60          /// <param name="substitution">
61          /// <para>The substitution.</para>
62          /// <para></para>
63          /// </param>
64          /// <returns>
```

```
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Update(IList<TLink> restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler)
        {
            var constants = _constants;
            var indexPartConstant = constants.IndexPart;
            var sourcePartConstant = constants.SourcePart;
            var targetPartConstant = constants.TargetPart;
            var nullConstant = constants.Null;
            var itselfConstant = constants.Itself;
            var existedLink = nullConstant;
            var updatedLink = restriction[indexPartConstant];
            var newSource = substitution[sourcePartConstant];
            var newTarget = substitution[targetPartConstant];
            var links = _links;
            if (newSource != itselfConstant && newTarget != itselfConstant)
            {
                existedLink = links.SearchOrDefault(newSource, newTarget);
            }
            if (existedLink == nullConstant)
            {
                var before = links.GetLink(updatedLink);
                if (before[sourcePartConstant] != newSource || before[targetPartConstant] !=
                ↪  newTarget)
                {
                    var source = newSource == itselfConstant ? updatedLink : newSource;
                    var target = newTarget == itselfConstant ? updatedLink : newTarget;
                    return links.Update(new Link<TLink>(updatedLink, source, target), handler);
                }
                return _links.Constants.Continue;
            }
            else
            {
                return _facade.MergeAndDelete(updatedLink, existedLink, handler);
            }
        }

        /// <summary>
        /// <para>
        /// Deletes the substitution.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
        {
            var linkIndex = restriction[_constants.IndexPart];
            var constants = _links.Constants;
            WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
            ↪  handler);
            handlerState.Apply( _links.EnforceResetValues(linkIndex, handlerState.Handler));
            handlerState.Apply(_facade.DeleteAllUsages(linkIndex, handlerState.Handler));
            handlerState.Apply(_links.Delete(restriction, handlerState.Handler));
            return handlerState.Result;
        }
    }
}
```

1.16 ./csharp/Platform.Data.Doublets/Decorators/UInt64Links.cs

```
using System.Collections.Generic;
using System.Net.Security;
using System.Runtime.CompilerServices;
using Platform.Delegates;
using TLink = System.UInt64;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <summary>
    /// <para>Represents a combined decorator that implements the basic logic for interacting
    ↪  with the links storage for links with addresses represented as <see cref="System.UInt64"
    ↪  />.</para>
```

```
13      /// <para>Представляет комбинированный декоратор, реализующий основную логику по
        ↪  взаимодействии с хранилищем связей, для связей с адресами представленными в виде <see
        ↪  cref="System.UInt64"/>.</para>
14      /// </summary>
15      /// <remarks>
16      /// Возможные оптимизации:
17      /// Объединение в одном поле Source и Target с уменьшением до 32 бит.
18      ///     + меньше объём БД
19      ///     - меньше производительность
20      ///     - больше ограничение на количество связей в БД)
21      /// Ленивое хранение размеров поддеревьев (расчитываемое по мере использования БД)
22      ///     + меньше объём БД
23      ///     - больше сложность
24      ///
25      /// Текущее теоретическое ограничение на индекс связи, из-за использования 5 бит в размере
        ↪  поддеревьев для AVL баланса и флагов нитей: 2 в степени(64 минус 5 равно 59 ) равно 576
        ↪  460 752 303 423 488
26      /// Желательно реализовать поддержку переключения между деревьями и битовыми индексами
        ↪  (битовыми строками) - вариант матрицы (выстраеваемой лениво).
27      ///
28      /// Решить отключать ли проверки при компиляции под Release. T.e. исключения будут
        ↪  выбрасываться только при #if DEBUG
29      /// </remarks>
30      public class UInt64Links : LinksDisposableDecoratorBase<TLink>
31      {
32          /// <summary>
33          /// <para>
34          /// Initializes a new <see cref="UInt64Links"/> instance.
35          /// </para>
36          /// <para></para>
37          /// </summary>
38          /// <param name="links">
39          /// <para>A links.</para>
40          /// <para></para>
41          /// </param>
42          [MethodImpl(MethodImplOptions.AggressiveInlining)]
43          public UInt64Links(ILinks<TLink> links) : base(links) { }
44
45          /// <summary>
46          /// <para>
47          /// Creates the substitution.
48          /// </para>
49          /// <para></para>
50          /// </summary>
51          /// <param name="substitution">
52          /// <para>The substitution.</para>
53          /// <para></para>
54          /// </param>
55          /// <returns>
56          /// <para>The TLink</para>
57          /// <para></para>
58          /// </returns>
59          [MethodImpl(MethodImplOptions.AggressiveInlining)]
60          public override TLink Create(IList<TLink>? substitution, WriteHandler<TLink> handler) =>
            ↪  _links.CreatePoint(handler);
61
62          /// <summary>
63          /// <para>
64          /// Updates the substitution.
65          /// </para>
66          /// <para></para>
67          /// </summary>
68          /// <param name="restriction">
69          /// <para>The substitution.</para>
70          /// <para></para>
71          /// </param>
72          /// <param name="substitution">
73          /// <para>The substitution.</para>
74          /// <para></para>
75          /// </param>
76          /// <returns>
77          /// <para>The TLink</para>
78          /// <para></para>
79          /// </returns>
80          [MethodImpl(MethodImplOptions.AggressiveInlining)]
81          public override TLink Update(IList<TLink> restriction, IList<TLink> substitution,
            ↪  WriteHandler<TLink> handler)
```

```
        {
            var constants = _constants;
            var indexPartConstant = constants.IndexPart;
            var sourcePartConstant = constants.SourcePart;
            var targetPartConstant = constants.TargetPart;
            var nullConstant = constants.Null;
            var itselfConstant = constants.Itself;
            var existedLink = nullConstant;
            var updatedLink = restriction[indexPartConstant];
            var newSource = substitution[sourcePartConstant];
            var newTarget = substitution[targetPartConstant];
            var links = _links;
            if (newSource != itselfConstant && newTarget != itselfConstant)
            {
                existedLink = links.SearchOrDefault(newSource, newTarget);
            }
            if (existedLink == nullConstant)
            {
                var before = links.GetLink(updatedLink);
                if (before[sourcePartConstant] != newSource || before[targetPartConstant] !=
                ↪  newTarget)
                {
                    var source = newSource == itselfConstant ? updatedLink : newSource;
                    var target = newTarget == itselfConstant ? updatedLink : newTarget;
                    return links.Update(new Link<TLink>(updatedLink, source, target), handler);
                }
                return _links.Constants.Continue;
            }
            else
            {
                return _facade.MergeAndDelete(updatedLink, existedLink, handler);
            }
        }

        /// <summary>
        /// <para>
        /// Deletes the substitution.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
        {
            var linkIndex = restriction[_constants.IndexPart];
            var constants = _links.Constants;
            WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
            ↪  handler);
            handlerState.Apply(_links.EnforceResetValues(linkIndex, handlerState.Handler));
            handlerState.Apply(_facade.DeleteAllUsages(linkIndex, handlerState.Handler));
            handlerState.Apply(_links.Delete(restriction, handlerState.Handler));
            return handlerState.Result;
        }
    }
}
```

1.17 ./csharp/Platform.Data.Doublets/Decorators/UniLinks.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using Platform.Collections;
using Platform.Collections.Lists;
using Platform.Data.Universal;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Decorators
{
    /// <remarks>
    /// What does empty pattern (for condition or substitution) mean? Nothing or Everything?
    /// Now we go with nothing. And nothing is something one, but empty, and cannot be changed
    ↪  by itself. But can cause creation (update from nothing) or deletion (update to nothing).
    ///
    /// TODO: Decide to change to IDoubletLinks or not to change. (Better to create
    ↪  DefaultUniLinksBase, that contains logic itself and can be implemented using both
    ↪  IDoubletLinks and ILinks.)
```

```
18      /// </remarks>
19      internal class UniLinks<TLink> : LinksDecoratorBase<TLink>, IUniLinks<TLink>
20      {
21          private static readonly EqualityComparer<TLink> _equalityComparer =
            ↪  EqualityComparer<TLink>.Default;
22
23          /// <summary>
24          /// <para>
25          /// Initializes a new <see cref="UniLinks"/> instance.
26          /// </para>
27          /// <para></para>
28          /// </summary>
29          /// <param name="links">
30          /// <para>A links.</para>
31          /// <para></para>
32          /// </param>
33          public UniLinks(ILinks<TLink> links) : base(links) { }
34          private struct Transition
35          {
36              /// <summary>
37              /// <para>
38              /// The before.
39              /// </para>
40              /// <para></para>
41              /// </summary>
42              public IList<TLink>? Before;
43              /// <summary>
44              /// <para>
45              /// The after.
46              /// </para>
47              /// <para></para>
48              /// </summary>
49              public IList<TLink> After;
50
51              /// <summary>
52              /// <para>
53              /// Initializes a new <see cref="Transition"/> instance.
54              /// </para>
55              /// <para></para>
56              /// </summary>
57              /// <param name="before">
58              /// <para>A before.</para>
59              /// <para></para>
60              /// </param>
61              /// <param name="after">
62              /// <para>A after.</para>
63              /// <para></para>
64              /// </param>
65              public Transition(IList<TLink> before, IList<TLink> after)
66              {
67                  Before = before;
68                  After = after;
69              }
70          }
71
72          //public static readonly TLink NullConstant = Use<LinksConstants<TLink>>.Single.Null;
73          //public static readonly IReadOnlyList<TLink> NullLink = new
            ↪  ReadOnlyCollection<TLink>(new List<TLink> { NullConstant, NullConstant, NullConstant
            ↪  });
74
75          // TODO: Подумать о том, как реализовать древовидный Restriction и Substitution
            ↪  (Links-Expression)
76          /// <summary>
77          /// <para>
78          /// Triggers the restriction.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="restriction">
83          /// <para>The restriction.</para>
84          /// <para></para>
85          /// </param>
86          /// <param name="matchedHandler">
87          /// <para>The matched handler.</para>
88          /// <para></para>
89          /// </param>
90          /// <param name="substitution">
91          /// <para>The substitution.</para>
```

```
92          /// <para></para>
93          /// </param>
94          /// <param name="substitutedHandler">
95          /// <para>The substituted handler.</para>
96          /// <para></para>
97          /// </param>
98          /// <returns>
99          /// <para>The link</para>
100         /// <para></para>
101         /// </returns>
102         public TLink Trigger(IList<TLink> restriction, WriteHandler<TLink> matchedHandler,
            ↪ IList<TLink> substitution, WriteHandler<TLink> substitutedHandler)
103         {
104             ////List<Transition> transitions = null;
105             ////if (!restriction.IsNullOrEmpty())
106             ////{
107             ////    // Есть причина делать проход (чтение)
108             ////    if (matchedHandler != null)
109             ////    {
110             ////        if (!substitution.IsNullOrEmpty())
111             ////        {
112             ////            // restriction => { 0, 0, 0 } | { 0 } // Create
113             ////            // substitution => { itself, 0, 0 } | { itself, itself, itself } //
                ↪ Create / Update
114             ////            // substitution => { 0, 0, 0 } | { 0 } // Delete
115             ////            transitions = new List<Transition>();
116             ////            if (Equals(substitution[Constants.IndexPart], Constants.Null))
117             ////            {
118             ////                // If index is Null, that means we always ignore every other
                ↪ value (they are also Null by definition)
119             ////                var matchDecision = matchedHandler(, NullLink);
120             ////                if (Equals(matchDecision, Constants.Break))
121             ////                    return false;
122             ////                if (!Equals(matchDecision, Constants.Skip))
123             ////                    transitions.Add(new Transition(matchedLink, newValue));
124             ////            }
125             ////            else
126             ////            {
127             ////                Func<T, bool> handler;
128             ////                handler = link =>
129             ////                {
130             ////                    var matchedLink = Memory.GetLinkValue(link);
131             ////                    var newValue = Memory.GetLinkValue(link);
132             ////                    newValue[Constants.IndexPart] = Constants.Itself;
133             ////                    newValue[Constants.SourcePart] =
                ↪ Equals(substitution[Constants.SourcePart], Constants.Itself) ?
                ↪ matchedLink[Constants.IndexPart] : substitution[Constants.SourcePart];
134             ////                    newValue[Constants.TargetPart] =
                ↪ Equals(substitution[Constants.TargetPart], Constants.Itself) ?
                ↪ matchedLink[Constants.IndexPart] : substitution[Constants.TargetPart];
135             ////                    var matchDecision = matchedHandler(matchedLink, newValue);
136             ////                    if (Equals(matchDecision, Constants.Break))
137             ////                        return false;
138             ////                    if (!Equals(matchDecision, Constants.Skip))
139             ////                        transitions.Add(new Transition(matchedLink, newValue));
140             ////                    return true;
141             ////                };
142             ////                if (!Memory.Each(handler, restriction))
143             ////                    return Constants.Break;
144             ////            }
145             ////        }
146             ////        else
147             ////        {
148             ////            Func<T, bool> handler = link =>
149             ////            {
150             ////                var matchedLink = Memory.GetLinkValue(link);
151             ////                var matchDecision = matchedHandler(matchedLink, matchedLink);
152             ////                return !Equals(matchDecision, Constants.Break);
153             ////            };
154             ////            if (!Memory.Each(handler, restriction))
155             ////                return Constants.Break;
156             ////        }
157             ////    }
158             ////    else
159             ////    {
160             ////        if (substitution != null)
161             ////        {
```

```
162             ////            transitions = new List<IList<T>>();
163             ////            Func<T, bool> handler = link =>
164             ////            {
165             ////                var matchedLink = Memory.GetLinkValue(link);
166             ////                transitions.Add(matchedLink);
167             ////                return true;
168             ////            };
169             ////            if (!Memory.Each(handler, restriction))
170             ////                return Constants.Break;
171             ////        }
172             ////        else
173             ////        {
174             ////            return Constants.Continue;
175             ////        }
176             ////    }
177             ////}
178             ////if (substitution != null)
179             ////{
180             ////    // Есть причина делать замену (запись)
181             ////    if (substitutedHandler != null)
182             ////    {
183             ////    }
184             ////    else
185             ////    {
186             ////    }
187             ////}
188             ////return Constants.Continue;
189
190             //if (restriction.IsNullOrEmpty()) // Create
191             //{
192             //    substitution[Constants.IndexPart] = Memory.AllocateLink();
193             //    Memory.SetLinkValue(substitution);
194             //}
195             //else if (substitution.IsNullOrEmpty()) // Delete
196             //{
197             //    Memory.FreeLink(restriction[Constants.IndexPart]);
198             //}
199             //else if (restriction.EqualTo(substitution)) // Read or ("repeat" the state) // Each
200             //{
201             //    // No need to collect links to list
202             //    // Skip == Continue
203             //    // No need to check substituedHandler
204             //    if (!Memory.Each(link => !Equals(matchedHandler(Memory.GetLinkValue(link)),
                ↪  Constants.Break), restriction))
205             //        return Constants.Break;
206             //}
207             //else // Update
208             //{
209             //    //List<IList<T>> matchedLinks = null;
210             //    if (matchedHandler != null)
211             //    {
212             //        matchedLinks = new List<IList<T>>();
213             //        Func<T, bool> handler = link =>
214             //        {
215             //            var matchedLink = Memory.GetLinkValue(link);
216             //            var matchDecision = matchedHandler(matchedLink);
217             //            if (Equals(matchDecision, Constants.Break))
218             //                return false;
219             //            if (!Equals(matchDecision, Constants.Skip))
220             //                matchedLinks.Add(matchedLink);
221             //            return true;
222             //        };
223             //        if (!Memory.Each(handler, restriction))
224             //            return Constants.Break;
225             //    }
226             //    if (!matchedLinks.IsNullOrEmpty())
227             //    {
228             //        var totalMatchedLinks = matchedLinks.Count;
229             //        for (var i = 0; i < totalMatchedLinks; i++)
230             //        {
231             //            var matchedLink = matchedLinks[i];
232             //            if (substitutedHandler != null)
233             //            {
234             //                var newValue = new List<T>(); // TODO: Prepare value to update here
235             //                // TODO: Decide is it actually needed to use Before and After
                ↪  substitution handling.
236             //                var substitutedDecision = substitutedHandler(matchedLink,
                ↪  newValue);
```

```
            //                if (Equals(substitutedDecision, Constants.Break))
            //                    return Constants.Break;
            //                if (Equals(substitutedDecision, Constants.Continue))
            //                {
            //                    // Actual update here
            //                    Memory.SetLinkValue(newValue);
            //                }
            //                if (Equals(substitutedDecision, Constants.Skip))
            //                {
            //                    // Cancel the update. TODO: decide use separate Cancel constant or Skip is enough?
            //                }
            //            }
            //        }
            //    }
            //}
            return _constants.Continue;
        }

        /// <summary>
        /// <para>
        /// Triggers the pattern or condition.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="patternOrCondition">
        /// <para>The pattern or condition.</para>
        /// <para></para>
        /// </param>
        /// <param name="matchHandler">
        /// <para>The match handler.</para>
        /// <para></para>
        /// </param>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <param name="substitutionHandler">
        /// <para>The substitution handler.</para>
        /// <para></para>
        /// </param>
        /// <exception cref="NotImplementedException">
        /// <para></para>
        /// <para></para>
        /// </exception>
        /// <exception cref="NotSupportedException">
        /// <para></para>
        /// <para></para>
        /// </exception>
        /// <exception cref="NotSupportedException">
        /// <para></para>
        /// <para></para>
        /// </exception>
        /// <exception cref="NotSupportedException">
        /// <para></para>
        /// <para></para>
        /// </exception>
        /// <exception cref="NotSupportedException">
        /// <para></para>
        /// <para></para>
        /// </exception>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        public TLink Trigger(IList<TLink> patternOrCondition, ReadHandler<TLink>? matchHandler, IList<TLink> substitution, WriteHandler<TLink> substitutionHandler)
        {
            var constants = _constants;
            if (patternOrCondition.IsNullOrEmpty() && substitution.IsNullOrEmpty())
            {
                return constants.Continue;
            }
            else if (patternOrCondition.EqualTo(substitution)) // Should be Each here TODO: Check if it is a correct condition
            {
                // Or it only applies to trigger without matchHandler.
                throw new NotImplementedException();
```

```
312                 }
313                 else if (!substitution.IsNullOrEmpty()) // Creation
314                 {
315                     var before = Array.Empty<TLink>();
316                     // Что должно означать False здесь? Остановиться (перестать идти) или пропустить
                        ↪  (пройти мимо) или пустить (взять)?
317                     if (matchHandler != null && _equalityComparer.Equals(matchHandler(before),
                        ↪  constants.Break))
318                     {
319                         return constants.Break;
320                     }
321                     var after = (IList<TLink>)substitution.ToArray();
322                     if (_equalityComparer.Equals(after[0], default))
323                     {
324                         var newLink = _links.Create();
325                         after[0] = newLink;
326                     }
327                     if (substitution.Count == 1)
328                     {
329                         after = _links.GetLink(substitution[0]);
330                     }
331                     else if (substitution.Count == 3)
332                     {
333                         //Links.Create(after);
334                     }
335                     else
336                     {
337                         throw new NotSupportedException();
338                     }
339                     return matchHandler != null ? substitutionHandler(before, after) :
                        ↪  constants.Continue;
340                 }
341                 else if (!patternOrCondition.IsNullOrEmpty()) // Deletion
342                 {
343                     if (patternOrCondition.Count == 1)
344                     {
345                         var linkToDelete = patternOrCondition[0];
346                         var before = _links.GetLink(linkToDelete);
347                         if (matchHandler != null && _equalityComparer.Equals(matchHandler(before),
                            ↪  constants.Break))
348                         {
349                             return constants.Break;
350                         }
351                         var after = Array.Empty<TLink>();
352                         _links.Update(linkToDelete, constants.Null, constants.Null);
353                         _links.Delete(linkToDelete);
354                         return matchHandler != null ? substitutionHandler(before, after) :
                            ↪  constants.Continue;
355                     }
356                     else
357                     {
358                         throw new NotSupportedException();
359                     }
360                 }
361                 else // Replace / Update
362                 {
363                     if (patternOrCondition.Count == 1) //-V3125
364                     {
365                         var linkToUpdate = patternOrCondition[0];
366                         var before = _links.GetLink(linkToUpdate);
367                         if (matchHandler != null && _equalityComparer.Equals(matchHandler(before),
                            ↪  constants.Break))
368                         {
369                             return constants.Break;
370                         }
371                         var after = (IList<TLink>)substitution.ToArray(); //-V3125
372                         if (_equalityComparer.Equals(after[0], default))
373                         {
374                             after[0] = linkToUpdate;
375                         }
376                         if (substitution.Count == 1)
377                         {
378                             if (!_equalityComparer.Equals(substitution[0], linkToUpdate))
379                             {
380                                 after = _links.GetLink(substitution[0]);
381                                 _links.Update(linkToUpdate, constants.Null, constants.Null);
382                                 _links.Delete(linkToUpdate);
383                             }
```

```
                    }
                    else if (substitution.Count == 3)
                    {
                        //Links.Update(after);
                    }
                    else
                    {
                        throw new NotSupportedException();
                    }
                    return matchHandler != null ? substitutionHandler(before, after) :
                    ↪  constants.Continue;
                }
                else
                {
                    throw new NotSupportedException();
                }
            }
        }

        /// <remarks>
        /// IList[IList[IList[T]]]
        /// |      |      |      |||
        /// |      |      |       ------ ||
        /// |      |      |        link  ||
        /// |      |       -------------  |
        /// |      |          change      |
        ///  --------------------
        ///         changes
        /// </remarks>
        public IList<IList<IList<TLink>>> Trigger(IList<TLink> condition, IList<TLink>
        ↪  substitution)
        {
            var changes = new List<IList<IList<TLink>>>();
            var @continue = _constants.Continue;
            Trigger(condition, AlwaysContinue, substitution, (before, after) =>
            {
                var change = new[] { before, after };
                changes.Add(change);
                return @continue;
            });
            return changes;
        }
        private TLink AlwaysContinue(IList<TLink> linkToMatch) => _constants.Continue;
    }
}
```

1.18 ./csharp/Platform.Data.Doublets/Doublet.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets
{

    /// <summury>
    /// <para>.</para>
    /// <para>.</para>
    /// </summury>
    /// <typeparam>
    /// <para>.</para>
    /// <para>.</para>
    /// </typeparam>
    public struct Doublet<T> : IEquatable<Doublet<T>>
    {
        private static readonly EqualityComparer<T> _equalityComparer =
        ↪  EqualityComparer<T>.Default;

        /// <summury>
        /// <para>.</para>
        /// <para>.</para>
        /// </summury>
        /// <typeparam name="T">
        /// <para>.</para>
        /// <para>.</para>
        /// </typeparam>
        public readonly T Source;

```

```
        /// <summury>
        /// <para>.</para>
        /// <para>.</para>
        /// </summury>
        /// <typeparam name="T">
        /// <para>.</para>
        /// <para>.</para>
        /// </typeparam>
        public readonly T Target;

        /// <summury>
        /// <para>.</para>
        /// <para>.</para>
        /// </summury>
        /// <typeparam name="T">
        /// <para>.</para>
        /// <para>.</para>
        /// </typeparam>
        /// <param name="source">
        /// <para>.</para>
        /// <para>.</para>
        /// </param>
        /// <param name="target">
        /// <para>.</para>
        /// <para>.</para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public Doublet(T source, T target)
        {
            Source = source;
            Target = target;
        }

        /// <summury>
        /// <para>.</para>
        /// <para>.</para>
        /// </summury>
        /// <returns>
        /// <para>.</para>
        /// <para>.</para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override string ToString() => $"{Source}->{Target}";

        /// <summury>
        /// <para>.</para>
        /// <para>.</para>
        /// </summury>
        /// <typeparam>
        /// <para>.</para>
        /// <para>.</para>
        /// </typeparam>
        /// <param name="other">
        /// <para>.</para>
        /// <para>.</para>
        /// </param>
        /// <returns>
        /// <para>.</para>
        /// <para>.</para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool Equals(Doublet<T> other) => _equalityComparer.Equals(Source, other.Source)
        ↪  && _equalityComparer.Equals(Target, other.Target);

        /// <summury>
        /// <para>.</para>
        /// <para>.</para>
        /// </summury>
        /// <typeparam>
        /// <para>.</para>
        /// <para>.</para>
        /// </typeparam>
        /// <param name="obj">
        /// <para>.</para>
        /// <para>.</para>
        /// </param>
        /// <returns>
        /// <para>.</para>
```

```
109         /// <para>.</para>
110         /// </returns>
111         [MethodImpl(MethodImplOptions.AggressiveInlining)]
112         public override bool Equals(object obj) => obj is Doublet<T> doublet ?
            ↪  base.Equals(doublet) : false;
113 
114         /// <summury>
115         /// <para>.</para>
116         /// <para>.</para>
117         /// </summury>
118         /// <returns>
119         /// <para>.</para>
120         /// <para>.</para>
121         /// </returns>
122         [MethodImpl(MethodImplOptions.AggressiveInlining)]
123         public override int GetHashCode() => (Source, Target).GetHashCode();
124 
125         /// <summury>
126         /// <para>.</para>
127         /// <para>.</para>
128         /// </summury>
129         /// <param name="left">
130         /// <para>.</para>
131         /// <para>.</para>
132         /// </param>
133         /// <param name="right">
134         /// <para>.</para>
135         /// <para>.</para>
136         /// </param>
137         /// <returns>
138         /// <para>.</para>
139         /// <para>.</para>
140         /// </returns>
141         [MethodImpl(MethodImplOptions.AggressiveInlining)]
142         public static bool operator ==(Doublet<T> left, Doublet<T> right) => left.Equals(right);
143 
144         /// <summury>
145         /// <para>.</para>
146         /// <para>.</para>
147         /// </summury>
148         /// <param name="left">
149         /// <para>.</para>
150         /// <para>.</para>
151         /// </param>
152         /// <param name="right">
153         /// <para>.</para>
154         /// <para>.</para>
155         /// </param>
156         /// <returns>
157         /// <para>.</para>
158         /// <para>.</para>
159         /// </returns>
160         [MethodImpl(MethodImplOptions.AggressiveInlining)]
161         public static bool operator !=(Doublet<T> left, Doublet<T> right) => !(left == right);
162     }
163 }
```

1.19 ./csharp/Platform.Data.Doublets/DoubletComparer.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.Data.Doublets
7  {
8      /// <remarks>
9      /// TODO: Может стоит попробовать ref во всех методах (IRefEqualityComparer)
10     /// 2x faster with comparer
11     /// </remarks>
12     public class DoubletComparer<T> : IEqualityComparer<Doublet<T>>
13     {
14         /// <summary>
15         /// <para>
16         /// The .
17         /// </para>
18         /// <para></para>
19         /// </summary>
20         public static readonly DoubletComparer<T> Default = new DoubletComparer<T>();
```

```

        /// <summary>
        /// <para>
        /// Determines whether this instance equals.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="x">
        /// <para>The .</para>
        /// <para></para>
        /// </param>
        /// <param name="y">
        /// <para>The .</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool Equals(Doublet<T> x, Doublet<T> y) => x.Equals(y);

        /// <summary>
        /// <para>
        /// Gets the hash code using the specified obj.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="obj">
        /// <para>The obj.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The int</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public int GetHashCode(Doublet<T> obj) => obj.GetHashCode();
    }
}
```

1.20 ./csharp/Platform.Data.Doublets/FFI/UInt32UnitedMemoryLinks.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Runtime.InteropServices;
using Platform.Converters;
using Platform.Delegates;
using Platform.Disposables;

namespace Platform.Data.Doublets.FFI
{
    using TLink = System.UInt32;

    public class UInt32UnitedMemoryLinks : DisposableBase, ILinks<TLink>
    {
        public LinksConstants<TLink> Constants { get; }

        private readonly unsafe void* _ptr;

        public UInt32UnitedMemoryLinks(string path)
        {
            unsafe
            {
                _ptr = Methods.UInt32UnitedMemoryLinks_New(path);

                // TODO: Update api
                Constants = new LinksConstants<TLink>(enableExternalReferencesSupport: true);
            }
        }

        public TLink Count(IList<TLink>? restriction)
        {
            unsafe
            {
                var array = stackalloc uint[restriction.Count];
                for (var i = 0; i < restriction.Count; i++)
                {
                    array[i] = restriction[i];
```

```
38                  }
39                  return Methods.UInt32UnitedMemoryLinks_Count(_ptr, array,
                    ↪  (nuint)(restriction?.Count ?? 0));
40              }
41          }
42
43          public TLink Each(IList<TLink> restriction, ReadHandler<TLink>? handler)
44          {
45              unsafe
46              {
47                  Methods.EachCallback_UInt32 callback = (link) => handler?.Invoke(new
                    ↪  Link<TLink>(link.Index, link.Source, link.Target)) ?? Constants.Continue;
48                  var array = stackalloc uint[restriction.Count];
49                  for (var i = 0; i < restriction.Count; i++)
50                  {
51                      array[i] = restriction[i];
52                  }
53                  return Methods.UInt32UnitedMemoryLinks_Each(_ptr, array,
                    ↪  (nuint)(restriction?.Count ?? 0), callback);
54              }
55          }
56
57          public TLink Create(IList<TLink> substitution, WriteHandler<TLink> handler)
58          {
59              unsafe
60              {
61                  Methods.CreateCallback_UInt32 callback = (before, after) => handler != null ?
                    ↪  handler(new Link<TLink>(before.Index, before.Source, before.Target), new
                    ↪  Link<TLink>(after.Index, after.Source, after.Target)) : Constants.Continue;
62                  fixed (uint* substitutionPtr = (uint[])substitution)
63                  {
64                      return Methods.UInt32UnitedMemoryLinks_Create(_ptr, substitutionPtr,
                        ↪  (nuint)(substitution?.Count ?? 0), callback);
65                  }
66              }
67          }
68
69          public TLink Update(IList<TLink> restriction, IList<TLink> substitution,
            ↪  WriteHandler<TLink> handler)
70          {
71              unsafe
72              {
73                  var restrictionArray = stackalloc uint[restriction.Count];
74                  for (var i = 0; i < restriction.Count; i++)
75                  {
76                      restrictionArray[i] = restriction[i];
77                  }
78                  var substitutionArray = stackalloc uint[substitution.Count];
79                  for (var i = 0; i < restriction.Count; i++)
80                  {
81                      substitutionArray[i] = restriction[i];
82                  }
83                  Methods.UpdateCallback_UInt32 callback = (before, after) => handler?.Invoke(new
                    ↪  Link<TLink>(before.Index, before.Source, before.Target), new
                    ↪  Link<TLink>(after.Index, after.Source, after.Target)) ?? Constants.Continue;
84                  return Methods.UInt32UnitedMemoryLinks_Update(_ptr, restrictionArray,
                    ↪  (nuint)(restriction?.Count ?? 0), substitutionArray,
                    ↪  (nuint)(substitution?.Count ?? 0), callback);
85              }
86          }
87
88          public TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
89          {
90              unsafe
91              {
92                  var restrictionArray = stackalloc uint[restriction.Count];
93                  for (var i = 0; i < restriction.Count; i++)
94                  {
95                      restrictionArray[i] = restriction[i];
96                  }
97                  Methods.DeleteCallback_UInt32 callback = (before, after) => handler?.Invoke(new
                    ↪  Link<TLink>(before.Index, before.Source, before.Target), new
                    ↪  Link<TLink>(after.Index, after.Source, after.Target)) ?? Constants.Continue;
98                  return Methods.UInt32UnitedMemoryLinks_Delete(_ptr, restrictionArray,
                    ↪  (nuint)(restriction?.Count ?? 0), callback);
99              }
100         }
```

```
101
102         protected override void Dispose(bool manual, bool wasDisposed)
103         {
104             unsafe
105             {
106                 if (wasDisposed || _ptr == null)
107                 {
108                     return;
109                 }
110                 Methods.UInt32UnitedMemoryLinks_Drop(_ptr);
111             }
112         }
113     }
114 }
```

1.21 ./csharp/Platform.Data.Doublets/FFI/UnitedMemoryLinks.cs

```
1  using System;
2  using System.Collections.Generic;
3  using System.Linq;
4  using System.Runtime.InteropServices;
5  using Platform.Converters;
6  using Platform.Delegates;
7  using Platform.Disposables;
8
9  namespace Platform.Data.Doublets.FFI
10 {
11     struct FfiLink_UInt8
12     {
13         public Byte Index;
14         public Byte Source;
15         public Byte Target;
16     }
17
18     struct FfiLink_UInt16
19     {
20         public UInt16 Index;
21         public UInt16 Source;
22         public UInt16 Target;
23     }
24
25     struct FfiLink_UInt32
26     {
27         public UInt32 Index;
28         public UInt32 Source;
29         public UInt32 Target;
30     }
31
32     struct FfiLink_UInt64
33     {
34         public UInt64 Index;
35         public UInt64 Source;
36         public UInt64 Target;
37     }
38
39     unsafe static class Methods
40     {
41         private const string DllName = "Platform.Doublets";
42
43         [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
44         public delegate Byte EachCallback_UInt8(FfiLink_UInt8 link);
45
46         [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
47         public delegate UInt16 EachCallback_UInt16(FfiLink_UInt16 link);
48
49         [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
50         public delegate UInt32 EachCallback_UInt32(FfiLink_UInt32 link);
51
52         [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
53         public delegate UInt64 EachCallback_UInt64(FfiLink_UInt64 link);
54
55         [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
56         public delegate Byte CreateCallback_UInt8(FfiLink_UInt8 before, FfiLink_UInt8 after);
57
58         [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
59         public delegate UInt16 CreateCallback_UInt16(FfiLink_UInt16 before, FfiLink_UInt16
           ↪  after);
60
61         [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
62         public delegate UInt32 CreateCallback_UInt32(FfiLink_UInt32 before, FfiLink_UInt32
           ↪  after);
63
```

```
64          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
65          public delegate UInt64 CreateCallback_UInt64(FfiLink_UInt64 before, FfiLink_UInt64
            ↪  after);
66
67          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
68          public delegate Byte UpdateCallback_UInt8(FfiLink_UInt8 before, FfiLink_UInt8 after);
69
70          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
71          public delegate UInt16 UpdateCallback_UInt16(FfiLink_UInt16 before, FfiLink_UInt16
            ↪  after);
72
73          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
74          public delegate UInt32 UpdateCallback_UInt32(FfiLink_UInt32 before, FfiLink_UInt32
            ↪  after);
75
76          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
77          public delegate UInt64 UpdateCallback_UInt64(FfiLink_UInt64 before, FfiLink_UInt64
            ↪  after);
78
79          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
80          public delegate Byte DeleteCallback_UInt8(FfiLink_UInt8 before, FfiLink_UInt8 after);
81
82          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
83          public delegate UInt16 DeleteCallback_UInt16(FfiLink_UInt16 before, FfiLink_UInt16
            ↪  after);
84
85          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
86          public delegate UInt32 DeleteCallback_UInt32(FfiLink_UInt32 before, FfiLink_UInt32
            ↪  after);
87
88          [UnmanagedFunctionPointer(CallingConvention.Cdecl)]
89          public delegate UInt64 DeleteCallback_UInt64(FfiLink_UInt64 before, FfiLink_UInt64
            ↪  after);
90
91          [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
92          public static extern void* ByteUnitedMemoryLinks_New(string path);
93
94          [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
95          public static extern void* UInt16UnitedMemoryLinks_New(string path);
96
97          [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
98          public static extern void* UInt32UnitedMemoryLinks_New(string path);
99
100         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
101         public static extern void* UInt64UnitedMemoryLinks_New(string path);
102
103         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
104         public static extern void ByteUnitedMemoryLinks_Drop(void* self);
105
106         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
107         public static extern void UInt16UnitedMemoryLinks_Drop(void* self);
108
109         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
110         public static extern void UInt32UnitedMemoryLinks_Drop(void* self);
111
112         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
113         public static extern void UInt64UnitedMemoryLinks_Drop(void* self);
114
115         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
116         public static extern byte ByteUnitedMemoryLinks_Create(void* self, byte* substitution,
            ↪  nuint substitutionLength, CreateCallback_UInt8 callback);
117
118         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
119         public static extern ushort UInt16UnitedMemoryLinks_Create(void* self, ushort*
            ↪  substitution, nuint substitutionLength, CreateCallback_UInt16 callback);
120
121         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
122         public static extern uint UInt32UnitedMemoryLinks_Create(void* self, uint* substitution,
            ↪  nuint substitutionLength, CreateCallback_UInt32 callback);
123
124         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
125         public static extern ulong UInt64UnitedMemoryLinks_Create(void* self, ulong*
            ↪  substitution, nuint substitutionLength, CreateCallback_UInt64 callback);
126
127         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
128         public static extern byte ByteUnitedMemoryLinks_Count(void* self, byte* restriction,
            ↪  nuint len);
129
```

```
130         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
131         public static extern ushort UInt16UnitedMemoryLinks_Count(void* self, ushort*
            ↪  restriction, nuint len);
132
133         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
134         public static extern uint UInt32UnitedMemoryLinks_Count(void* self, uint* restriction,
            ↪  nuint len);
135
136         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
137         public static extern ulong UInt64UnitedMemoryLinks_Count(void* self, ulong* restriction,
            ↪  nuint len);
138
139         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
140         public static extern byte ByteUnitedMemoryLinks_Each(void* self, byte* restriction,
            ↪  nuint len, EachCallback_UInt8 callback);
141
142         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
143         public static extern ushort UInt16UnitedMemoryLinks_Each(void* self, ushort*
            ↪  restriction, nuint len, EachCallback_UInt16 callback);
144
145         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
146         public static extern uint UInt32UnitedMemoryLinks_Each(void* self, uint* restriction,
            ↪  nuint len, EachCallback_UInt32 callback);
147
148         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
149         public static extern ulong UInt64UnitedMemoryLinks_Each(void* self, ulong* restriction,
            ↪  nuint len, EachCallback_UInt64 callback);
150
151         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
152         public static extern byte ByteUnitedMemoryLinks_Update(void* self, byte* restriction,
            ↪  nuint restrictionLength,  byte* substitution, nuint substitutionLength,
            ↪  UpdateCallback_UInt8 callback);
153
154         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
155         public static extern ushort UInt16UnitedMemoryLinks_Update(void* self, ushort*
            ↪  restriction, nuint restrictionLength,  ushort* substitution, nuint
            ↪  substitutionLength, UpdateCallback_UInt16 callback);
156
157         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
158         public static extern uint UInt32UnitedMemoryLinks_Update(void* self, uint* restriction,
            ↪  nuint restrictionLength,  uint* substitution, nuint substitutionLength,
            ↪  UpdateCallback_UInt32 callback);
159
160         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
161         public static extern ulong UInt64UnitedMemoryLinks_Update(void* self, ulong*
            ↪  restriction, nuint restrictionLength,  ulong* substitution, nuint
            ↪  substitutionLength, UpdateCallback_UInt64 callback);
162
163         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
164         public static extern byte ByteUnitedMemoryLinks_Delete(void* self, byte* restriction,
            ↪  nuint restrictionLength, DeleteCallback_UInt8 callback);
165
166         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
167         public static extern ushort UInt16UnitedMemoryLinks_Delete(void* self, ushort*
            ↪  restriction, nuint len, DeleteCallback_UInt16 callback);
168
169         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
170         public static extern uint UInt32UnitedMemoryLinks_Delete(void* self, uint* restriction,
            ↪  nuint len, DeleteCallback_UInt32 callback);
171
172         [DllImport(DllName, CallingConvention = CallingConvention.Cdecl)]
173         public static extern ulong UInt64UnitedMemoryLinks_Delete(void* self, ulong*
            ↪  restriction, nuint len, DeleteCallback_UInt64 callback);
174     }
175
176     public class UnitedMemoryLinks<TLink> : DisposableBase, ILinks<TLink>
177     {
178         private static readonly UncheckedConverter<byte, TLink> from_u8 =
            ↪  UncheckedConverter<byte, TLink>.Default;
179         private static readonly UncheckedConverter<ushort, TLink> from_u16 =
            ↪  UncheckedConverter<ushort, TLink>.Default;
180         private static readonly UncheckedConverter<uint, TLink> from_u32 =
            ↪  UncheckedConverter<uint, TLink>.Default;
181         private static readonly UncheckedConverter<ulong, TLink> from_u64 =
            ↪  UncheckedConverter<ulong, TLink>.Default;
182         private static readonly UncheckedConverter<TLink, ulong> from_t =
            ↪  UncheckedConverter<TLink, ulong>.Default;
183
```

```
184         public LinksConstants<TLink> Constants { get; }
185
186         private readonly unsafe void* _ptr;
187
188         public UnitedMemoryLinks(string path)
189         {
190             TLink t = default;
191             unsafe
192             {
193                 _ptr = t switch
194                 {
195                     byte => Methods.ByteUnitedMemoryLinks_New(path),
196                     ushort => Methods.UInt16UnitedMemoryLinks_New(path),
197                     uint => Methods.UInt32UnitedMemoryLinks_New(path),
198                     ulong => Methods.UInt64UnitedMemoryLinks_New(path),
199                     _ => throw new NotImplementedException()
200                 };
201
202                 // TODO: Update api
203                 Constants = new LinksConstants<TLink>(enableExternalReferencesSupport: true);
204             }
205         }
206
207         public TLink Count(IList<TLink>? restriction)
208         {
209             var restrictionLength = restriction?.Count ?? 0;
210             unsafe
211             {
212                 TLink t = default;
213                 switch (t)
214                 {
215                     case byte:
216                     {
217                         var restrictionArray = stackalloc byte[restrictionLength];
218                         var byteRestrictionArray = (IList<byte>)restriction;
219                         for (var i = 0; i < restrictionLength; i++)
220                         {
221                             restrictionArray[i] = byteRestrictionArray[i];
222                         }
223                         return from_u8.Convert(Methods.ByteUnitedMemoryLinks_Count(_ptr,
                            ↪  restrictionArray, (nuint)restrictionLength));
224                     }
225                     case ushort:
226                     {
227                         var restrictionArray = stackalloc ushort[restrictionLength];
228                         var ushortRestrictionArray = (IList<ushort>)restriction;
229                         for (var i = 0; i < restrictionLength; i++)
230                         {
231                             restrictionArray[i] = ushortRestrictionArray[i];
232                         }
233                         return from_u16.Convert(Methods.UInt16UnitedMemoryLinks_Count(_ptr,
                            ↪  restrictionArray, (nuint)restrictionLength));
234                     }
235                     case uint:
236                     {
237                         var restrictionArray = stackalloc uint[restrictionLength];
238                         var uintRestrictionArray = (IList<uint>)restriction;
239                         for (var i = 0; i < restrictionLength; i++)
240                         {
241                             restrictionArray[i] = uintRestrictionArray[i];
242                         }
243                         return from_u32.Convert(Methods.UInt32UnitedMemoryLinks_Count(_ptr,
                            ↪  restrictionArray, (nuint)restrictionLength));
244                     }
245                     case ulong:
246                     {
247                         {
248                             var restrictionArray = stackalloc ulong[restrictionLength];
249                             var ulongRestrictionArray = (IList<ulong>)restriction;
250                             for (var i = 0; i < restrictionLength; i++)
251                             {
252                                 restrictionArray[i] = ulongRestrictionArray[i];
253                             }
254                             return from_u64.Convert(Methods.UInt64UnitedMemoryLinks_Count(_ptr,
                                ↪  restrictionArray, (nuint)restrictionLength));
255                         }
256                     }
257                     default:
258                     {
```

```
259                         throw new NotImplementedException();
260                     }
261                 }
262             }
263         }
264 
265         public TLink Each(IList<TLink> restriction, ReadHandler<TLink>? handler)
266         {
267             var restrictionLength = restriction?.Count ?? 0;
268             unsafe
269             {
270                 TLink t = default;
271                 switch (t)
272                 {
273                     case byte:
274                     {
275                         byte Callback(FfiLink_UInt8 link) => (byte)from_t.Convert(handler !=
                            ↪  null ? handler(new Link<TLink>(from_u8.Convert(link.Index),
                            ↪  from_u8.Convert(link.Source), from_u8.Convert(link.Target))) :
                            ↪  Constants.Continue);
276                         var restrictionArray = stackalloc byte[restrictionLength];
277                         var byteRestrictionArray = (IList<byte>)restriction;
278                         for (var i = 0; i < restrictionLength; i++)
279                         {
280                             restrictionArray[i] = byteRestrictionArray[i];
281                         }
282                         return from_u8.Convert(Methods.ByteUnitedMemoryLinks_Each(_ptr,
                            ↪  restrictionArray, (nuint)restrictionLength, Callback));
283                     }
284                     case ushort:
285                     {
286                         ushort Callback(FfiLink_UInt16 link) => (ushort)from_t.Convert(handler
                            ↪  != null ? handler(new Link<TLink>(from_u16.Convert(link.Index),
                            ↪  from_u16.Convert(link.Source), from_u16.Convert(link.Target))) :
                            ↪  Constants.Continue);
287                         var restrictionArray = stackalloc ushort[restrictionLength];
288                         var ushortRestrictionArray = (IList<ushort>)restriction;
289                         for (var i = 0; i < restrictionLength; i++)
290                         {
291                             restrictionArray[i] = ushortRestrictionArray[i];
292                         }
293                         return from_u16.Convert(Methods.UInt16UnitedMemoryLinks_Each(_ptr,
                            ↪  restrictionArray, (nuint)restrictionLength, Callback));
294                     }
295                     case uint:
296                     {
297                         uint Callback(FfiLink_UInt32 link) => (uint)from_t.Convert(handler !=
                            ↪  null ? handler(new Link<TLink>(from_u32.Convert(link.Index),
                            ↪  from_u32.Convert(link.Source), from_u32.Convert(link.Target))) :
                            ↪  Constants.Continue);
298                         var restrictionArray = stackalloc uint[restrictionLength];
299                         var uintRestrictionArray = (IList<uint>)restriction;
300                         for (var i = 0; i < restrictionLength; i++)
301                         {
302                             restrictionArray[i] = uintRestrictionArray[i];
303                         }
304                         return from_u32.Convert(Methods.UInt32UnitedMemoryLinks_Each(_ptr,
                            ↪  restrictionArray, (nuint)restrictionLength, Callback));
305                     }
306                     case ulong:
307                     {
308                         {
309                             ulong Callback(FfiLink_UInt64 link) => from_t.Convert(handler !=
                                ↪  null ? handler(new Link<TLink>(from_u64.Convert(link.Index),
                                ↪  from_u64.Convert(link.Source), from_u64.Convert(link.Target))) :
                                ↪  Constants.Continue);
310                             var restrictionArray = stackalloc UInt64[restrictionLength];
311                             var ulongRestrictionArray = (IList<ulong>)restriction;
312                             for (var i = 0; i < restrictionLength; i++)
313                             {
314                                 restrictionArray[i] = ulongRestrictionArray[i];
315                             }
316                             return from_u64.Convert(Methods.UInt64UnitedMemoryLinks_Each(_ptr,
                                ↪  restrictionArray, (nuint)restrictionLength, Callback));
317                         }
318                     }
319                     default:
320                     {
```

```
                    throw new NotImplementedException();
                }
            }
        }
    }

    public TLink Create(IList<TLink> substitution, WriteHandler<TLink> handler)
    {
        var substitutionLength = substitution?.Count ?? 0;
        unsafe
        {
            TLink t = default;
            switch (t)
            {
                case byte:
                {
                    byte Callback(FfiLink_UInt8 before, FfiLink_UInt8 after) =>
                        (byte)from_t.Convert(handler != null ? handler(new
                        Link<TLink>(from_u8.Convert(before.Index),
                        from_u8.Convert(before.Source), from_u8.Convert(before.Target)), new
                        Link<TLink>(from_u8.Convert(after.Index),
                        from_u8.Convert(after.Source), from_u8.Convert(after.Target))) :
                        Constants.Continue);
                    var substitutionArray = stackalloc byte[substitutionLength];
                    var byteSubstitutionArray = (IList<byte>)substitution;
                    for (var i = 0; i < substitutionLength; i++)
                    {
                        substitutionArray[i] = byteSubstitutionArray[i];
                    }
                    return from_u8.Convert(Methods.ByteUnitedMemoryLinks_Create(_ptr,
                        substitutionArray, (nuint)(substitution?.Count ?? 0), Callback));
                }
                case ushort:
                {
                    ushort Callback(FfiLink_UInt16 before, FfiLink_UInt16 after) =>
                        (ushort)from_t.Convert(handler != null ? handler(new
                        Link<TLink>(from_u16.Convert(before.Index),
                        from_u16.Convert(before.Source), from_u16.Convert(before.Target)),
                        new Link<TLink>(from_u16.Convert(after.Index),
                        from_u16.Convert(after.Source), from_u16.Convert(after.Target))) :
                        Constants.Continue);
                    var substitutionArray = stackalloc ushort[substitutionLength];
                    var ushortSubstitutionArray = (IList<ushort>)substitution;
                    for (var i = 0; i < substitutionLength; i++)
                    {
                        substitutionArray[i] = ushortSubstitutionArray[i];
                    }
                    return from_u16.Convert(Methods.UInt16UnitedMemoryLinks_Create(_ptr,
                        substitutionArray, (nuint)(substitution?.Count ?? 0), Callback));
                }
                case uint:
                {
                    uint Callback(FfiLink_UInt32 before, FfiLink_UInt32 after) =>
                        (uint)from_t.Convert(handler != null ? handler(new
                        Link<TLink>(from_u32.Convert(before.Index),
                        from_u32.Convert(before.Source), from_u32.Convert(before.Target)),
                        new Link<TLink>(from_u32.Convert(after.Index),
                        from_u32.Convert(after.Source), from_u32.Convert(after.Target))) :
                        Constants.Continue);
                    var substitutionArray = stackalloc uint[substitutionLength];
                    var uintSubstitutionArray = (IList<uint>)substitution;
                    for (var i = 0; i < substitutionLength; i++)
                    {
                        substitutionArray[i] = uintSubstitutionArray[i];
                    }
                    return from_u32.Convert(Methods.UInt32UnitedMemoryLinks_Create(_ptr,
                        substitutionArray, (nuint)(substitution?.Count ?? 0), Callback));

                }
                case ulong:
                {
                    ulong Callback(FfiLink_UInt64 before, FfiLink_UInt64 after) =>
                        (ulong)from_t.Convert(handler != null ? handler(new
                        Link<TLink>(from_u64.Convert(before.Index),
                        from_u64.Convert(before.Source), from_u64.Convert(before.Target)),
                        new Link<TLink>(from_u64.Convert(after.Index),
                        from_u64.Convert(after.Source), from_u64.Convert(after.Target))) :
                        Constants.Continue);
```

```
372                         var substitutionArray = stackalloc ulong[substitutionLength];
373                         var ulongSubstitutionArray = (IList<ulong>)substitution;
374                         for (var i = 0; i < substitutionLength; i++)
375                         {
376                             substitutionArray[i] = ulongSubstitutionArray[i];
377                         }
378                         return from_u64.Convert(Methods.UInt64UnitedMemoryLinks_Create(_ptr,
                            ↪  substitutionArray, (nuint)(substitution?.Count ?? 0), Callback));
379
380                     }
381                     default:
382                     {
383                         throw new NotImplementedException();
384                     }
385                 };
386             }
387         }
388
389         public TLink Update(IList<TLink> restriction, IList<TLink> substitution,
            ↪  WriteHandler<TLink> handler)
390         {
391             var restrictionLength = restriction?.Count ?? 0;
392             var substitutionLength = substitution?.Count ?? 0;
393             unsafe
394             {
395                 TLink t = default;
396                 switch (t)
397                 {
398                     case byte:
399                     {
400                         var restrictionArray = stackalloc byte[restrictionLength];
401                         var byteRestrictionArray = (IList<byte>)restriction;
402                         for (var i = 0; i < restrictionLength; i++)
403                         {
404                             restrictionArray[i] = byteRestrictionArray[i];
405                         }
406                         var substitutionArray = stackalloc byte[substitutionLength];
407                         var byteSubstitutionArray = (IList<byte>)substitution;
408                         for (var i = 0; i < substitutionLength; i++)
409                         {
410                             substitutionArray[i] = byteSubstitutionArray[i];
411                         }
412                         byte Callback(FfiLink_UInt8 before, FfiLink_UInt8 after) =>
                            ↪  (byte)from_t.Convert(handler != null ? handler(new
                            ↪  Link<TLink>(from_u8.Convert(before.Index),
                            ↪  from_u8.Convert(before.Source), from_u8.Convert(before.Target)), new
                            ↪  Link<TLink>(from_u8.Convert(after.Index),
                            ↪  from_u8.Convert(after.Source), from_u8.Convert(after.Target))) :
                            ↪  Constants.Continue);
413                         return from_u8.Convert(Methods.ByteUnitedMemoryLinks_Update(_ptr,
                            ↪  restrictionArray, (nuint)restrictionLength, substitutionArray,
                            ↪  (nuint)(substitution?.Count ?? 0), Callback));
414                     }
415                     case ushort:
416                     {
417                         var restrictionArray = stackalloc ushort[restrictionLength];
418                         var ushortRestrictionArray = (IList<ushort>)restriction;
419                         for (var i = 0; i < restrictionLength; i++)
420                         {
421                             restrictionArray[i] = ushortRestrictionArray[i];
422                         }
423                         var substitutionArray = stackalloc ushort[substitutionLength];
424                         var ushortSubstitutionArray = (IList<ushort>)substitution;
425                         for (var i = 0; i < substitutionLength; i++)
426                         {
427                             substitutionArray[i] = ushortSubstitutionArray[i];
428                         }
429                         ushort Callback(FfiLink_UInt16 before, FfiLink_UInt16 after) =>
                            ↪  (ushort)from_t.Convert(handler != null ? handler(new
                            ↪  Link<TLink>(from_u16.Convert(before.Index),
                            ↪  from_u16.Convert(before.Source), from_u16.Convert(before.Target)),
                            ↪  new Link<TLink>(from_u16.Convert(after.Index),
                            ↪  from_u16.Convert(after.Source), from_u16.Convert(after.Target))) :
                            ↪  Constants.Continue);
430                         return from_u16.Convert(Methods.UInt16UnitedMemoryLinks_Update(_ptr,
                            ↪  restrictionArray, (nuint)restrictionLength, substitutionArray,
                            ↪  (nuint)(substitution?.Count ?? 0), Callback));
431                     }
```

```
                    case uint:
                    {
                        var restrictionArray = stackalloc uint[restrictionLength];
                        var uintRestrictionArray = (IList<uint>)restriction;
                        for (var i = 0; i < restrictionLength; i++)
                        {
                            restrictionArray[i] = uintRestrictionArray[i];
                        }
                        var substitutionArray = stackalloc uint[substitutionLength];
                        var uintSubstitutionArray = (IList<uint>)substitution;
                        for (var i = 0; i < substitutionLength; i++)
                        {
                            substitutionArray[i] = uintSubstitutionArray[i];
                        }
                        uint Callback(FfiLink_UInt32 before, FfiLink_UInt32 after) =>
                            (uint)from_t.Convert(handler != null ? handler(new
                            Link<TLink>(from_u32.Convert(before.Index),
                            from_u32.Convert(before.Source), from_u32.Convert(before.Target)),
                            new Link<TLink>(from_u32.Convert(after.Index),
                            from_u32.Convert(after.Source), from_u32.Convert(after.Target))) :
                            Constants.Continue);
                        return from_u32.Convert(Methods.UInt32UnitedMemoryLinks_Update(_ptr,
                            restrictionArray, (nuint)restrictionLength, substitutionArray,
                            (nuint)(substitution?.Count ?? 0), Callback));
                    }
                    case ulong:
                    {
                        var restrictionArray = stackalloc ulong[restrictionLength];
                        var ulongRestrictionArray = (IList<ulong>)restriction;
                        for (var i = 0; i < restrictionLength; i++)
                        {
                            restrictionArray[i] = ulongRestrictionArray[i];
                        }
                        var substitutionArray = stackalloc ulong[substitutionLength];
                        var ulongSubstitutionArray = (IList<ulong>)substitution;
                        for (var i = 0; i < substitutionLength; i++)
                        {
                            substitutionArray[i] = ulongSubstitutionArray[i];
                        }
                        ulong Callback(FfiLink_UInt64 before, FfiLink_UInt64 after) =>
                            (ulong)from_t.Convert(handler != null ? handler(new
                            Link<TLink>(from_u64.Convert(before.Index),
                            from_u64.Convert(before.Source), from_u64.Convert(before.Target)),
                            new Link<TLink>(from_u64.Convert(after.Index),
                            from_u64.Convert(after.Source), from_u64.Convert(after.Target))) :
                            Constants.Continue);
                        return from_u64.Convert(Methods.UInt64UnitedMemoryLinks_Update(_ptr,
                            restrictionArray, (nuint)restrictionLength, substitutionArray,
                            (nuint)(substitution?.Count ?? 0), Callback));
                    }
                    default:
                    {
                        throw new NotImplementedException();
                    }
                }
            }
        }

        public TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
        {
            var restrictionLength = restriction?.Count ?? 0;
            unsafe
            {
                TLink t = default;
                switch (t)
                {
                    case byte:
                    {
                        var restrictionArray = stackalloc byte[restrictionLength];
                        var byteRestrictionArray = (IList<byte>)restriction;
                        for (var i = 0; i < restrictionLength; i++)
                        {
                            restrictionArray[i] = byteRestrictionArray[i];
                        }
```

```
490                         byte Callback(FfiLink_UInt8 before, FfiLink_UInt8 after) =>
                                ↪ (byte)from_t.Convert(handler != null ? handler(new
                                ↪ Link<TLink>(from_u8.Convert(before.Index),
                                ↪ from_u8.Convert(before.Source), from_u8.Convert(before.Target)), new
                                ↪ Link<TLink>(from_u8.Convert(after.Index),
                                ↪ from_u8.Convert(after.Source), from_u8.Convert(after.Target))) :
                                ↪ Constants.Continue);
491                         return (TLink)(object)Methods.ByteUnitedMemoryLinks_Delete(_ptr,
                                ↪ restrictionArray, (nuint)restrictionLength, Callback);
492                     }
493                     case ushort:
494                     {
495                         var restrictionArray = stackalloc ushort[restrictionLength];
496                         var ushortRestrictionArray = (IList<ushort>)restriction;
497                         for (var i = 0; i < restrictionLength; i++)
498                         {
499                             restrictionArray[i] = ushortRestrictionArray[i];
500                         }
501                         ushort Callback(FfiLink_UInt16 before, FfiLink_UInt16 after) =>
                                ↪ (ushort)from_t.Convert(handler != null ? handler(new
                                ↪ Link<TLink>(from_u16.Convert(before.Index),
                                ↪ from_u16.Convert(before.Source), from_u16.Convert(before.Target)),
                                ↪ new Link<TLink>(from_u16.Convert(after.Index),
                                ↪ from_u16.Convert(after.Source), from_u16.Convert(after.Target))) :
                                ↪ Constants.Continue);
502                         return (TLink)(object)Methods.UInt16UnitedMemoryLinks_Delete(_ptr,
                                ↪ restrictionArray, (nuint)restrictionLength, Callback);
503                     }
504                     case uint:
505                     {
506                         var restrictionArray = stackalloc uint[restrictionLength];
507                         var uintRestrictionArray = (IList<uint>)restriction;
508                         for (var i = 0; i < restrictionLength; i++)
509                         {
510                             restrictionArray[i] = uintRestrictionArray[i];
511                         }
512                         uint Callback(FfiLink_UInt32 before, FfiLink_UInt32 after) =>
                                ↪ (uint)from_t.Convert(handler != null ? handler(new
                                ↪ Link<TLink>(from_u32.Convert(before.Index),
                                ↪ from_u32.Convert(before.Source), from_u32.Convert(before.Target)),
                                ↪ new Link<TLink>(from_u32.Convert(after.Index),
                                ↪ from_u32.Convert(after.Source), from_u32.Convert(after.Target))) :
                                ↪ Constants.Continue);
513                         return (TLink)(object)Methods.UInt32UnitedMemoryLinks_Delete(_ptr,
                                ↪ restrictionArray, (nuint)restrictionLength, Callback);
514                     }
515                     case ulong:
516                     {
517                         var restrictionArray = stackalloc ulong[restrictionLength];
518                         var ulongRestrictionArray = (IList<ulong>)restriction;
519                         for (var i = 0; i < restrictionLength; i++)
520                         {
521                             restrictionArray[i] = ulongRestrictionArray[i];
522                         }
523                         ulong Callback(FfiLink_UInt64 before, FfiLink_UInt64 after) =>
                                ↪ (ulong)from_t.Convert(handler != null ? handler(new
                                ↪ Link<TLink>(from_u64.Convert(before.Index),
                                ↪ from_u64.Convert(before.Source), from_u64.Convert(before.Target)),
                                ↪ new Link<TLink>(from_u64.Convert(after.Index),
                                ↪ from_u64.Convert(after.Source), from_u64.Convert(after.Target))) :
                                ↪ Constants.Continue);
524                         return (TLink)(object)Methods.UInt64UnitedMemoryLinks_Delete(_ptr,
                                ↪ restrictionArray, (nuint)restrictionLength, Callback);
525                     }
526                     default:
527                     {
528                         throw new NotImplementedException();
529                     }
530                 }
531             }
532         }
533
534         protected override void Dispose(bool manual, bool wasDisposed)
535         {
536             unsafe
537             {
538                 if (wasDisposed && _ptr != null)
539                 {
```

```
                    return;
                }
                TLink t = default;
                switch (t)
                    {
                        case byte:
                            Methods.ByteUnitedMemoryLinks_Drop(_ptr);
                            break;
                        case ushort:
                            Methods.UInt16UnitedMemoryLinks_Drop(_ptr);
                            break;
                        case uint:
                            Methods.UInt32UnitedMemoryLinks_Drop(_ptr);
                            break;
                        case ulong:
                            Methods.UInt64UnitedMemoryLinks_Drop(_ptr);
                            break;
                        default:
                            throw new NotImplementedException();
                    }
            }
        }
    }
}
```

1.22 ./csharp/Platform.Data.Doublets/ILinks.cs

```
#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

using System.Collections.Generic;

namespace Platform.Data.Doublets
{
    /// <summary>
    /// <para>
    /// Defines the links.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="ILinks{TLink, LinksConstants{TLink}}"/>
    public interface ILinks<TLink> : ILinks<TLink, LinksConstants<TLink>>
    {
    }
}
```

1.23 ./csharp/Platform.Data.Doublets/ILinksExtensions.cs

```
using System;
using System.Collections;
using System.Collections.Generic;
using System.Linq;
using System.Runtime.CompilerServices;
using Platform.Ranges;
using Platform.Collections.Lists;
using Platform.Random;
using Platform.Setters;
using Platform.Converters;
using Platform.Numbers;
using Platform.Data.Exceptions;
using Platform.Data.Doublets.Decorators;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets
{
    /// <summary>
    /// <para>
    /// Represents the links extensions.
    /// </para>
    /// <para></para>
    /// </summary>
    public static class ILinksExtensions
    {
        /// <summary>
        /// <para>
        /// Runs the random creations using the specified links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <typeparam name="TLink">
        /// <para>The link.</para>
```

```
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="amountOfCreations">
        /// <para>The amount of creations.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static void RunRandomCreations<TLink>(this ILinks<TLink> links, ulong
        ↪  amountOfCreations)
        {
            var random = RandomHelpers.Default;
            var addressToUInt64Converter = UncheckedConverter<TLink, ulong>.Default;
            var uInt64ToAddressConverter = UncheckedConverter<ulong, TLink>.Default;
            for (var i = 0UL; i < amountOfCreations; i++)
            {
                var linksAddressRange = new Range<ulong>(0,
                ↪  addressToUInt64Converter.Convert(links.Count()));
                var source =
                ↪  uInt64ToAddressConverter.Convert(random.NextUInt64(linksAddressRange));
                var target =
                ↪  uInt64ToAddressConverter.Convert(random.NextUInt64(linksAddressRange));
                links.GetOrCreate(source, target);
            }
        }

        /// <summary>
        /// <para>
        /// Runs the random searches using the specified links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <typeparam name="TLink">
        /// <para>The link.</para>
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="amountOfSearches">
        /// <para>The amount of searches.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static void RunRandomSearches<TLink>(this ILinks<TLink> links, ulong
        ↪  amountOfSearches)
        {
            var random = RandomHelpers.Default;
            var addressToUInt64Converter = UncheckedConverter<TLink, ulong>.Default;
            var uInt64ToAddressConverter = UncheckedConverter<ulong, TLink>.Default;
            for (var i = 0UL; i < amountOfSearches; i++)
            {
                var linksAddressRange = new Range<ulong>(0,
                ↪  addressToUInt64Converter.Convert(links.Count()));
                var source =
                ↪  uInt64ToAddressConverter.Convert(random.NextUInt64(linksAddressRange));
                var target =
                ↪  uInt64ToAddressConverter.Convert(random.NextUInt64(linksAddressRange));
                links.SearchOrDefault(source, target);
            }
        }

        /// <summary>
        /// <para>
        /// Runs the random deletions using the specified links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <typeparam name="TLink">
        /// <para>The link.</para>
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
```

```
        /// <para></para>
        /// </param>
        /// <param name="amountOfDeletions">
        /// <para>The amount of deletions.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static void RunRandomDeletions<TLink>(this ILinks<TLink> links, ulong
        ↪  amountOfDeletions)
        {
            var random = RandomHelpers.Default;
            var addressToUInt64Converter = UncheckedConverter<TLink, ulong>.Default;
            var uInt64ToAddressConverter = UncheckedConverter<ulong, TLink>.Default;
            var linksCount = addressToUInt64Converter.Convert(links.Count());
            var min = amountOfDeletions > linksCount ? OUL : linksCount - amountOfDeletions;
            for (var i = OUL; i < amountOfDeletions; i++)
            {
                linksCount = addressToUInt64Converter.Convert(links.Count());
                if (linksCount <= min)
                {
                    break;
                }
                var linksAddressRange = new Range<ulong>(min, linksCount);
                var link =
                ↪  uInt64ToAddressConverter.Convert(random.NextUInt64(linksAddressRange));
                links.Delete(link);
            }
        }

        /// <summary>
        /// <para>
        /// Deletes the links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <typeparam name="TLink">
        /// <para>The link.</para>
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="linkToDelete">
        /// <para>The link to delete.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static TLink Delete<TLink>(this ILinks<TLink> links, TLink linkToDelete,
        ↪  WriteHandler<TLink>? handler)
        {
            if (links.Exists(linkToDelete))
            {
                links.EnforceResetValues(linkToDelete, handler);
            }
            return links.Delete(new LinkAddress<TLink>(linkToDelete), handler);
        }

        /// <remarks>
        /// TODO: Возможно есть очень простой способ это сделать.
        /// (Например просто удалить файл, или изменить его размер таким образом,
        /// чтобы удалился весь контент)
        /// Например через _header->AllocatedLinks в ResizableDirectMemoryLinks
        /// </remarks>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static void DeleteAll<TLink>(this ILinks<TLink> links)
        {
            var equalityComparer = EqualityComparer<TLink>.Default;
            var comparer = Comparer<TLink>.Default;
            for (var i = links.Count(); comparer.Compare(i, default) > 0; i =
            ↪  Arithmetic.Decrement(i))
            {
                links.Delete(i);
                if (!equalityComparer.Equals(links.Count(), Arithmetic.Decrement(i)))
                {
                    i = links.Count();
                }
            }
```

```
180         }
181
182         /// <summary>
183         /// <para>
184         /// Firsts the links.
185         /// </para>
186         /// <para></para>
187         /// </summary>
188         /// <typeparam name="TLink">
189         /// <para>The link.</para>
190         /// <para></para>
191         /// </typeparam>
192         /// <param name="links">
193         /// <para>The links.</para>
194         /// <para></para>
195         /// </param>
196         /// <exception cref="InvalidOperationException">
197         /// <para>В процессе поиска по хранилищу не было найдено связей.</para>
198         /// <para></para>
199         /// </exception>
200         /// <exception cref="InvalidOperationException">
201         /// <para>В хранилище нет связей.</para>
202         /// <para></para>
203         /// </exception>
204         /// <returns>
205         /// <para>The first link.</para>
206         /// <para></para>
207         /// </returns>
208         [MethodImpl(MethodImplOptions.AggressiveInlining)]
209         public static TLink First<TLink>(this ILinks<TLink> links)
210         {
211             TLink firstLink = default;
212             var equalityComparer = EqualityComparer<TLink>.Default;
213             if (equalityComparer.Equals(links.Count(), default))
214             {
215                 throw new InvalidOperationException("В хранилище нет связей.");
216             }
217             links.Each(links.Constants.Any, links.Constants.Any, link =>
218             {
219                 firstLink = link[links.Constants.IndexPart];
220                 return links.Constants.Break;
221             });
222             if (equalityComparer.Equals(firstLink, default))
223             {
224                 throw new InvalidOperationException("В процессе поиска по хранилищу не было
                    ↪  найдено связей.");
225             }
226             return firstLink;
227         }
228
229         /// <summary>
230         /// <para>
231         /// Singles the or default using the specified links.
232         /// </para>
233         /// <para></para>
234         /// </summary>
235         /// <typeparam name="TLink">
236         /// <para>The link.</para>
237         /// <para></para>
238         /// </typeparam>
239         /// <param name="links">
240         /// <para>The links.</para>
241         /// <para></para>
242         /// </param>
243         /// <param name="query">
244         /// <para>The query.</para>
245         /// <para></para>
246         /// </param>
247         /// <returns>
248         /// <para>The result.</para>
249         /// <para></para>
250         /// </returns>
251         [MethodImpl(MethodImplOptions.AggressiveInlining)]
252         public static IList<TLink> SingleOrDefault<TLink>(this ILinks<TLink> links, IList<TLink>
            ↪  query)
253         {
254             IList<TLink> result = null;
255             var count = 0;
```

```
256             var constants = links.Constants;
257             var @continue = constants.Continue;
258             var @break = constants.Break;
259             links.Each(query, linkHandler);
260             return result;
261 
262             TLink linkHandler(IList<TLink> link)
263             {
264                 if (count == 0)
265                 {
266                     result = link;
267                     count++;
268                     return @continue;
269                 }
270                 else
271                 {
272                     result = null;
273                     return @break;
274                 }
275             }
276         }
277 
278         #region Paths
279 
280         /// <remarks>
281         /// TODO: Как так? Как то что ниже может быть корректно?
282         /// Скорее всего практически не применимо
283         /// Предполагалось, что можно было конвертировать формируемый в проходе через
            ↪ SequenceWalker
284         /// Stack в конкретный путь из Source, Target до связи, но это не всегда так.
285         /// TODO: Возможно нужен метод, который именно выбрасывает исключения (EnsurePathExists)
286         /// </remarks>
287         [MethodImpl(MethodImplOptions.AggressiveInlining)]
288         public static bool CheckPathExistance<TLink>(this ILinks<TLink> links, params TLink[]
            ↪ path)
289         {
290             var current = path[0];
291             //EnsureLinkExists(current, "path");
292             if (!links.Exists(current))
293             {
294                 return false;
295             }
296             var equalityComparer = EqualityComparer<TLink>.Default;
297             var constants = links.Constants;
298             for (var i = 1; i < path.Length; i++)
299             {
300                 var next = path[i];
301                 var values = links.GetLink(current);
302                 var source = values[constants.SourcePart];
303                 var target = values[constants.TargetPart];
304                 if (equalityComparer.Equals(source, target) && equalityComparer.Equals(source,
                    ↪ next))
305                 {
306                     //throw new InvalidOperationException(string.Format("Невозможно выбрать
                        ↪ путь, так как и Source и Target совпадают с элементом пути {0}.", next));
307                     return false;
308                 }
309                 if (!equalityComparer.Equals(next, source) && !equalityComparer.Equals(next,
                    ↪ target))
310                 {
311                     //throw new InvalidOperationException(string.Format("Невозможно продолжить
                        ↪ путь через элемент пути {0}", next));
312                     return false;
313                 }
314                 current = next;
315             }
316             return true;
317         }
318 
319         /// <remarks>
320         /// Может потребовать дополнительного стека для PathElement's при использовании
            ↪ SequenceWalker.
321         /// </remarks>
322         [MethodImpl(MethodImplOptions.AggressiveInlining)]
323         public static TLink GetByKeys<TLink>(this ILinks<TLink> links, TLink root, params int[]
            ↪ path)
324         {
325             links.EnsureLinkExists(root, "root");
326             var currentLink = root;
```

```
            for (var i = 0; i < path.Length; i++)
            {
                currentLink = links.GetLink(currentLink)[path[i]];
            }
            return currentLink;
        }

        /// <summary>
        /// <para>
        /// Gets the square matrix sequence element by index using the specified links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <typeparam name="TLink">
        /// <para>The link.</para>
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="root">
        /// <para>The root.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        /// <param name="index">
        /// <para>The index.</para>
        /// <para></para>
        /// </param>
        /// <exception cref="ArgumentOutOfRangeException">
        /// <para>Sequences with sizes other than powers of two are not supported.</para>
        /// <para></para>
        /// </exception>
        /// <returns>
        /// <para>The current link.</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static TLink GetSquareMatrixSequenceElementByIndex<TLink>(this ILinks<TLink>
        ↪  links, TLink root, ulong size, ulong index)
        {
            var constants = links.Constants;
            var source = constants.SourcePart;
            var target = constants.TargetPart;
            if (!Platform.Numbers.Math.IsPowerOfTwo(size))
            {
                throw new ArgumentOutOfRangeException(nameof(size), "Sequences with sizes other
                ↪  than powers of two are not supported.");
            }
            var path = new BitArray(BitConverter.GetBytes(index));
            var length = Bit.GetLowestPosition(size);
            links.EnsureLinkExists(root, "root");
            var currentLink = root;
            for (var i = length - 1; i >= 0; i--)
            {
                currentLink = links.GetLink(currentLink)[path[i] ? target : source];
            }
            return currentLink;
        }

        #endregion

        /// <summary>
        /// Возвращает индекс указанной связи.
        /// </summary>
        /// <param name="links">Хранилище связей.</param>
        /// <param name="link">Связь представленная списком, состоящим из её адреса и
        ↪  содержимого.</param>
        /// <returns>Индекс начальной связи для указанной связи.</returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static TLink GetIndex<TLink>(this ILinks<TLink> links, IList<TLink> link) =>
        ↪  link[links.Constants.IndexPart];

        /// <summary>
```

```
401         /// Возвращает индекс начальной (Source) связи для указанной связи.
402         /// </summary>
403         /// <param name="links">Хранилище связей.</param>
404         /// <param name="link">Индекс связи.</param>
405         /// <returns>Индекс начальной связи для указанной связи.</returns>
406         [MethodImpl(MethodImplOptions.AggressiveInlining)]
407         public static TLink GetSource<TLink>(this ILinks<TLink> links, TLink link) =>
            ↪ links.GetLink(link)[links.Constants.SourcePart];
408
409         /// <summary>
410         /// Возвращает индекс начальной (Source) связи для указанной связи.
411         /// </summary>
412         /// <param name="links">Хранилище связей.</param>
413         /// <param name="link">Связь представленная списком, состоящим из её адреса и
            ↪ содержимого.</param>
414         /// <returns>Индекс начальной связи для указанной связи.</returns>
415         [MethodImpl(MethodImplOptions.AggressiveInlining)]
416         public static TLink GetSource<TLink>(this ILinks<TLink> links, IList<TLink> link) =>
            ↪ link[links.Constants.SourcePart];
417
418         /// <summary>
419         /// Возвращает индекс конечной (Target) связи для указанной связи.
420         /// </summary>
421         /// <param name="links">Хранилище связей.</param>
422         /// <param name="link">Индекс связи.</param>
423         /// <returns>Индекс конечной связи для указанной связи.</returns>
424         [MethodImpl(MethodImplOptions.AggressiveInlining)]
425         public static TLink GetTarget<TLink>(this ILinks<TLink> links, TLink link) =>
            ↪ links.GetLink(link)[links.Constants.TargetPart];
426
427         /// <summary>
428         /// Возвращает индекс конечной (Target) связи для указанной связи.
429         /// </summary>
430         /// <param name="links">Хранилище связей.</param>
431         /// <param name="link">Связь представленная списком, состоящим из её адреса и
            ↪ содержимого.</param>
432         /// <returns>Индекс конечной связи для указанной связи.</returns>
433         [MethodImpl(MethodImplOptions.AggressiveInlining)]
434         public static TLink GetTarget<TLink>(this ILinks<TLink> links, IList<TLink> link) =>
            ↪ link[links.Constants.TargetPart];
435
436         /// <summary>
437         /// Выполняет проход по всем связям, соответствующим шаблону, вызывая обработчик
            ↪ (handler) для каждой подходящей связи.
438         /// </summary>
439         /// <param name="links">Хранилище связей.</param>
440         /// <param name="handler">Обработчик каждой подходящей связи.</param>
441         /// <param name="restriction">Ограничения на содержимое связей. Каждое ограничение может
            ↪ иметь значения: Constants.Null - 0-я связь, обозначающая ссылку на пустоту, Any -
            ↪ отсутствие ограничения, 1..∞ конкретный адрес связи.</param>
442         /// <returns>True, в случае если проход по связям не был прерван и False в обратном
            ↪ случае.</returns>
443         [MethodImpl(MethodImplOptions.AggressiveInlining)]
444         public static bool Each<TLink>(this ILinks<TLink> links, ReadHandler<TLink>? handler,
            ↪ params TLink[] restriction)
445             => EqualityComparer<TLink>.Default.Equals(links.Each(restriction, handler),
                ↪ links.Constants.Continue);
446
447         public static bool Each<TLink>(this ILinks<TLink> links, Func<TLink, bool> handler,
            ↪ TLink source, TLink target) => links.Each(source, target, handler);
448
449
450         /// <summary>
451         /// Выполняет проход по всем связям, соответствующим шаблону, вызывая обработчик
            ↪ (handler) для каждой подходящей связи.
452         /// </summary>
453         /// <param name="links">Хранилище связей.</param>
454         /// <param name="source">Значение, определяющее соответствующие шаблону связи.
            ↪ (Constants.Null - 0-я связь, обозначающая ссылку на пустоту в качестве начала,
            ↪ Constants.Any - любое начало, 1..∞ конкретное начало)</param>
455         /// <param name="target">Значение, определяющее соответствующие шаблону связи.
            ↪ (Constants.Null - 0-я связь, обозначающая ссылку на пустоту в качестве конца,
            ↪ Constants.Any - любой конец, 1..∞ конкретный конец)</param>
456         /// <param name="handler">Обработчик каждой подходящей связи.</param>
457         /// <returns>True, в случае если проход по связям не был прерван и False в обратном
            ↪ случае.</returns>
458         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
459         public static bool Each<TLink>(this ILinks<TLink> links, TLink source, TLink target,
            ↪  Func<TLink, bool> handler)
460         {
461             var constants = links.Constants;
462             return links.Each(link => handler(link[constants.IndexPart]) ? constants.Continue :
                ↪  constants.Break, constants.Any, source, target);
463         }
464
465         public static bool Each<TLink>(this ILinks<TLink> links, ReadHandler<TLink>? handler,
            ↪  TLink source, TLink target) => links.Each(source, target, handler);
466
467
468         /// <summary>
469         /// Выполняет проход по всем связям, соответствующим шаблону, вызывая обработчик
            ↪  (handler) для каждой подходящей связи.
470         /// </summary>
471         /// <param name="links">Хранилище связей.</param>
472         /// <param name="source">Значение, определяющее соответствующие шаблону связи.
            ↪  (Constants.Null - 0-я связь, обозначающая ссылку на пустоту в качестве начала,
            ↪  Constants.Any - любое начало, 1..∞ конкретное начало)</param>
473         /// <param name="target">Значение, определяющее соответствующие шаблону связи.
            ↪  (Constants.Null - 0-я связь, обозначающая ссылку на пустоту в качестве конца,
            ↪  Constants.Any - любой конец, 1..∞ конкретный конец)</param>
474         /// <param name="handler">Обработчик каждой подходящей связи.</param>
475         /// <returns>True, в случае если проход по связям не был прерван и False в обратном
            ↪  случае.</returns>
476         [MethodImpl(MethodImplOptions.AggressiveInlining)]
477         public static bool Each<TLink>(this ILinks<TLink> links, TLink source, TLink target,
            ↪  ReadHandler<TLink>? handler) => links.Each(handler, links.Constants.Any, source,
            ↪  target);
478
479         /// <summary>
480         /// <para>
481         /// Alls the links.
482         /// </para>
483         /// <para></para>
484         /// </summary>
485         /// <typeparam name="TLink">
486         /// <para>The link.</para>
487         /// <para></para>
488         /// </typeparam>
489         /// <param name="links">
490         /// <para>The links.</para>
491         /// <para></para>
492         /// </param>
493         /// <param name="restriction">
494         /// <para>The restriction.</para>
495         /// <para></para>
496         /// </param>
497         /// <returns>
498         /// <para>A list of i list t link</para>
499         /// <para></para>
500         /// </returns>
501         [MethodImpl(MethodImplOptions.AggressiveInlining)]
502         public static IList<IList<TLink>> All<TLink>(this ILinks<TLink> links, params TLink[]
            ↪  restriction)
503         {
504             var allLinks = new List<IList<TLink>>();
505             var filler = new ListFiller<IList<TLink>, TLink>(allLinks, links.Constants.Continue);
506             links.Each(filler.AddAndReturnConstant, restriction);
507             return allLinks;
508         }
509
510         /// <summary>
511         /// <para>
512         /// Alls the indices using the specified links.
513         /// </para>
514         /// <para></para>
515         /// </summary>
516         /// <typeparam name="TLink">
517         /// <para>The link.</para>
518         /// <para></para>
519         /// </typeparam>
520         /// <param name="links">
521         /// <para>The links.</para>
522         /// <para></para>
523         /// </param>
```

```
524         /// <param name="restriction">
525         /// <para>The restriction.</para>
526         /// <para></para>
527         /// </param>
528         /// <returns>
529         /// <para>A list of t link</para>
530         /// <para></para>
531         /// </returns>
532         [MethodImpl(MethodImplOptions.AggressiveInlining)]
533         public static IList<TLink> AllIndices<TLink>(this ILinks<TLink> links, params TLink[]
            ↪ restriction)
534         {
535             var allIndices = new List<TLink>();
536             var filler = new ListFiller<TLink, TLink>(allIndices, links.Constants.Continue);
537             links.Each(filler.AddFirstAndReturnConstant, restriction);
538             return allIndices;
539         }
540 
541         /// <summary>
542         /// Возвращает значение, определяющее существует ли связь с указанными началом и концом
            ↪ в хранилище связей.
543         /// </summary>
544         /// <param name="links">Хранилище связей.</param>
545         /// <param name="source">Начало связи.</param>
546         /// <param name="target">Конец связи.</param>
547         /// <returns>Значение, определяющее существует ли связь.</returns>
548         [MethodImpl(MethodImplOptions.AggressiveInlining)]
549         public static bool Exists<TLink>(this ILinks<TLink> links, TLink source, TLink target)
            ↪ => Comparer<TLink>.Default.Compare(links.Count(links.Constants.Any, source, target),
            ↪ default) > 0;
550 
551         #region Ensure
552         // TODO: May be move to EnsureExtensions or make it both there and here
553 
554         /// <summary>
555         /// <para>
556         /// Ensures the link exists using the specified links.
557         /// </para>
558         /// <para></para>
559         /// </summary>
560         /// <typeparam name="TLink">
561         /// <para>The link.</para>
562         /// <para></para>
563         /// </typeparam>
564         /// <param name="links">
565         /// <para>The links.</para>
566         /// <para></para>
567         /// </param>
568         /// <param name="restriction">
569         /// <para>The restriction.</para>
570         /// <para></para>
571         /// </param>
572         /// <exception cref="ArgumentLinkDoesNotExistsException{TLink}">
573         /// <para>sequence[{i}]</para>
574         /// <para></para>
575         /// </exception>
576         [MethodImpl(MethodImplOptions.AggressiveInlining)]
577         public static void EnsureLinkExists<TLink>(this ILinks<TLink> links, IList<TLink>
            ↪ restriction)
578         {
579             for (var i = 0; i < restriction.Count; i++)
580             {
581                 if (!links.Exists(restriction[i]))
582                 {
583                     throw new ArgumentLinkDoesNotExistsException<TLink>(restriction[i],
                        ↪ $"sequence[{i}]");
584                 }
585             }
586         }
587 
588         /// <summary>
589         /// <para>
590         /// Ensures the inner reference exists using the specified links.
591         /// </para>
592         /// <para></para>
593         /// </summary>
594         /// <typeparam name="TLink">
595         /// <para>The link.</para>
```

```
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="reference">
        /// <para>The reference.</para>
        /// <para></para>
        /// </param>
        /// <param name="argumentName">
        /// <para>The argument name.</para>
        /// <para></para>
        /// </param>
        /// <exception cref="ArgumentLinkDoesNotExistsException{TLink}">
        /// <para></para>
        /// <para></para>
        /// </exception>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static void EnsureInnerReferenceExists<TLink>(this ILinks<TLink> links, TLink
        ↪  reference, string argumentName)
        {
            if (links.Constants.IsInternalReference(reference) && !links.Exists(reference))
            {
                throw new ArgumentLinkDoesNotExistsException<TLink>(reference, argumentName);
            }
        }

        /// <summary>
        /// <para>
        /// Ensures the inner reference exists using the specified links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <typeparam name="TLink">
        /// <para>The link.</para>
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
        /// <param name="argumentName">
        /// <para>The argument name.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static void EnsureInnerReferenceExists<TLink>(this ILinks<TLink> links,
        ↪  IList<TLink> restriction, string argumentName)
        {
            for (int i = 0; i < restriction.Count; i++)
            {
                links.EnsureInnerReferenceExists(restriction[i], argumentName);
            }
        }

        /// <summary>
        /// <para>
        /// Ensures the link is any or exists using the specified links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <typeparam name="TLink">
        /// <para>The link.</para>
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="restriction">
        /// <para>The restriction.</para>
        /// <para></para>
        /// </param>
```

```
672         /// <exception cref="ArgumentLinkDoesNotExistsException{TLink}">
673         /// <para>sequence[{i}]</para>
674         /// <para></para>
675         /// </exception>
676         [MethodImpl(MethodImplOptions.AggressiveInlining)]
677         public static void EnsureLinkIsAnyOrExists<TLink>(this ILinks<TLink> links, IList<TLink>
            ↪ restriction)
678         {
679             var equalityComparer = EqualityComparer<TLink>.Default;
680             var any = links.Constants.Any;
681             for (var i = 0; i < restriction.Count; i++)
682             {
683                 if (!equalityComparer.Equals(restriction[i], any) &&
                    ↪ !links.Exists(restriction[i]))
684                 {
685                     throw new ArgumentLinkDoesNotExistsException<TLink>(restriction[i],
                        ↪ $"sequence[{i}]");
686                 }
687             }
688         }
689
690         /// <summary>
691         /// <para>
692         /// Ensures the link is any or exists using the specified links.
693         /// </para>
694         /// <para></para>
695         /// </summary>
696         /// <typeparam name="TLink">
697         /// <para>The link.</para>
698         /// <para></para>
699         /// </typeparam>
700         /// <param name="links">
701         /// <para>The links.</para>
702         /// <para></para>
703         /// </param>
704         /// <param name="link">
705         /// <para>The link.</para>
706         /// <para></para>
707         /// </param>
708         /// <param name="argumentName">
709         /// <para>The argument name.</para>
710         /// <para></para>
711         /// </param>
712         /// <exception cref="ArgumentLinkDoesNotExistsException{TLink}">
713         /// <para></para>
714         /// <para></para>
715         /// </exception>
716         [MethodImpl(MethodImplOptions.AggressiveInlining)]
717         public static void EnsureLinkIsAnyOrExists<TLink>(this ILinks<TLink> links, TLink link,
            ↪ string argumentName)
718         {
719             var equalityComparer = EqualityComparer<TLink>.Default;
720             if (!equalityComparer.Equals(link, links.Constants.Any) && !links.Exists(link))
721             {
722                 throw new ArgumentLinkDoesNotExistsException<TLink>(link, argumentName);
723             }
724         }
725
726         /// <summary>
727         /// <para>
728         /// Ensures the link is itself or exists using the specified links.
729         /// </para>
730         /// <para></para>
731         /// </summary>
732         /// <typeparam name="TLink">
733         /// <para>The link.</para>
734         /// <para></para>
735         /// </typeparam>
736         /// <param name="links">
737         /// <para>The links.</para>
738         /// <para></para>
739         /// </param>
740         /// <param name="link">
741         /// <para>The link.</para>
742         /// <para></para>
743         /// </param>
744         /// <param name="argumentName">
745         /// <para>The argument name.</para>
```

```
746         /// <para></para>
747         /// </param>
748         /// <exception cref="ArgumentLinkDoesNotExistsException{TLink}">
749         /// <para></para>
750         /// <para></para>
751         /// </exception>
752         [MethodImpl(MethodImplOptions.AggressiveInlining)]
753         public static void EnsureLinkIsItselfOrExists<TLink>(this ILinks<TLink> links, TLink
            ↪ link, string argumentName)
754         {
755             var equalityComparer = EqualityComparer<TLink>.Default;
756             if (!equalityComparer.Equals(link, links.Constants.Itself) && !links.Exists(link))
757             {
758                 throw new ArgumentLinkDoesNotExistsException<TLink>(link, argumentName);
759             }
760         }
761 
762         /// <param name="links">Хранилище связей.</param>
763         [MethodImpl(MethodImplOptions.AggressiveInlining)]
764         public static void EnsureDoesNotExists<TLink>(this ILinks<TLink> links, TLink source,
            ↪ TLink target)
765         {
766             if (links.Exists(source, target))
767             {
768                 throw new LinkWithSameValueAlreadyExistsException();
769             }
770         }
771 
772         /// <param name="links">Хранилище связей.</param>
773         [MethodImpl(MethodImplOptions.AggressiveInlining)]
774         public static void EnsureNoUsages<TLink>(this ILinks<TLink> links, TLink link)
775         {
776             if (links.HasUsages(link))
777             {
778                 throw new ArgumentLinkHasDependenciesException<TLink>(link);
779             }
780         }
781 
782         /// <param name="links">Хранилище связей.</param>
783         [MethodImpl(MethodImplOptions.AggressiveInlining)]
784         public static void EnsureCreated<TLink>(this ILinks<TLink> links, params TLink[]
            ↪ addresses) => links.EnsureCreated(links.Create, addresses);
785 
786         /// <param name="links">Хранилище связей.</param>
787         [MethodImpl(MethodImplOptions.AggressiveInlining)]
788         public static void EnsurePointsCreated<TLink>(this ILinks<TLink> links, params TLink[]
            ↪ addresses) => links.EnsureCreated(links.CreatePoint, addresses);
789 
790         /// <param name="links">Хранилище связей.</param>
791         [MethodImpl(MethodImplOptions.AggressiveInlining)]
792         public static void EnsureCreated<TLink>(this ILinks<TLink> links, Func<TLink> creator,
            ↪ params TLink[] addresses)
793         {
794             var addressToUInt64Converter = CheckedConverter<TLink, ulong>.Default;
795             var uInt64ToAddressConverter = CheckedConverter<ulong, TLink>.Default;
796             var nonExistentAddresses = new HashSet<TLink>(addresses.Where(x =>
                ↪ !links.Exists(x)));
797             if (nonExistentAddresses.Count > 0)
798             {
799                 var max = nonExistentAddresses.Max();
800                 max = uInt64ToAddressConverter.Convert(System.Math.Min(addressToUInt64Converter.
                    ↪ Convert(max),
                    ↪ addressToUInt64Converter.Convert(links.Constants.InternalReferencesRange.Max
                    ↪ imum)));
801                 var createdLinks = new List<TLink>();
802                 var equalityComparer = EqualityComparer<TLink>.Default;
803                 TLink createdLink = creator();
804                 while (!equalityComparer.Equals(createdLink, max))
805                 {
806                     createdLinks.Add(createdLink);
807                 }
808                 for (var i = 0; i < createdLinks.Count; i++)
809                 {
810                     if (!nonExistentAddresses.Contains(createdLinks[i]))
811                     {
812                         links.Delete(createdLinks[i]);
813                     }
814                 }
```

```
815             }
816         }
817 
818         #endregion
819 
820         /// <param name="links">Хранилище связей.</param>
821         [MethodImpl(MethodImplOptions.AggressiveInlining)]
822         public static TLink CountUsages<TLink>(this ILinks<TLink> links, TLink link)
823         {
824             var constants = links.Constants;
825             var values = links.GetLink(link);
826             TLink usagesAsSource = links.Count(new Link<TLink>(constants.Any, link,
                ↪  constants.Any));
827             var equalityComparer = EqualityComparer<TLink>.Default;
828             if (equalityComparer.Equals(values[constants.SourcePart], link))
829             {
830                 usagesAsSource = Arithmetic<TLink>.Decrement(usagesAsSource);
831             }
832             TLink usagesAsTarget = links.Count(new Link<TLink>(constants.Any, constants.Any,
                ↪  link));
833             if (equalityComparer.Equals(values[constants.TargetPart], link))
834             {
835                 usagesAsTarget = Arithmetic<TLink>.Decrement(usagesAsTarget);
836             }
837             return Arithmetic<TLink>.Add(usagesAsSource, usagesAsTarget);
838         }
839 
840         /// <param name="links">Хранилище связей.</param>
841         [MethodImpl(MethodImplOptions.AggressiveInlining)]
842         public static bool HasUsages<TLink>(this ILinks<TLink> links, TLink link) =>
            ↪  Comparer<TLink>.Default.Compare(links.CountUsages(link), default) > 0;
843 
844         /// <param name="links">Хранилище связей.</param>
845         [MethodImpl(MethodImplOptions.AggressiveInlining)]
846         public static bool Equals<TLink>(this ILinks<TLink> links, TLink link, TLink source,
            ↪  TLink target)
847         {
848             var constants = links.Constants;
849             var values = links.GetLink(link);
850             var equalityComparer = EqualityComparer<TLink>.Default;
851             return equalityComparer.Equals(values[constants.SourcePart], source) &&
                ↪  equalityComparer.Equals(values[constants.TargetPart], target);
852         }
853 
854         /// <summary>
855         /// Выполняет поиск связи с указанными Source (началом) и Target (концом).
856         /// </summary>
857         /// <param name="links">Хранилище связей.</param>
858         /// <param name="source">Индекс связи, которая является началом для искомой
            ↪  связи.</param>
859         /// <param name="target">Индекс связи, которая является концом для искомой связи.</param>
860         /// <returns>Индекс искомой связи с указанными Source (началом) и Target
            ↪  (концом).</returns>
861         [MethodImpl(MethodImplOptions.AggressiveInlining)]
862         public static TLink SearchOrDefault<TLink>(this ILinks<TLink> links, TLink source, TLink
            ↪  target)
863         {
864             var contants = links.Constants;
865             var setter = new Setter<TLink, TLink>(contants.Continue, contants.Break, default);
866             links.Each(setter.SetFirstAndReturnFalse, contants.Any, source, target);
867             return setter.Result;
868         }
869 
870         public static TLink CreatePoint<TLink>(this ILinks<TLink> links)
871         {
872             var constants = links.Constants;
873             var setter = new Setter<TLink, TLink>(constants.Continue, constants.Break);
874             links.CreatePoint(setter.SetFirstFromSecondListAndReturnTrue);
875             return setter.Result;
876         }
877 
878         /// <param name="links">Хранилище связей.</param>
879         [MethodImpl(MethodImplOptions.AggressiveInlining)]
880         public static TLink CreatePoint<TLink>(this ILinks<TLink> links, WriteHandler<TLink>
            ↪  handler)
881         {
882             var constants = links.Constants;
```

```
883             WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
                ↪  handler);
884             TLink link = default;
885             TLink HandlerWrapper(IList<TLink> before, IList<TLink> after)
886             {
887                 link = after[constants.IndexPart];
888                 return handlerState.Handler != null ? handlerState.Handler(before, after) :
                    ↪  constants.Continue;
889             }
890             handlerState.Apply(links.Create(null, HandlerWrapper));
891             handlerState.Apply(links.Update(link, link, link, HandlerWrapper));
892             return handlerState.Result;
893         }
894
895         public static TLink CreateAndUpdate<TLink>(this ILinks<TLink> links, TLink source, TLink
            ↪  target)
896         {
897             var constants = links.Constants;
898             var setter = new Setter<TLink, TLink>(constants.Continue, constants.Break);
899             links.CreateAndUpdate(source, target, setter.SetFirstFromSecondListAndReturnTrue);
900             return setter.Result;
901         }
902
903
904         /// <param name="links">Хранилище связей.</param>
905         [MethodImpl(MethodImplOptions.AggressiveInlining)]
906         public static TLink CreateAndUpdate<TLink>(this ILinks<TLink> links, TLink source, TLink
            ↪  target, WriteHandler<TLink> handler)
907         {
908             var constants = links.Constants;
909             TLink createdLink = default;
910             WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
                ↪  handler);
911             handlerState.Apply(links.Create(null, (before, after) =>
912             {
913                 createdLink = links.GetIndex(after);
914                 return handlerState.Handler != null ? handlerState.Handler(before, after) :
                    ↪  constants.Continue;
915             }));
916             handlerState.Apply(links.Update(createdLink, source, target, handler));
917             return handlerState.Result;
918         }
919
920         /// <summary>
921         /// Обновляет связь с указанными началом (Source) и концом (Target)
922         /// на связь с указанными началом (NewSource) и концом (NewTarget).
923         /// </summary>
924         /// <param name="links">Хранилище связей.</param>
925         /// <param name="link">Индекс обновляемой связи.</param>
926         /// <param name="newSource">Индекс связи, которая является началом связи, на которую
            ↪  выполняется обновление.</param>
927         /// <param name="newTarget">Индекс связи, которая является концом связи, на которую
            ↪  выполняется обновление.</param>
928         /// <returns>Индекс обновлённой связи.</returns>
929         [MethodImpl(MethodImplOptions.AggressiveInlining)]
930         public static TLink Update<TLink>(this ILinks<TLink> links, TLink link, TLink newSource,
            ↪  TLink newTarget) => links.Update(new LinkAddress<TLink>(link), new Link<TLink>(link,
            ↪  newSource, newTarget));
931
932         public static TLink Update<TLink>(this ILinks<TLink> links, params TLink[] restriction)
            ↪  => links.Update(restriction, null);
933
934         public static TLink Update<TLink>(this ILinks<TLink> links, WriteHandler<TLink> handler,
            ↪  params TLink[] restriction) => links.Update(restriction, handler);
935
936         public static TLink Update<TLink>(this ILinks<TLink> links, IList<TLink> restriction)
937         {
938             var constants = links.Constants;
939             var setter = new Setter<TLink, TLink>(constants.Continue, constants.Break);
940             links.Update(restriction, setter.SetFirstFromSecondListAndReturnTrue);
941             return setter.Result;
942         }
943
944
945         /// <summary>
946         /// Обновляет связь с указанными началом (Source) и концом (Target)
947         /// на связь с указанными началом (NewSource) и концом (NewTarget).
948         /// </summary>
```

```
949         /// <param name="links">Хранилище связей.</param>
950         /// <param name="restriction">Ограничения на содержимое связей. Каждое ограничение может
            ↪ иметь значения: Constants.Null - 0-я связь, обозначающая ссылку на пустоту, Itself -
            ↪ требование установить ссылку на себя, 1..∞ конкретный адрес другой связи.</param>
951         /// <returns>Индекс обновлённой связи.</returns>
952         [MethodImpl(MethodImplOptions.AggressiveInlining)]
953         public static TLink Update<TLink>(this ILinks<TLink> links, IList<TLink> restriction,
            ↪ WriteHandler<TLink> handler)
954         {
955             return restriction.Count switch
956             {
957                 2 => links.MergeAndDelete(restriction[0], restriction[1], handler),
958                 4 => links.UpdateOrCreateOrGet(restriction[0], restriction[1], restriction[2],
                    ↪ restriction[3], handler),
959                 _ => links.Update(restriction[0], restriction[1], restriction[2], handler)
960             };
961         }
962 
963         public static TLink Update<TLink>(this ILinks<TLink> links, TLink link, TLink newSource,
            ↪ TLink newTarget, WriteHandler<TLink> handler) => links.Update(new
            ↪ LinkAddress<TLink>(link), new Link<TLink>(link, newSource, newTarget), handler);
964 
965         /// <summary>
966         /// <para>
967         /// Resolves the constant as self reference using the specified links.
968         /// </para>
969         /// <para></para>
970         /// </summary>
971         /// <typeparam name="TLink">
972         /// <para>The link.</para>
973         /// <para></para>
974         /// </typeparam>
975         /// <param name="links">
976         /// <para>The links.</para>
977         /// <para></para>
978         /// </param>
979         /// <param name="constant">
980         /// <para>The constant.</para>
981         /// <para></para>
982         /// </param>
983         /// <param name="restriction">
984         /// <para>The restriction.</para>
985         /// <para></para>
986         /// </param>
987         /// <param name="substitution">
988         /// <para>The substitution.</para>
989         /// <para></para>
990         /// </param>
991         /// <returns>
992         /// <para>A list of t link</para>
993         /// <para></para>
994         /// </returns>
995         [MethodImpl(MethodImplOptions.AggressiveInlining)]
996         public static IList<TLink> ResolveConstantAsSelfReference<TLink>(this ILinks<TLink>
            ↪ links, TLink constant, IList<TLink> restriction, IList<TLink> substitution)
997         {
998             var equalityComparer = EqualityComparer<TLink>.Default;
999             var constants = links.Constants;
1000            var restrictionIndex = restriction[constants.IndexPart];
1001            var substitutionIndex = substitution[constants.IndexPart];
1002            if (equalityComparer.Equals(substitutionIndex, default))
1003            {
1004                substitutionIndex = restrictionIndex;
1005            }
1006            var source = substitution[constants.SourcePart];
1007            var target = substitution[constants.TargetPart];
1008            source = equalityComparer.Equals(source, constant) ? substitutionIndex : source;
1009            target = equalityComparer.Equals(target, constant) ? substitutionIndex : target;
1010            return new Link<TLink>(substitutionIndex, source, target);
1011        }
1012 
1013        /// <summary>
1014        /// Создаёт связь (если она не существовала), либо возвращает индекс существующей связи
            ↪ с указанными Source (началом) и Target (концом).
1015        /// </summary>
1016        /// <param name="links">Хранилище связей.</param>
1017        /// <param name="source">Индекс связи, которая является началом на создаваемой
            ↪ связи.</param>
```

```
1018            /// <param name="target">Индекс связи, которая является концом для создаваемой
                ↪  связи.</param>
1019            /// <returns>Индекс связи, с указанным Source (началом) и Target (концом)</returns>
1020            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1021            public static TLink GetOrCreate<TLink>(this ILinks<TLink> links, TLink source, TLink
                ↪  target)
1022            {
1023                var link = links.SearchOrDefault(source, target);
1024                if (EqualityComparer<TLink>.Default.Equals(link, default))
1025                {
1026                    link = links.CreateAndUpdate(source, target);
1027                }
1028                return link;
1029            }
1030
1031            public static TLink UpdateOrCreateOrGet<TLink>(this ILinks<TLink> links, TLink source,
                ↪  TLink target, TLink newSource, TLink newTarget)
1032            {
1033                var constants = links.Constants;
1034                var setter = new Setter<TLink, TLink>(constants.Continue, constants.Break);
1035                links.UpdateOrCreateOrGet(source, target, newSource, newTarget,
                    ↪  setter.SetFirstFromSecondListAndReturnTrue);
1036                return setter.Result;
1037            }
1038
1039            /// <summary>
1040            /// Обновляет связь с указанными началом (Source) и концом (Target)
1041            /// на связь с указанными началом (NewSource) и концом (NewTarget).
1042            /// </summary>
1043            /// <param name="links">Хранилище связей.</param>
1044            /// <param name="source">Индекс связи, которая является началом обновляемой
                ↪  связи.</param>
1045            /// <param name="target">Индекс связи, которая является концом обновляемой связи.</param>
1046            /// <param name="newSource">Индекс связи, которая является началом связи, на которую
                ↪  выполняется обновление.</param>
1047            /// <param name="newTarget">Индекс связи, которая является концом связи, на которую
                ↪  выполняется обновление.</param>
1048            /// <returns>Индекс обновлённой связи.</returns>
1049            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1050            public static TLink UpdateOrCreateOrGet<TLink>(this ILinks<TLink> links, TLink source,
                ↪  TLink target, TLink newSource, TLink newTarget, WriteHandler<TLink> handler)
1051            {
1052                var equalityComparer = EqualityComparer<TLink>.Default;
1053                var link = links.SearchOrDefault(source, target);
1054                if (equalityComparer.Equals(link, default))
1055                {
1056                    return links.CreateAndUpdate(newSource, newTarget, handler);
1057                }
1058                if (equalityComparer.Equals(newSource, source) && equalityComparer.Equals(newTarget,
                    ↪  target))
1059                {
1060                    var linkStruct = new Link<TLink>(link, source, target);
1061                    return link;
1062                }
1063                return links.Update(link, newSource, newTarget, handler);
1064            }
1065
1066            /// <summary>Удаляет связь с указанными началом (Source) и концом (Target).</summary>
1067            /// <param name="links">Хранилище связей.</param>
1068            /// <param name="source">Индекс связи, которая является началом удаляемой связи.</param>
1069            /// <param name="target">Индекс связи, которая является концом удаляемой связи.</param>
1070            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1071            public static TLink DeleteIfExists<TLink>(this ILinks<TLink> links, TLink source, TLink
                ↪  target)
1072            {
1073                var link = links.SearchOrDefault(source, target);
1074                if (!EqualityComparer<TLink>.Default.Equals(link, default))
1075                {
1076                    links.Delete(link);
1077                    return link;
1078                }
1079                return default;
1080            }
1081
1082            /// <summary>Удаляет несколько связей.</summary>
1083            /// <param name="links">Хранилище связей.</param>
1084            /// <param name="deletedLinks">Список адресов связей к удалению.</param>
1085            [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
1086            public static void DeleteMany<TLink>(this ILinks<TLink> links, IList<TLink> deletedLinks)
1087            {
1088                for (int i = 0; i < deletedLinks.Count; i++)
1089                {
1090                    links.Delete(deletedLinks[i]);
1091                }
1092            }
1093
1094            public static void DeleteAllUsages<TLink>(this ILinks<TLink> links, TLink linkIndex) =>
                ↪ links.DeleteAllUsages(linkIndex, null);
1095
1096            /// <remarks>Before execution of this method ensure that deleted link is detached (all
                ↪ values - source and target are reset to null) or it might enter into infinite
                ↪ recursion.</remarks>
1097            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1098            public static TLink DeleteAllUsages<TLink>(this ILinks<TLink> links, TLink linkIndex,
                ↪ WriteHandler<TLink> handler)
1099            {
1100                var constants = links.Constants;
1101                var any = constants.Any;
1102                var equalityComparer = EqualityComparer<TLink>.Default;
1103                var usagesAsSourceQuery = new Link<TLink>(any, linkIndex, any);
1104                var usagesAsTargetQuery = new Link<TLink>(any, any, linkIndex);
1105                var usages = new List<IList<TLink>>();
1106                var usagesFiller = new ListFiller<IList<TLink>, TLink>(usages, constants.Continue);
1107                links.Each(usagesFiller.AddAndReturnConstant, usagesAsSourceQuery);
1108                links.Each(usagesFiller.AddAndReturnConstant, usagesAsTargetQuery);
1109                WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
                    ↪ handler);
1110                foreach (var usage in usages)
1111                {
1112                    if (equalityComparer.Equals(links.GetIndex(usage), linkIndex) ||
                        ↪ !links.Exists(links.GetIndex(usage)))
1113                    {
1114                        continue;
1115                    }
1116                    handlerState.Apply(links.Delete(links.GetIndex(usage), handlerState.Handler));
1117                }
1118                return handlerState.Result;
1119            }
1120
1121            /// <summary>
1122            /// <para>
1123            /// Deletes the by query using the specified links.
1124            /// </para>
1125            /// <para></para>
1126            /// </summary>
1127            /// <typeparam name="TLink">
1128            /// <para>The link.</para>
1129            /// <para></para>
1130            /// </typeparam>
1131            /// <param name="links">
1132            /// <para>The links.</para>
1133            /// <para></para>
1134            /// </param>
1135            /// <param name="query">
1136            /// <para>The query.</para>
1137            /// <para></para>
1138            /// </param>
1139            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1140            public static void DeleteByQuery<TLink>(this ILinks<TLink> links, Link<TLink> query)
1141            {
1142                var queryResult = new List<TLink>();
1143                var queryResultFiller = new ListFiller<TLink, TLink>(queryResult,
                    ↪ links.Constants.Continue);
1144                links.Each(queryResultFiller.AddFirstAndReturnConstant, query);
1145                foreach (var link in queryResult)
1146                {
1147                    links.Delete(link);
1148                }
1149            }
1150
1151            // TODO: Move to Platform.Data
1152            /// <summary>
1153            /// <para>
1154            /// Determines whether are values reset.
1155            /// </para>
1156            /// <para></para>
```

```
1157            /// </summary>
1158            /// <typeparam name="TLink">
1159            /// <para>The link.</para>
1160            /// <para></para>
1161            /// </typeparam>
1162            /// <param name="links">
1163            /// <para>The links.</para>
1164            /// <para></para>
1165            /// </param>
1166            /// <param name="linkIndex">
1167            /// <para>The link index.</para>
1168            /// <para></para>
1169            /// </param>
1170            /// <returns>
1171            /// <para>The bool</para>
1172            /// <para></para>
1173            /// </returns>
1174            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1175            public static bool AreValuesReset<TLink>(this ILinks<TLink> links, TLink linkIndex)
1176            {
1177                var nullConstant = links.Constants.Null;
1178                var equalityComparer = EqualityComparer<TLink>.Default;
1179                var link = links.GetLink(linkIndex);
1180                for (int i = 1; i < link.Count; i++)
1181                {
1182                    if (!equalityComparer.Equals(link[i], nullConstant))
1183                    {
1184                        return false;
1185                    }
1186                }
1187                return true;
1188            }
1189
1190            public static void ResetValues<TLink>(this ILinks<TLink> links, TLink linkIndex) =>
                ↪ links.ResetValues(linkIndex, null);
1191
1192            // TODO: Create a universal version of this method in Platform.Data (with using of for
                ↪ loop)
1193            /// <summary>
1194            /// <para>
1195            /// Resets the values using the specified links.
1196            /// </para>
1197            /// <para></para>
1198            /// </summary>
1199            /// <typeparam name="TLink">
1200            /// <para>The link.</para>
1201            /// <para></para>
1202            /// </typeparam>
1203            /// <param name="links">
1204            /// <para>The links.</para>
1205            /// <para></para>
1206            /// </param>
1207            /// <param name="linkIndex">
1208            /// <para>The link index.</para>
1209            /// <para></para>
1210            /// </param>
1211            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1212            public static TLink ResetValues<TLink>(this ILinks<TLink> links, TLink linkIndex,
                ↪ WriteHandler<TLink> handler)
1213            {
1214                var nullConstant = links.Constants.Null;
1215                var updateRequest = new Link<TLink>(linkIndex, nullConstant, nullConstant);
1216                return links.Update(updateRequest, handler);
1217            }
1218
1219            public static void EnforceResetValues<TLink>(this ILinks<TLink> links, TLink linkIndex)
                ↪ => links.EnforceResetValues(linkIndex, null);
1220
1221
1222            // TODO: Create a universal version of this method in Platform.Data (with using of for
                ↪ loop)
1223            /// <summary>
1224            /// <para>
1225            /// Enforces the reset values using the specified links.
1226            /// </para>
1227            /// <para></para>
1228            /// </summary>
1229            /// <typeparam name="TLink">
```

```
1230            /// <para>The link.</para>
1231            /// <para></para>
1232            /// </typeparam>
1233            /// <param name="links">
1234            /// <para>The links.</para>
1235            /// <para></para>
1236            /// </param>
1237            /// <param name="linkIndex">
1238            /// <para>The link index.</para>
1239            /// <para></para>
1240            /// </param>
1241            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1242            public static TLink EnforceResetValues<TLink>(this ILinks<TLink> links, TLink linkIndex,
                ↪ WriteHandler<TLink> handler)
1243            {
1244                if (!links.AreValuesReset(linkIndex))
1245                {
1246                    return links.ResetValues(linkIndex, handler);
1247                }
1248                return links.Constants.Continue;
1249            }
1250
1251            public static void MergeUsages<TLink>(this ILinks<TLink> links, TLink oldLinkIndex,
                ↪ TLink newLinkIndex) => links.MergeUsages(oldLinkIndex, newLinkIndex, null);
1252
1253            /// <summary>
1254            /// Merging two usages graphs, all children of old link moved to be children of new link
                ↪ or deleted.
1255            /// </summary>
1256            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1257            public static TLink MergeUsages<TLink>(this ILinks<TLink> links, TLink oldLinkIndex,
                ↪ TLink newLinkIndex, WriteHandler<TLink> handler)
1258            {
1259                var equalityComparer = EqualityComparer<TLink>.Default;
1260                if (equalityComparer.Equals(oldLinkIndex, newLinkIndex))
1261                {
1262                    return newLinkIndex;
1263                }
1264                var constants = links.Constants;
1265                var usagesAsSource = links.All(new Link<TLink>(constants.Any, oldLinkIndex,
                    ↪ constants.Any));
1266                WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
                    ↪ handler);
1267                for (var i = 0; i < usagesAsSource.Count; i++)
1268                {
1269                    var usageAsSource = usagesAsSource[i];
1270                    if (equalityComparer.Equals(usageAsSource[constants.IndexPart], oldLinkIndex))
1271                    {
1272                        continue;
1273                    }
1274                    var restriction = new LinkAddress<TLink>(usageAsSource[constants.IndexPart]);
1275                    var substitution = new Link<TLink>(newLinkIndex,
                        ↪ usageAsSource[constants.TargetPart]);
1276                    handlerState.Apply(links.Update(restriction, substitution,
                        ↪ handlerState.Handler));
1277                }
1278                var usagesAsTarget = links.All(new Link<TLink>(constants.Any, constants.Any,
                    ↪ oldLinkIndex));
1279                for (var i = 0; i < usagesAsTarget.Count; i++)
1280                {
1281                    var usageAsTarget = usagesAsTarget[i];
1282                    if (equalityComparer.Equals(usageAsTarget[constants.IndexPart], oldLinkIndex))
1283                    {
1284                        continue;
1285                    }
1286                    var restriction = links.GetLink(usageAsTarget[constants.IndexPart]);
1287                    var substitution = new Link<TLink>(usageAsTarget[constants.TargetPart],
                        ↪ newLinkIndex);
1288                    handlerState.Apply(links.Update(restriction, substitution,
                        ↪ handlerState.Handler));
1289                }
1290                return handlerState.Result;
1291            }
1292
1293            public static TLink MergeAndDelete<TLink>(this ILinks<TLink> links, TLink oldLinkIndex,
                ↪ TLink newLinkIndex)
1294            {
```

```
1295            var equalityComparer = EqualityComparer<TLink>.Default;
1296            if (!equalityComparer.Equals(oldLinkIndex, newLinkIndex))
1297            {
1298                links.MergeUsages(oldLinkIndex, newLinkIndex);
1299                links.Delete(oldLinkIndex);
1300            }
1301            return newLinkIndex;
1302        }
1303
1304        /// <summary>
1305        /// Replace one link with another (replaced link is deleted, children are updated or
            ↪ deleted).
1306        /// </summary>
1307        [MethodImpl(MethodImplOptions.AggressiveInlining)]
1308        public static TLink MergeAndDelete<TLink>(this ILinks<TLink> links, TLink oldLinkIndex,
            ↪ TLink newLinkIndex, WriteHandler<TLink> handler)
1309        {
1310            var equalityComparer = EqualityComparer<TLink>.Default;
1311            var constants = links.Constants;
1312            WriteHandlerState<TLink> handlerState = new(constants.Continue, constants.Break,
                ↪ handler);
1313            if (!equalityComparer.Equals(oldLinkIndex, newLinkIndex))
1314            {
1315                handlerState.Apply(links.MergeUsages(oldLinkIndex, newLinkIndex,
                    ↪ handlerState.Handler));
1316                handlerState.Apply(links.Delete(oldLinkIndex, handlerState.Handler));
1317            }
1318            return handlerState.Result;
1319        }
1320
1321        /// <summary>
1322        /// <para>
1323        /// Decorates the with automatic uniqueness and usages resolution using the specified
            ↪ links.
1324        /// </para>
1325        /// <para></para>
1326        /// </summary>
1327        /// <typeparam name="TLink">
1328        /// <para>The link.</para>
1329        /// <para></para>
1330        /// </typeparam>
1331        /// <param name="links">
1332        /// <para>The links.</para>
1333        /// <para></para>
1334        /// </param>
1335        /// <returns>
1336        /// <para>The links.</para>
1337        /// <para></para>
1338        /// </returns>
1339        [MethodImpl(MethodImplOptions.AggressiveInlining)]
1340        public static ILinks<TLink>
            ↪ DecorateWithAutomaticUniquenessAndUsagesResolution<TLink>(this ILinks<TLink> links)
1341        {
1342            links = new LinksCascadeUsagesResolver<TLink>(links);
1343            links = new NonNullContentsLinkDeletionResolver<TLink>(links);
1344            links = new LinksCascadeUniquenessAndUsagesResolver<TLink>(links);
1345            return links;
1346        }
1347
1348        /// <summary>
1349        /// <para>
1350        /// Formats the links.
1351        /// </para>
1352        /// <para></para>
1353        /// </summary>
1354        /// <typeparam name="TLink">
1355        /// <para>The link.</para>
1356        /// <para></para>
1357        /// </typeparam>
1358        /// <param name="links">
1359        /// <para>The links.</para>
1360        /// <para></para>
1361        /// </param>
1362        /// <param name="link">
1363        /// <para>The link.</para>
1364        /// <para></para>
1365        /// </param>
1366        /// <returns>
```

```
1367          /// <para>The string</para>
1368          /// <para></para>
1369          /// </returns>
1370          [MethodImpl(MethodImplOptions.AggressiveInlining)]
1371          public static string Format<TLink>(this ILinks<TLink> links, IList<TLink> link)
1372          {
1373              var constants = links.Constants;
1374              return $"({link[constants.IndexPart]}: {link[constants.SourcePart]}
                  ↪  {link[constants.TargetPart]})";
1375          }
1376
1377          /// <summary>
1378          /// <para>
1379          /// Formats the links.
1380          /// </para>
1381          /// <para></para>
1382          /// </summary>
1383          /// <typeparam name="TLink">
1384          /// <para>The link.</para>
1385          /// <para></para>
1386          /// </typeparam>
1387          /// <param name="links">
1388          /// <para>The links.</para>
1389          /// <para></para>
1390          /// </param>
1391          /// <param name="link">
1392          /// <para>The link.</para>
1393          /// <para></para>
1394          /// </param>
1395          /// <returns>
1396          /// <para>The string</para>
1397          /// <para></para>
1398          /// </returns>
1399          [MethodImpl(MethodImplOptions.AggressiveInlining)]
1400          public static string Format<TLink>(this ILinks<TLink> links, TLink link) =>
                  ↪  links.Format(links.GetLink(link));
1401      }
1402  }
```

1.24 ./csharp/Platform.Data.Doublets/ISynchronizedLinks.cs

```
1   #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
2
3   namespace Platform.Data.Doublets
4   {
5       /// <summary>
6       /// <para>
7       /// Defines the synchronized links.
8       /// </para>
9       /// <para></para>
10      /// </summary>
11      /// <seealso cref="ISynchronizedLinks{TLink, ILinks{TLink}, LinksConstants{TLink}}"/>
12      /// <seealso cref="ILinks{TLink}"/>
13      public interface ISynchronizedLinks<TLink> : ISynchronizedLinks<TLink, ILinks<TLink>,
            ↪  LinksConstants<TLink>>, ILinks<TLink>
14      {
15      }
16  }
```

1.25 ./csharp/Platform.Data.Doublets/Link.cs

```
1   using Platform.Collections.Lists;
2   using Platform.Exceptions;
3   using Platform.Ranges;
4   using Platform.Singletons;
5   using System;
6   using System.Collections;
7   using System.Collections.Generic;
8   using System.Runtime.CompilerServices;
9
10  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
11
12  namespace Platform.Data.Doublets
13  {
14      /// <summary>
15      /// Структура описывающая уникальную связь.
16      /// </summary>
17      public struct Link<TLink> : IEquatable<Link<TLink>>, IReadOnlyList<TLink>, IList<TLink>
18      {
19          /// <summary>
```

```
20          /// <para>
21          /// The link.
22          /// </para>
23          /// <para></para>
24          /// </summary>
25          public static readonly Link<TLink> Null = new Link<TLink>();
26          private static readonly LinksConstants<TLink> _constants =
            ↪  Default<LinksConstants<TLink>>.Instance;
27          private static readonly EqualityComparer<TLink> _equalityComparer =
            ↪  EqualityComparer<TLink>.Default;
28          private const int Length = 3;
29
30          /// <summary>
31          /// <para>
32          /// The index.
33          /// </para>
34          /// <para></para>
35          /// </summary>
36          public readonly TLink Index;
37          /// <summary>
38          /// <para>
39          /// The source.
40          /// </para>
41          /// <para></para>
42          /// </summary>
43          public readonly TLink Source;
44          /// <summary>
45          /// <para>
46          /// The target.
47          /// </para>
48          /// <para></para>
49          /// </summary>
50          public readonly TLink Target;
51
52          /// <summary>
53          /// <para>
54          /// Initializes a new <see cref="Link"/> instance.
55          /// </para>
56          /// <para></para>
57          /// </summary>
58          /// <param name="values">
59          /// <para>A values.</para>
60          /// <para></para>
61          /// </param>
62          [MethodImpl(MethodImplOptions.AggressiveInlining)]
63          public Link(params TLink[] values) => SetValues(values, out Index, out Source, out
            ↪  Target);
64
65          /// <summary>
66          /// <para>
67          /// Initializes a new <see cref="Link"/> instance.
68          /// </para>
69          /// <para></para>
70          /// </summary>
71          /// <param name="values">
72          /// <para>A values.</para>
73          /// <para></para>
74          /// </param>
75          [MethodImpl(MethodImplOptions.AggressiveInlining)]
76          public Link(IList<TLink> values) => SetValues(values, out Index, out Source, out Target);
77
78          /// <summary>
79          /// <para>
80          /// Initializes a new <see cref="Link"/> instance.
81          /// </para>
82          /// <para></para>
83          /// </summary>
84          /// <param name="other">
85          /// <para>A other.</para>
86          /// <para></para>
87          /// </param>
88          /// <exception cref="NotSupportedException">
89          /// <para></para>
90          /// <para></para>
91          /// </exception>
92          [MethodImpl(MethodImplOptions.AggressiveInlining)]
93          public Link(object other)
94          {
```

```
95              if (other is Link<TLink> otherLink)
96              {
97                  SetValues(ref otherLink, out Index, out Source, out Target);
98              }
99              else if(other is IList<TLink> otherList)
100             {
101                 SetValues(otherList, out Index, out Source, out Target);
102             }
103             else
104             {
105                 throw new NotSupportedException();
106             }
107         }
108
109         /// <summary>
110         /// <para>
111         /// Initializes a new <see cref="Link"/> instance.
112         /// </para>
113         /// <para></para>
114         /// </summary>
115         /// <param name="other">
116         /// <para>A other.</para>
117         /// <para></para>
118         /// </param>
119         [MethodImpl(MethodImplOptions.AggressiveInlining)]
120         public Link(ref Link<TLink> other) => SetValues(ref other, out Index, out Source, out
            ↪ Target);
121
122         /// <summary>
123         /// <para>
124         /// Initializes a new <see cref="Link"/> instance.
125         /// </para>
126         /// <para></para>
127         /// </summary>
128         /// <param name="index">
129         /// <para>A index.</para>
130         /// <para></para>
131         /// </param>
132         /// <param name="source">
133         /// <para>A source.</para>
134         /// <para></para>
135         /// </param>
136         /// <param name="target">
137         /// <para>A target.</para>
138         /// <para></para>
139         /// </param>
140         [MethodImpl(MethodImplOptions.AggressiveInlining)]
141         public Link(TLink index, TLink source, TLink target)
142         {
143             Index = index;
144             Source = source;
145             Target = target;
146         }
147         [MethodImpl(MethodImplOptions.AggressiveInlining)]
148         private static void SetValues(ref Link<TLink> other, out TLink index, out TLink source,
            ↪ out TLink target)
149         {
150             index = other.Index;
151             source = other.Source;
152             target = other.Target;
153         }
154         [MethodImpl(MethodImplOptions.AggressiveInlining)]
155         private static void SetValues(IList<TLink> values, out TLink index, out TLink source,
            ↪ out TLink target)
156         {
157             if (values == null)
158             {
159                 index = default;
160                 source = default;
161                 target = default;
162                 return;
163             }
164             switch (values.Count)
165             {
166                 case 3:
167                     index = values[0];
168                     source = values[1];
169                     target = values[2];
170                     break;
```

```
                case 2:
                    index = values[0];
                    source = values[1];
                    target = default;
                    break;
                case 1:
                    index = values[0];
                    source = default;
                    target = default;
                    break;
                default:
                    index = default;
                    source = default;
                    target = default;
                    break;
            }
        }

        /// <summary>
        /// <para>
        /// Gets the hash code.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The int</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override int GetHashCode() => (Index, Source, Target).GetHashCode();

        /// <summary>
        /// <para>
        /// Determines whether this instance is null.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool IsNull() => _equalityComparer.Equals(Index, _constants.Null)
                             && _equalityComparer.Equals(Source, _constants.Null)
                             && _equalityComparer.Equals(Target, _constants.Null);

        /// <summary>
        /// <para>
        /// Determines whether this instance equals.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="other">
        /// <para>The other.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override bool Equals(object other) => other is Link<TLink> &&
        ↪  Equals((Link<TLink>)other);

        /// <summary>
        /// <para>
        /// Determines whether this instance equals.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="other">
        /// <para>The other.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
249         public bool Equals(Link<TLink> other) => _equalityComparer.Equals(Index, other.Index)
250                                                 && _equalityComparer.Equals(Source, other.Source)
251                                                 && _equalityComparer.Equals(Target, other.Target);
252 
253         /// <summary>
254         /// <para>
255         /// Returns the string using the specified index.
256         /// </para>
257         /// <para></para>
258         /// </summary>
259         /// <param name="index">
260         /// <para>The index.</para>
261         /// <para></para>
262         /// </param>
263         /// <param name="source">
264         /// <para>The source.</para>
265         /// <para></para>
266         /// </param>
267         /// <param name="target">
268         /// <para>The target.</para>
269         /// <para></para>
270         /// </param>
271         /// <returns>
272         /// <para>The string</para>
273         /// <para></para>
274         /// </returns>
275         [MethodImpl(MethodImplOptions.AggressiveInlining)]
276         public static string ToString(TLink index, TLink source, TLink target) => $"({index}:
            ↪ {source}->{target})";
277 
278         /// <summary>
279         /// <para>
280         /// Returns the string using the specified source.
281         /// </para>
282         /// <para></para>
283         /// </summary>
284         /// <param name="source">
285         /// <para>The source.</para>
286         /// <para></para>
287         /// </param>
288         /// <param name="target">
289         /// <para>The target.</para>
290         /// <para></para>
291         /// </param>
292         /// <returns>
293         /// <para>The string</para>
294         /// <para></para>
295         /// </returns>
296         [MethodImpl(MethodImplOptions.AggressiveInlining)]
297         public static string ToString(TLink source, TLink target) => $"({source}->{target})";
298 
299         [MethodImpl(MethodImplOptions.AggressiveInlining)]
300         public static implicit operator TLink[](Link<TLink> link) => link.ToArray();
301 
302         [MethodImpl(MethodImplOptions.AggressiveInlining)]
303         public static implicit operator Link<TLink>(TLink[] linkArray) => new
            ↪ Link<TLink>(linkArray);
304 
305         /// <summary>
306         /// <para>
307         /// Returns the string.
308         /// </para>
309         /// <para></para>
310         /// </summary>
311         /// <returns>
312         /// <para>The string</para>
313         /// <para></para>
314         /// </returns>
315         [MethodImpl(MethodImplOptions.AggressiveInlining)]
316         public override string ToString() => _equalityComparer.Equals(Index, _constants.Null) ?
            ↪ ToString(Source, Target) : ToString(Index, Source, Target);
317 
318         #region IList
319 
320         /// <summary>
321         /// <para>
322         /// Gets the count value.
323         /// </para>
```

```
324             /// <para></para>
325             /// </summary>
326             public int Count
327             {
328                 [MethodImpl(MethodImplOptions.AggressiveInlining)]
329                 get => Length;
330             }
331
332             /// <summary>
333             /// <para>
334             /// Gets the is read only value.
335             /// </para>
336             /// <para></para>
337             /// </summary>
338             public bool IsReadOnly
339             {
340                 [MethodImpl(MethodImplOptions.AggressiveInlining)]
341                 get => true;
342             }
343
344             /// <summary>
345             /// <para>
346             /// The not supported exception.
347             /// </para>
348             /// <para></para>
349             /// </summary>
350             public TLink this[int index]
351             {
352                 [MethodImpl(MethodImplOptions.AggressiveInlining)]
353                 get
354                 {
355                     Ensure.OnDebug.ArgumentInRange(index, new Range<int>(0, Length - 1),
                        ↪ nameof(index));
356                     if (index == _constants.IndexPart)
357                     {
358                         return Index;
359                     }
360                     if (index == _constants.SourcePart)
361                     {
362                         return Source;
363                     }
364                     if (index == _constants.TargetPart)
365                     {
366                         return Target;
367                     }
368                     throw new NotSupportedException(); // Impossible path due to
                        ↪ Ensure.ArgumentInRange
369                 }
370                 [MethodImpl(MethodImplOptions.AggressiveInlining)]
371                 set => throw new NotSupportedException();
372             }
373
374             /// <summary>
375             /// <para>
376             /// Gets the enumerator.
377             /// </para>
378             /// <para></para>
379             /// </summary>
380             /// <returns>
381             /// <para>The enumerator</para>
382             /// <para></para>
383             /// </returns>
384             [MethodImpl(MethodImplOptions.AggressiveInlining)]
385             IEnumerator IEnumerable.GetEnumerator() => GetEnumerator();
386
387             /// <summary>
388             /// <para>
389             /// Gets the enumerator.
390             /// </para>
391             /// <para></para>
392             /// </summary>
393             /// <returns>
394             /// <para>An enumerator of t link</para>
395             /// <para></para>
396             /// </returns>
397             [MethodImpl(MethodImplOptions.AggressiveInlining)]
398             public IEnumerator<TLink> GetEnumerator()
399             {
400                 yield return Index;
```

```
            yield return Source;
            yield return Target;
        }

        /// <summary>
        /// <para>
        /// Adds the item.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="item">
        /// <para>The item.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void Add(TLink item) => throw new NotSupportedException();

        /// <summary>
        /// <para>
        /// Clears this instance.
        /// </para>
        /// <para></para>
        /// </summary>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void Clear() => throw new NotSupportedException();

        /// <summary>
        /// <para>
        /// Determines whether this instance contains.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="item">
        /// <para>The item.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool Contains(TLink item) => IndexOf(item) >= 0;

        /// <summary>
        /// <para>
        /// Copies the to using the specified array.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="array">
        /// <para>The array.</para>
        /// <para></para>
        /// </param>
        /// <param name="arrayIndex">
        /// <para>The array index.</para>
        /// <para></para>
        /// </param>
        /// <exception cref="InvalidOperationException">
        /// <para></para>
        /// <para></para>
        /// </exception>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void CopyTo(TLink[] array, int arrayIndex)
        {
            Ensure.OnDebug.ArgumentNotNull(array, nameof(array));
            Ensure.OnDebug.ArgumentInRange(arrayIndex, new Range<int>(0, array.Length - 1),
            ↪  nameof(arrayIndex));
            if (arrayIndex + Length > array.Length)
            {
                throw new InvalidOperationException();
            }
            array[arrayIndex++] = Index;
            array[arrayIndex++] = Source;
            array[arrayIndex] = Target;
        }

        /// <summary>
        /// <para>
```

```
        /// Determines whether this instance remove.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="item">
        /// <para>The item.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool Remove(TLink item) => Throw.A.NotSupportedExceptionAndReturn<bool>();

        /// <summary>
        /// <para>
        /// Indexes the of using the specified item.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="item">
        /// <para>The item.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The int</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public int IndexOf(TLink item)
        {
            if (_equalityComparer.Equals(Index, item))
            {
                return _constants.IndexPart;
            }
            if (_equalityComparer.Equals(Source, item))
            {
                return _constants.SourcePart;
            }
            if (_equalityComparer.Equals(Target, item))
            {
                return _constants.TargetPart;
            }
            return -1;
        }

        /// <summary>
        /// <para>
        /// Inserts the index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="index">
        /// <para>The index.</para>
        /// <para></para>
        /// </param>
        /// <param name="item">
        /// <para>The item.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void Insert(int index, TLink item) => throw new NotSupportedException();

        /// <summary>
        /// <para>
        /// Removes the at using the specified index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="index">
        /// <para>The index.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void RemoveAt(int index) => throw new NotSupportedException();

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
556         public static bool operator ==(Link<TLink> left, Link<TLink> right) =>
            ↪ left.Equals(right);
557
558         [MethodImpl(MethodImplOptions.AggressiveInlining)]
559         public static bool operator !=(Link<TLink> left, Link<TLink> right) => !(left == right);
560
561         #endregion
562     }
563 }
```

1.26 ./csharp/Platform.Data.Doublets/LinkExtensions.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.Data.Doublets
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the link extensions.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     public static class LinkExtensions
14     {
15         /// <summary>
16         /// <para>
17         /// Determines whether is full point.
18         /// </para>
19         /// <para></para>
20         /// </summary>
21         /// <typeparam name="TLink">
22         /// <para>The link.</para>
23         /// <para></para>
24         /// </typeparam>
25         /// <param name="link">
26         /// <para>The link.</para>
27         /// <para></para>
28         /// </param>
29         /// <returns>
30         /// <para>The bool</para>
31         /// <para></para>
32         /// </returns>
33         [MethodImpl(MethodImplOptions.AggressiveInlining)]
34         public static bool IsFullPoint<TLink>(this Link<TLink> link) =>
            ↪ Point<TLink>.IsFullPoint(link);
35
36         /// <summary>
37         /// <para>
38         /// Determines whether is partial point.
39         /// </para>
40         /// <para></para>
41         /// </summary>
42         /// <typeparam name="TLink">
43         /// <para>The link.</para>
44         /// <para></para>
45         /// </typeparam>
46         /// <param name="link">
47         /// <para>The link.</para>
48         /// <para></para>
49         /// </param>
50         /// <returns>
51         /// <para>The bool</para>
52         /// <para></para>
53         /// </returns>
54         [MethodImpl(MethodImplOptions.AggressiveInlining)]
55         public static bool IsPartialPoint<TLink>(this Link<TLink> link) =>
            ↪ Point<TLink>.IsPartialPoint(link);
56     }
57 }
```

1.27 ./csharp/Platform.Data.Doublets/LinksOperatorBase.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.Data.Doublets
6  {
```

```
    /// <summary>
    /// <para>
    /// Represents the links operator base.
    /// </para>
    /// <para></para>
    /// </summary>
    public abstract class LinksOperatorBase<TLink>
    {
        /// <summary>
        /// <para>
        /// The links.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly ILinks<TLink> _links;

        /// <summary>
        /// <para>
        /// Gets the links value.
        /// </para>
        /// <para></para>
        /// </summary>
        public ILinks<TLink> Links
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get => _links;
        }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksOperatorBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected LinksOperatorBase(ILinks<TLink> links) => _links = links;
    }
}
```

1.28 ./csharp/Platform.Data.Doublets/Memory/ILinksListMethods.cs

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory
{
    /// <summary>
    /// <para>
    /// Defines the links list methods.
    /// </para>
    /// <para></para>
    /// </summary>
    public interface ILinksListMethods<TLink>
    {
        /// <summary>
        /// <para>
        /// Detaches the free link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="freeLink">
        /// <para>The free link.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        void Detach(TLink freeLink);

        /// <summary>
        /// <para>
        /// Attaches the as first using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
```

```
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        void AttachAsFirst(TLink link);
    }
}
```

1.29 ./csharp/Platform.Data.Doublets/Memory/ILinksTreeMethods.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory
{
    /// <summary>
    /// <para>
    /// Defines the links tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    public interface ILinksTreeMethods<TLink>
    {
        /// <summary>
        /// <para>
        /// Counts the usages using the specified root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="root">
        /// <para>The root.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        TLink CountUsages(TLink root);

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        TLink Search(TLink source, TLink target);

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="root">
        /// <para>The root.</para>
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        TLink EachUsage(TLink root, ReadHandler<TLink>? handler);

        /// <summary>
        /// <para>
        /// Detaches the root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="root">
        /// <para>The root.</para>
        /// <para></para>
        /// </param>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        void Detach(ref TLink root, TLink linkIndex);

        /// <summary>
        /// <para>
        /// Attaches the root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="root">
        /// <para>The root.</para>
        /// <para></para>
        /// </param>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        void Attach(ref TLink root, TLink linkIndex);
    }
}
```

1.30 ./csharp/Platform.Data.Doublets/Memory/IndexTreeType.cs

```
#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory
{
    /// <summary>
    /// <para>
    /// The index tree type enum.
    /// </para>
    /// <para></para>
    /// </summary>
    public enum IndexTreeType
    {
        /// <summary>
        /// <para>
        /// The default index tree type.
        /// </para>
        /// <para></para>
        /// </summary>
        Default = 0,
        /// <summary>
        /// <para>
        /// The size balanced tree index tree type.
        /// </para>
        /// <para></para>
        /// </summary>
        SizeBalancedTree = 1,
        /// <summary>
        /// <para>
        /// The recursionless size balanced tree index tree type.
        /// </para>
        /// <para></para>
        /// </summary>
        RecursionlessSizeBalancedTree = 2,
        /// <summary>
        /// <para>
        /// The sized and threaded avl balanced tree index tree type.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        SizedAndThreadedAVLBalancedTree = 3
    }
}
```

1.31 ./csharp/Platform.Data.Doublets/Memory/LinksHeader.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Unsafe;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory
{
    /// <summary>
    /// <para>
    /// The links header.
    /// </para>
    /// <para></para>
    /// </summary>
    public struct LinksHeader<TLink> : IEquatable<LinksHeader<TLink>>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;

        /// <summary>
        /// <para>
        /// The size.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly long SizeInBytes = Structure<LinksHeader<TLink>>.Size;

        /// <summary>
        /// <para>
        /// The allocated links.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink AllocatedLinks;
        /// <summary>
        /// <para>
        /// The reserved links.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink ReservedLinks;
        /// <summary>
        /// <para>
        /// The free links.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink FreeLinks;
        /// <summary>
        /// <para>
        /// The first free link.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink FirstFreeLink;
        /// <summary>
        /// <para>
        /// The root as source.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink RootAsSource;
        /// <summary>
        /// <para>
        /// The root as target.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink RootAsTarget;
        /// <summary>
```

```
        /// <para>
        /// The last free link.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink LastFreeLink;
        /// <summary>
        /// <para>
        /// The reserved.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink Reserved8;

        /// <summary>
        /// <para>
        /// Determines whether this instance equals.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="obj">
        /// <para>The obj.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override bool Equals(object obj) => obj is LinksHeader<TLink> linksHeader ?
        ↪  Equals(linksHeader) : false;

        /// <summary>
        /// <para>
        /// Determines whether this instance equals.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="other">
        /// <para>The other.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool Equals(LinksHeader<TLink> other)
            => _equalityComparer.Equals(AllocatedLinks, other.AllocatedLinks)
            && _equalityComparer.Equals(ReservedLinks, other.ReservedLinks)
            && _equalityComparer.Equals(FreeLinks, other.FreeLinks)
            && _equalityComparer.Equals(FirstFreeLink, other.FirstFreeLink)
            && _equalityComparer.Equals(RootAsSource, other.RootAsSource)
            && _equalityComparer.Equals(RootAsTarget, other.RootAsTarget)
            && _equalityComparer.Equals(LastFreeLink, other.LastFreeLink)
            && _equalityComparer.Equals(Reserved8, other.Reserved8);

        /// <summary>
        /// <para>
        /// Gets the hash code.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The int</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override int GetHashCode() => (AllocatedLinks, ReservedLinks, FreeLinks,
        ↪  FirstFreeLink, RootAsSource, RootAsTarget, LastFreeLink, Reserved8).GetHashCode();

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool operator ==(LinksHeader<TLink> left, LinksHeader<TLink> right) =>
        ↪  left.Equals(right);

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool operator !=(LinksHeader<TLink> left, LinksHeader<TLink> right) =>
        ↪  !(left == right);
```

```
    }
}
```

1.32 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/ExternalLinksRecursionlessSizeBalancedTreeMethod

```
using System;
using System.Text;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Collections.Methods.Trees;
using Platform.Converters;
using Platform.Delegates;
using static System.Runtime.CompilerServices.Unsafe;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
{
    /// <summary>
    /// <para>
    /// Represents the external links recursionless size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="RecursionlessSizeBalancedTreeMethods{TLink}"/>
    /// <seealso cref="ILinksTreeMethods{TLink}"/>
    public unsafe abstract class ExternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink> : RecursionlessSizeBalancedTreeMethods<TLink>, ILinksTreeMethods<TLink>
    {
        private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter = UncheckedConverter<TLink, long>.Default;

        /// <summary>
        /// <para>
        /// The break.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Break;
        /// <summary>
        /// <para>
        /// The continue.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Continue;
        /// <summary>
        /// <para>
        /// The links data parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* LinksDataParts;
        /// <summary>
        /// <para>
        /// The links index parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* LinksIndexParts;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="ExternalLinksRecursionlessSizeBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
```

```
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected ExternalLinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<TLink>
        ↪  constants, byte* linksDataParts, byte* linksIndexParts, byte* header)
        {
            LinksDataParts = linksDataParts;
            LinksIndexParts = linksIndexParts;
            Header = header;
            Break = constants.Break;
            Continue = constants.Continue;
        }

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetTreeRoot();

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetBasePartValue(TLink link);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <param name="rootSource">
        /// <para>The root source.</para>
        /// <para></para>
        /// </param>
        /// <param name="rootTarget">
        /// <para>The root target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
```

```
150         [MethodImpl(MethodImplOptions.AggressiveInlining)]
151         protected abstract bool FirstIsToTheRightOfSecond(TLink source, TLink target, TLink
            ↪  rootSource, TLink rootTarget);
152
153         /// <summary>
154         /// <para>
155         /// Determines whether this instance first is to the left of second.
156         /// </para>
157         /// <para></para>
158         /// </summary>
159         /// <param name="source">
160         /// <para>The source.</para>
161         /// <para></para>
162         /// </param>
163         /// <param name="target">
164         /// <para>The target.</para>
165         /// <para></para>
166         /// </param>
167         /// <param name="rootSource">
168         /// <para>The root source.</para>
169         /// <para></para>
170         /// </param>
171         /// <param name="rootTarget">
172         /// <para>The root target.</para>
173         /// <para></para>
174         /// </param>
175         /// <returns>
176         /// <para>The bool</para>
177         /// <para></para>
178         /// </returns>
179         [MethodImpl(MethodImplOptions.AggressiveInlining)]
180         protected abstract bool FirstIsToTheLeftOfSecond(TLink source, TLink target, TLink
            ↪  rootSource, TLink rootTarget);
181
182         /// <summary>
183         /// <para>
184         /// Gets the header reference.
185         /// </para>
186         /// <para></para>
187         /// </summary>
188         /// <returns>
189         /// <para>A ref links header of t link</para>
190         /// <para></para>
191         /// </returns>
192         [MethodImpl(MethodImplOptions.AggressiveInlining)]
193         protected virtual ref LinksHeader<TLink> GetHeaderReference() => ref
            ↪  AsRef<LinksHeader<TLink>>(Header);
194
195         /// <summary>
196         /// <para>
197         /// Gets the link data part reference using the specified link.
198         /// </para>
199         /// <para></para>
200         /// </summary>
201         /// <param name="link">
202         /// <para>The link.</para>
203         /// <para></para>
204         /// </param>
205         /// <returns>
206         /// <para>A ref raw link data part of t link</para>
207         /// <para></para>
208         /// </returns>
209         [MethodImpl(MethodImplOptions.AggressiveInlining)]
210         protected virtual ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) => ref
            ↪  AsRef<RawLinkDataPart<TLink>>(LinksDataParts + (RawLinkDataPart<TLink>.SizeInBytes *
            ↪  _addressToInt64Converter.Convert(link)));
211
212         /// <summary>
213         /// <para>
214         /// Gets the link index part reference using the specified link.
215         /// </para>
216         /// <para></para>
217         /// </summary>
218         /// <param name="link">
219         /// <para>The link.</para>
220         /// <para></para>
221         /// </param>
```

```
222             /// <returns>
223             /// <para>A ref raw link index part of t link</para>
224             /// <para></para>
225             /// </returns>
226             [MethodImpl(MethodImplOptions.AggressiveInlining)]
227             protected virtual ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
                ↪  ref AsRef<RawLinkIndexPart<TLink>>(LinksIndexParts +
                ↪  (RawLinkIndexPart<TLink>.SizeInBytes * _addressToInt64Converter.Convert(link)));
228
229             /// <summary>
230             /// <para>
231             /// Gets the link values using the specified link index.
232             /// </para>
233             /// <para></para>
234             /// </summary>
235             /// <param name="linkIndex">
236             /// <para>The link index.</para>
237             /// <para></para>
238             /// </param>
239             /// <returns>
240             /// <para>A list of t link</para>
241             /// <para></para>
242             /// </returns>
243             [MethodImpl(MethodImplOptions.AggressiveInlining)]
244             protected virtual IList<TLink>? GetLinkValues(TLink linkIndex)
245             {
246                 ref var link = ref GetLinkDataPartReference(linkIndex);
247                 return new Link<TLink>(linkIndex, link.Source, link.Target);
248             }
249
250             /// <summary>
251             /// <para>
252             /// Determines whether this instance first is to the left of second.
253             /// </para>
254             /// <para></para>
255             /// </summary>
256             /// <param name="first">
257             /// <para>The first.</para>
258             /// <para></para>
259             /// </param>
260             /// <param name="second">
261             /// <para>The second.</para>
262             /// <para></para>
263             /// </param>
264             /// <returns>
265             /// <para>The bool</para>
266             /// <para></para>
267             /// </returns>
268             [MethodImpl(MethodImplOptions.AggressiveInlining)]
269             protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
270             {
271                 ref var firstLink = ref GetLinkDataPartReference(first);
272                 ref var secondLink = ref GetLinkDataPartReference(second);
273                 return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                    ↪  secondLink.Source, secondLink.Target);
274             }
275
276             /// <summary>
277             /// <para>
278             /// Determines whether this instance first is to the right of second.
279             /// </para>
280             /// <para></para>
281             /// </summary>
282             /// <param name="first">
283             /// <para>The first.</para>
284             /// <para></para>
285             /// </param>
286             /// <param name="second">
287             /// <para>The second.</para>
288             /// <para></para>
289             /// </param>
290             /// <returns>
291             /// <para>The bool</para>
292             /// <para></para>
293             /// </returns>
294             [MethodImpl(MethodImplOptions.AggressiveInlining)]
295             protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
296             {
```

```
297             ref var firstLink = ref GetLinkDataPartReference(first);
298             ref var secondLink = ref GetLinkDataPartReference(second);
299             return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
                    ↪ secondLink.Source, secondLink.Target);
300         }
301
302         /// <summary>
303         /// <para>
304         /// The zero.
305         /// </para>
306         /// <para></para>
307         /// </summary>
308         public TLink this[TLink index]
309         {
310             [MethodImpl(MethodImplOptions.AggressiveInlining)]
311             get
312             {
313                 var root = GetTreeRoot();
314                 if (GreaterOrEqualThan(index, GetSize(root)))
315                 {
316                     return Zero;
317                 }
318                 while (!EqualToZero(root))
319                 {
320                     var left = GetLeftOrDefault(root);
321                     var leftSize = GetSizeOrZero(left);
322                     if (LessThan(index, leftSize))
323                     {
324                         root = left;
325                         continue;
326                     }
327                     if (AreEqual(index, leftSize))
328                     {
329                         return root;
330                     }
331                     root = GetRightOrDefault(root);
332                     index = Subtract(index, Increment(leftSize));
333                 }
334                 return Zero; // TODO: Impossible situation exception (only if tree structure
                        ↪ broken)
335             }
336         }
337
338         /// <summary>
339         /// Выполняет поиск и возвращает индекс связи с указанными Source (началом) и Target
                ↪ (концом).
340         /// </summary>
341         /// <param name="source">Индекс связи, которая является началом на искомой связи.</param>
342         /// <param name="target">Индекс связи, которая является концом на искомой связи.</param>
343         /// <returns>Индекс искомой связи.</returns>
344         [MethodImpl(MethodImplOptions.AggressiveInlining)]
345         public TLink Search(TLink source, TLink target)
346         {
347             var root = GetTreeRoot();
348             while (!EqualToZero(root))
349             {
350                 ref var rootLink = ref GetLinkDataPartReference(root);
351                 var rootSource = rootLink.Source;
352                 var rootTarget = rootLink.Target;
353                 if (FirstIsToTheLeftOfSecond(source, target, rootSource, rootTarget)) //
                        ↪ node.Key < root.Key
354                 {
355                     root = GetLeftOrDefault(root);
356                 }
357                 else if (FirstIsToTheRightOfSecond(source, target, rootSource, rootTarget)) //
                        ↪ node.Key > root.Key
358                 {
359                     root = GetRightOrDefault(root);
360                 }
361                 else // node.Key == root.Key
362                 {
363                     return root;
364                 }
365             }
366             return Zero;
367         }
368
369         // TODO: Return indices range instead of references count
```

```
        /// <summary>
        /// <para>
        /// Counts the usages using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink CountUsages(TLink link)
        {
            var root = GetTreeRoot();
            var total = GetSize(root);
            var totalRightIgnore = Zero;
            while (!EqualToZero(root))
            {
                var @base = GetBasePartValue(root);
                if (LessOrEqualThan(@base, link))
                {
                    root = GetRightOrDefault(root);
                }
                else
                {
                    totalRightIgnore = Add(totalRightIgnore, Increment(GetRightSize(root)));
                    root = GetLeftOrDefault(root);
                }
            }
            root = GetTreeRoot();
            var totalLeftIgnore = Zero;
            while (!EqualToZero(root))
            {
                var @base = GetBasePartValue(root);
                if (GreaterOrEqualThan(@base, link))
                {
                    root = GetLeftOrDefault(root);
                }
                else
                {
                    totalLeftIgnore = Add(totalLeftIgnore, Increment(GetLeftSize(root)));
                    root = GetRightOrDefault(root);
                }
            }
            return Subtract(Subtract(total, totalRightIgnore), totalLeftIgnore);
        }

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified base.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="@base">
        /// <para>The base.</para>
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink EachUsage(TLink @base, ReadHandler<TLink>? handler) => EachUsageCore(@base,
        ↪  GetTreeRoot(), handler);

        // TODO: 1. Move target, handler to separate object. 2. Use stack or walker 3. Use
        ↪  low-level MSIL stack.
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink EachUsageCore(TLink @base, TLink link, ReadHandler<TLink>? handler)
        {
```

```
            var @continue = Continue;
            if (EqualToZero(link))
            {
                return @continue;
            }
            var linkBasePart = GetBasePartValue(link);
            var @break = Break;
            if (GreaterThan(linkBasePart, @base))
            {
                if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            else if (LessThan(linkBasePart, @base))
            {
                if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            else //if (linkBasePart == @base)
            {
                if (AreEqual(handler(GetLinkValues(link)), @break))
                {
                    return @break;
                }
                if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
                {
                    return @break;
                }
                if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            return @continue;
        }

        /// <summary>
        /// <para>
        /// Prints the node value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="sb">
        /// <para>The sb.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void PrintNodeValue(TLink node, StringBuilder sb)
        {
            ref var link = ref GetLinkDataPartReference(node);
            sb.Append(' ');
            sb.Append(link.Source);
            sb.Append('-');
            sb.Append('>');
            sb.Append(link.Target);
        }
    }
}
```

1.33 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/ExternalLinksSizeBalancedTreeMethodsBase.cs

```
using System;
using System.Text;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Collections.Methods.Trees;
using Platform.Converters;
using Platform.Delegates;
using static System.Runtime.CompilerServices.Unsafe;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
```

```
{
    /// <summary>
    /// <para>
    /// Represents the external links size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="SizeBalancedTreeMethods{TLink}"/>
    /// <seealso cref="ILinksTreeMethods{TLink}"/>
    public unsafe abstract class ExternalLinksSizeBalancedTreeMethodsBase<TLink> : SizeBalancedTreeMethods<TLink>, ILinksTreeMethods<TLink>
    {
        private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter = UncheckedConverter<TLink, long>.Default;

        /// <summary>
        /// <para>
        /// The break.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Break;
        /// <summary>
        /// <para>
        /// The continue.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Continue;
        /// <summary>
        /// <para>
        /// The links data parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* LinksDataParts;
        /// <summary>
        /// <para>
        /// The links index parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* LinksIndexParts;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="ExternalLinksSizeBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected ExternalLinksSizeBalancedTreeMethodsBase(LinksConstants<TLink> constants, byte* linksDataParts, byte* linksIndexParts, byte* header)
        {
            LinksDataParts = linksDataParts;
```

```
            LinksIndexParts = linksIndexParts;
            Header = header;
            Break = constants.Break;
            Continue = constants.Continue;
        }

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetTreeRoot();

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetBasePartValue(TLink link);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <param name="rootSource">
        /// <para>The root source.</para>
        /// <para></para>
        /// </param>
        /// <param name="rootTarget">
        /// <para>The root target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract bool FirstIsToTheRightOfSecond(TLink source, TLink target, TLink
        ↪  rootSource, TLink rootTarget);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
```

```
        /// <para></para>
        /// </param>
        /// <param name="rootSource">
        /// <para>The root source.</para>
        /// <para></para>
        /// </param>
        /// <param name="rootTarget">
        /// <para>The root target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract bool FirstIsToTheLeftOfSecond(TLink source, TLink target, TLink
        ↪  rootSource, TLink rootTarget);

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref LinksHeader<TLink> GetHeaderReference() => ref
        ↪  AsRef<LinksHeader<TLink>>(Header);

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link data part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) => ref
        ↪  AsRef<RawLinkDataPart<TLink>>(LinksDataParts + (RawLinkDataPart<TLink>.SizeInBytes *
        ↪  _addressToInt64Converter.Convert(link)));

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
        ↪  ref AsRef<RawLinkIndexPart<TLink>>(LinksIndexParts +
        ↪  (RawLinkIndexPart<TLink>.SizeInBytes * _addressToInt64Converter.Convert(link)));

        /// <summary>
        /// <para>
        /// Gets the link values using the specified link index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
```

```
237         /// <para></para>
238         /// </param>
239         /// <returns>
240         /// <para>A list of t link</para>
241         /// <para></para>
242         /// </returns>
243         [MethodImpl(MethodImplOptions.AggressiveInlining)]
244         protected virtual IList<TLink>? GetLinkValues(TLink linkIndex)
245         {
246             ref var link = ref GetLinkDataPartReference(linkIndex);
247             return new Link<TLink>(linkIndex, link.Source, link.Target);
248         }
249 
250         /// <summary>
251         /// <para>
252         /// Determines whether this instance first is to the left of second.
253         /// </para>
254         /// <para></para>
255         /// </summary>
256         /// <param name="first">
257         /// <para>The first.</para>
258         /// <para></para>
259         /// </param>
260         /// <param name="second">
261         /// <para>The second.</para>
262         /// <para></para>
263         /// </param>
264         /// <returns>
265         /// <para>The bool</para>
266         /// <para></para>
267         /// </returns>
268         [MethodImpl(MethodImplOptions.AggressiveInlining)]
269         protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
270         {
271             ref var firstLink = ref GetLinkDataPartReference(first);
272             ref var secondLink = ref GetLinkDataPartReference(second);
273             return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                ↪  secondLink.Source, secondLink.Target);
274         }
275 
276         /// <summary>
277         /// <para>
278         /// Determines whether this instance first is to the right of second.
279         /// </para>
280         /// <para></para>
281         /// </summary>
282         /// <param name="first">
283         /// <para>The first.</para>
284         /// <para></para>
285         /// </param>
286         /// <param name="second">
287         /// <para>The second.</para>
288         /// <para></para>
289         /// </param>
290         /// <returns>
291         /// <para>The bool</para>
292         /// <para></para>
293         /// </returns>
294         [MethodImpl(MethodImplOptions.AggressiveInlining)]
295         protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
296         {
297             ref var firstLink = ref GetLinkDataPartReference(first);
298             ref var secondLink = ref GetLinkDataPartReference(second);
299             return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
                ↪  secondLink.Source, secondLink.Target);
300         }
301 
302         /// <summary>
303         /// <para>
304         /// The zero.
305         /// </para>
306         /// <para></para>
307         /// </summary>
308         public TLink this[TLink index]
309         {
310             [MethodImpl(MethodImplOptions.AggressiveInlining)]
311             get
312             {
```

```
313                 var root = GetTreeRoot();
314                 if (GreaterOrEqualThan(index, GetSize(root)))
315                 {
316                     return Zero;
317                 }
318                 while (!EqualToZero(root))
319                 {
320                     var left = GetLeftOrDefault(root);
321                     var leftSize = GetSizeOrZero(left);
322                     if (LessThan(index, leftSize))
323                     {
324                         root = left;
325                         continue;
326                     }
327                     if (AreEqual(index, leftSize))
328                     {
329                         return root;
330                     }
331                     root = GetRightOrDefault(root);
332                     index = Subtract(index, Increment(leftSize));
333                 }
334                 return Zero; // TODO: Impossible situation exception (only if tree structure
                    ↪ broken)
335             }
336         }
337 
338         /// <summary>
339         /// Выполняет поиск и возвращает индекс связи с указанными Source (началом) и Target
                ↪ (концом).
340         /// </summary>
341         /// <param name="source">Индекс связи, которая является началом на искомой связи.</param>
342         /// <param name="target">Индекс связи, которая является концом на искомой связи.</param>
343         /// <returns>Индекс искомой связи.</returns>
344         [MethodImpl(MethodImplOptions.AggressiveInlining)]
345         public TLink Search(TLink source, TLink target)
346         {
347             var root = GetTreeRoot();
348             while (!EqualToZero(root))
349             {
350                 ref var rootLink = ref GetLinkDataPartReference(root);
351                 var rootSource = rootLink.Source;
352                 var rootTarget = rootLink.Target;
353                 if (FirstIsToTheLeftOfSecond(source, target, rootSource, rootTarget)) //
                    ↪ node.Key < root.Key
354                 {
355                     root = GetLeftOrDefault(root);
356                 }
357                 else if (FirstIsToTheRightOfSecond(source, target, rootSource, rootTarget)) //
                    ↪ node.Key > root.Key
358                 {
359                     root = GetRightOrDefault(root);
360                 }
361                 else // node.Key == root.Key
362                 {
363                     return root;
364                 }
365             }
366             return Zero;
367         }
368 
369         // TODO: Return indices range instead of references count
370         /// <summary>
371         /// <para>
372         /// Counts the usages using the specified link.
373         /// </para>
374         /// <para></para>
375         /// </summary>
376         /// <param name="link">
377         /// <para>The link.</para>
378         /// <para></para>
379         /// </param>
380         /// <returns>
381         /// <para>The link</para>
382         /// <para></para>
383         /// </returns>
384         [MethodImpl(MethodImplOptions.AggressiveInlining)]
385         public TLink CountUsages(TLink link)
386         {
```

```
            var root = GetTreeRoot();
            var total = GetSize(root);
            var totalRightIgnore = Zero;
            while (!EqualToZero(root))
            {
                var @base = GetBasePartValue(root);
                if (LessOrEqualThan(@base, link))
                {
                    root = GetRightOrDefault(root);
                }
                else
                {
                    totalRightIgnore = Add(totalRightIgnore, Increment(GetRightSize(root)));
                    root = GetLeftOrDefault(root);
                }
            }
            root = GetTreeRoot();
            var totalLeftIgnore = Zero;
            while (!EqualToZero(root))
            {
                var @base = GetBasePartValue(root);
                if (GreaterOrEqualThan(@base, link))
                {
                    root = GetLeftOrDefault(root);
                }
                else
                {
                    totalLeftIgnore = Add(totalLeftIgnore, Increment(GetLeftSize(root)));
                    root = GetRightOrDefault(root);
                }
            }
            return Subtract(Subtract(total, totalRightIgnore), totalLeftIgnore);
        }

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified base.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="@base">
        /// <para>The base.</para>
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink EachUsage(TLink @base, ReadHandler<TLink>? handler) => EachUsageCore(@base,
        ↪  GetTreeRoot(), handler);

        // TODO: 1. Move target, handler to separate object. 2. Use stack or walker 3. Use
        ↪  low-level MSIL stack.
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink EachUsageCore(TLink @base, TLink link, ReadHandler<TLink>? handler)
        {
            var @continue = Continue;
            if (EqualToZero(link))
            {
                return @continue;
            }
            var linkBasePart = GetBasePartValue(link);
            var @break = Break;
            if (GreaterThan(linkBasePart, @base))
            {
                if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            else if (LessThan(linkBasePart, @base))
            {
                if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
```

```
                {
                    return @break;
                }
            }
            else //if (linkBasePart == @base)
            {
                if (AreEqual(handler(GetLinkValues(link)), @break))
                {
                    return @break;
                }
                if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
                {
                    return @break;
                }
                if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            return @continue;
        }

        /// <summary>
        /// <para>
        /// Prints the node value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="sb">
        /// <para>The sb.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void PrintNodeValue(TLink node, StringBuilder sb)
        {
            ref var link = ref GetLinkDataPartReference(node);
            sb.Append(' ');
            sb.Append(link.Source);
            sb.Append('-');
            sb.Append('>');
            sb.Append(link.Target);
        }
    }
}
```

1.34 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/ExternalLinksSourcesRecursionlessSizeBalancedTree

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
{
    /// <summary>
    /// <para>
    /// Represents the external links sources recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="ExternalLinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
    public unsafe class ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods<TLink> :
    ↪ ExternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪ cref="ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
```

```
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪  constants, byte* linksDataParts, byte* linksIndexParts, byte* header) :
        ↪  base(constants, linksDataParts, linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪  GetLinkIndexPartReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  GetLinkIndexPartReference(node).RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) =>
        ↪  GetLinkIndexPartReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
```

```
99          /// <para>The node.</para>
100         /// <para></para>
101         /// </param>
102         /// <returns>
103         /// <para>The link</para>
104         /// <para></para>
105         /// </returns>
106         [MethodImpl(MethodImplOptions.AggressiveInlining)]
107         protected override TLink GetRight(TLink node) =>
            ↪ GetLinkIndexPartReference(node).RightAsSource;
108
109         /// <summary>
110         /// <para>
111         /// Sets the left using the specified node.
112         /// </para>
113         /// <para></para>
114         /// </summary>
115         /// <param name="node">
116         /// <para>The node.</para>
117         /// <para></para>
118         /// </param>
119         /// <param name="left">
120         /// <para>The left.</para>
121         /// <para></para>
122         /// </param>
123         [MethodImpl(MethodImplOptions.AggressiveInlining)]
124         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkIndexPartReference(node).LeftAsSource = left;
125
126         /// <summary>
127         /// <para>
128         /// Sets the right using the specified node.
129         /// </para>
130         /// <para></para>
131         /// </summary>
132         /// <param name="node">
133         /// <para>The node.</para>
134         /// <para></para>
135         /// </param>
136         /// <param name="right">
137         /// <para>The right.</para>
138         /// <para></para>
139         /// </param>
140         [MethodImpl(MethodImplOptions.AggressiveInlining)]
141         protected override void SetRight(TLink node, TLink right) =>
            ↪ GetLinkIndexPartReference(node).RightAsSource = right;
142
143         /// <summary>
144         /// <para>
145         /// Gets the size using the specified node.
146         /// </para>
147         /// <para></para>
148         /// </summary>
149         /// <param name="node">
150         /// <para>The node.</para>
151         /// <para></para>
152         /// </param>
153         /// <returns>
154         /// <para>The link</para>
155         /// <para></para>
156         /// </returns>
157         [MethodImpl(MethodImplOptions.AggressiveInlining)]
158         protected override TLink GetSize(TLink node) =>
            ↪ GetLinkIndexPartReference(node).SizeAsSource;
159
160         /// <summary>
161         /// <para>
162         /// Sets the size using the specified node.
163         /// </para>
164         /// <para></para>
165         /// </summary>
166         /// <param name="node">
167         /// <para>The node.</para>
168         /// <para></para>
169         /// </param>
170         /// <param name="size">
171         /// <para>The size.</para>
172         /// <para></para>
```

```
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  GetLinkIndexPartReference(node).SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => GetHeaderReference().RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink link) =>
        ↪  GetLinkDataPartReference(link).Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => LessThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && LessThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
```

```
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => GreaterThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && GreaterThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref GetLinkIndexPartReference(node);
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }
    }
}
```

1.35 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/ExternalLinksSourcesSizeBalancedTreeMethods.cs

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
{
    /// <summary>
    /// <para>
    /// Represents the external links sources size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="ExternalLinksSizeBalancedTreeMethodsBase{TLink}"/>
    public unsafe class ExternalLinksSourcesSizeBalancedTreeMethods<TLink> :
    ↪  ExternalLinksSizeBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="ExternalLinksSourcesSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
```

```
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public ExternalLinksSourcesSizeBalancedTreeMethods(LinksConstants<TLink> constants,
        ↪  byte* linksDataParts, byte* linksIndexParts, byte* header) : base(constants,
        ↪  linksDataParts, linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪  GetLinkIndexPartReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  GetLinkIndexPartReference(node).RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) =>
        ↪  GetLinkIndexPartReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) =>
        ↪  GetLinkIndexPartReference(node).RightAsSource;
```

```
108
109         /// <summary>
110         /// <para>
111         /// Sets the left using the specified node.
112         /// </para>
113         /// <para></para>
114         /// </summary>
115         /// <param name="node">
116         /// <para>The node.</para>
117         /// <para></para>
118         /// </param>
119         /// <param name="left">
120         /// <para>The left.</para>
121         /// <para></para>
122         /// </param>
123         [MethodImpl(MethodImplOptions.AggressiveInlining)]
124         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkIndexPartReference(node).LeftAsSource = left;
125
126         /// <summary>
127         /// <para>
128         /// Sets the right using the specified node.
129         /// </para>
130         /// <para></para>
131         /// </summary>
132         /// <param name="node">
133         /// <para>The node.</para>
134         /// <para></para>
135         /// </param>
136         /// <param name="right">
137         /// <para>The right.</para>
138         /// <para></para>
139         /// </param>
140         [MethodImpl(MethodImplOptions.AggressiveInlining)]
141         protected override void SetRight(TLink node, TLink right) =>
            ↪ GetLinkIndexPartReference(node).RightAsSource = right;
142
143         /// <summary>
144         /// <para>
145         /// Gets the size using the specified node.
146         /// </para>
147         /// <para></para>
148         /// </summary>
149         /// <param name="node">
150         /// <para>The node.</para>
151         /// <para></para>
152         /// </param>
153         /// <returns>
154         /// <para>The link</para>
155         /// <para></para>
156         /// </returns>
157         [MethodImpl(MethodImplOptions.AggressiveInlining)]
158         protected override TLink GetSize(TLink node) =>
            ↪ GetLinkIndexPartReference(node).SizeAsSource;
159
160         /// <summary>
161         /// <para>
162         /// Sets the size using the specified node.
163         /// </para>
164         /// <para></para>
165         /// </summary>
166         /// <param name="node">
167         /// <para>The node.</para>
168         /// <para></para>
169         /// </param>
170         /// <param name="size">
171         /// <para>The size.</para>
172         /// <para></para>
173         /// </param>
174         [MethodImpl(MethodImplOptions.AggressiveInlining)]
175         protected override void SetSize(TLink node, TLink size) =>
            ↪ GetLinkIndexPartReference(node).SizeAsSource = size;
176
177         /// <summary>
178         /// <para>
179         /// Gets the tree root.
180         /// </para>
181         /// <para></para>
```

```
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => GetHeaderReference().RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink link) =>
        ↪  GetLinkDataPartReference(link).Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => LessThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && LessThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
```

```
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => GreaterThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && GreaterThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref GetLinkIndexPartReference(node);
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }
    }
}
```

1.36 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/ExternalLinksTargetsRecursionlessSizeBalancedTree

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
{
    /// <summary>
    /// <para>
    /// Represents the external links targets recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="ExternalLinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
    public unsafe class ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods<TLink> :
    ↪  ExternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪  cref="ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪  constants, byte* linksDataParts, byte* linksIndexParts, byte* header) :
        ↪  base(constants, linksDataParts, linksIndexParts, header) { }

        /// <summary>
        /// <para>
```

```
43          /// Gets the left reference using the specified node.
44          /// </para>
45          /// <para></para>
46          /// </summary>
47          /// <param name="node">
48          /// <para>The node.</para>
49          /// <para></para>
50          /// </param>
51          /// <returns>
52          /// <para>The ref link</para>
53          /// <para></para>
54          /// </returns>
55          [MethodImpl(MethodImplOptions.AggressiveInlining)]
56          protected override ref TLink GetLeftReference(TLink node) => ref
            ↪ GetLinkIndexPartReference(node).LeftAsTarget;
57
58          /// <summary>
59          /// <para>
60          /// Gets the right reference using the specified node.
61          /// </para>
62          /// <para></para>
63          /// </summary>
64          /// <param name="node">
65          /// <para>The node.</para>
66          /// <para></para>
67          /// </param>
68          /// <returns>
69          /// <para>The ref link</para>
70          /// <para></para>
71          /// </returns>
72          [MethodImpl(MethodImplOptions.AggressiveInlining)]
73          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ GetLinkIndexPartReference(node).RightAsTarget;
74
75          /// <summary>
76          /// <para>
77          /// Gets the left using the specified node.
78          /// </para>
79          /// <para></para>
80          /// </summary>
81          /// <param name="node">
82          /// <para>The node.</para>
83          /// <para></para>
84          /// </param>
85          /// <returns>
86          /// <para>The link</para>
87          /// <para></para>
88          /// </returns>
89          [MethodImpl(MethodImplOptions.AggressiveInlining)]
90          protected override TLink GetLeft(TLink node) =>
            ↪ GetLinkIndexPartReference(node).LeftAsTarget;
91
92          /// <summary>
93          /// <para>
94          /// Gets the right using the specified node.
95          /// </para>
96          /// <para></para>
97          /// </summary>
98          /// <param name="node">
99          /// <para>The node.</para>
100         /// <para></para>
101         /// </param>
102         /// <returns>
103         /// <para>The link</para>
104         /// <para></para>
105         /// </returns>
106         [MethodImpl(MethodImplOptions.AggressiveInlining)]
107         protected override TLink GetRight(TLink node) =>
            ↪ GetLinkIndexPartReference(node).RightAsTarget;
108
109         /// <summary>
110         /// <para>
111         /// Sets the left using the specified node.
112         /// </para>
113         /// <para></para>
114         /// </summary>
115         /// <param name="node">
116         /// <para>The node.</para>
```

```
117         /// <para></para>
118         /// </param>
119         /// <param name="left">
120         /// <para>The left.</para>
121         /// <para></para>
122         /// </param>
123         [MethodImpl(MethodImplOptions.AggressiveInlining)]
124         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkIndexPartReference(node).LeftAsTarget = left;
125
126         /// <summary>
127         /// <para>
128         /// Sets the right using the specified node.
129         /// </para>
130         /// <para></para>
131         /// </summary>
132         /// <param name="node">
133         /// <para>The node.</para>
134         /// <para></para>
135         /// </param>
136         /// <param name="right">
137         /// <para>The right.</para>
138         /// <para></para>
139         /// </param>
140         [MethodImpl(MethodImplOptions.AggressiveInlining)]
141         protected override void SetRight(TLink node, TLink right) =>
            ↪ GetLinkIndexPartReference(node).RightAsTarget = right;
142
143         /// <summary>
144         /// <para>
145         /// Gets the size using the specified node.
146         /// </para>
147         /// <para></para>
148         /// </summary>
149         /// <param name="node">
150         /// <para>The node.</para>
151         /// <para></para>
152         /// </param>
153         /// <returns>
154         /// <para>The link</para>
155         /// <para></para>
156         /// </returns>
157         [MethodImpl(MethodImplOptions.AggressiveInlining)]
158         protected override TLink GetSize(TLink node) =>
            ↪ GetLinkIndexPartReference(node).SizeAsTarget;
159
160         /// <summary>
161         /// <para>
162         /// Sets the size using the specified node.
163         /// </para>
164         /// <para></para>
165         /// </summary>
166         /// <param name="node">
167         /// <para>The node.</para>
168         /// <para></para>
169         /// </param>
170         /// <param name="size">
171         /// <para>The size.</para>
172         /// <para></para>
173         /// </param>
174         [MethodImpl(MethodImplOptions.AggressiveInlining)]
175         protected override void SetSize(TLink node, TLink size) =>
            ↪ GetLinkIndexPartReference(node).SizeAsTarget = size;
176
177         /// <summary>
178         /// <para>
179         /// Gets the tree root.
180         /// </para>
181         /// <para></para>
182         /// </summary>
183         /// <returns>
184         /// <para>The link</para>
185         /// <para></para>
186         /// </returns>
187         [MethodImpl(MethodImplOptions.AggressiveInlining)]
188         protected override TLink GetTreeRoot() => GetHeaderReference().RootAsTarget;
189
190         /// <summary>
```

```
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink link) =>
        ↪  GetLinkDataPartReference(link).Target;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => LessThan(firstTarget, secondTarget) ||
        ↪  (AreEqual(firstTarget, secondTarget) && LessThan(firstSource, secondSource));

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => GreaterThan(firstTarget, secondTarget) ||
        ↪  (AreEqual(firstTarget, secondTarget) && GreaterThan(firstSource, secondSource));
```

```
264
265         /// <summary>
266         /// <para>
267         /// Clears the node using the specified node.
268         /// </para>
269         /// <para></para>
270         /// </summary>
271         /// <param name="node">
272         /// <para>The node.</para>
273         /// <para></para>
274         /// </param>
275         [MethodImpl(MethodImplOptions.AggressiveInlining)]
276         protected override void ClearNode(TLink node)
277         {
278             ref var link = ref GetLinkIndexPartReference(node);
279             link.LeftAsTarget = Zero;
280             link.RightAsTarget = Zero;
281             link.SizeAsTarget = Zero;
282         }
283     }
284 }
```

1.37 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/ExternalLinksTargetsSizeBalancedTreeMethods.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.Data.Doublets.Memory.Split.Generic
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the external links targets size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="ExternalLinksSizeBalancedTreeMethodsBase{TLink}"/>
14     public unsafe class ExternalLinksTargetsSizeBalancedTreeMethods<TLink> :
       ↪  ExternalLinksSizeBalancedTreeMethodsBase<TLink>
15     {
16         /// <summary>
17         /// <para>
18         /// Initializes a new <see cref="ExternalLinksTargetsSizeBalancedTreeMethods"/> instance.
19         /// </para>
20         /// <para></para>
21         /// </summary>
22         /// <param name="constants">
23         /// <para>A constants.</para>
24         /// <para></para>
25         /// </param>
26         /// <param name="linksDataParts">
27         /// <para>A links data parts.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="linksIndexParts">
31         /// <para>A links index parts.</para>
32         /// <para></para>
33         /// </param>
34         /// <param name="header">
35         /// <para>A header.</para>
36         /// <para></para>
37         /// </param>
38         [MethodImpl(MethodImplOptions.AggressiveInlining)]
39         public ExternalLinksTargetsSizeBalancedTreeMethods(LinksConstants<TLink> constants,
           ↪  byte* linksDataParts, byte* linksIndexParts, byte* header) : base(constants,
           ↪  linksDataParts, linksIndexParts, header) { }
40
41         /// <summary>
42         /// <para>
43         /// Gets the left reference using the specified node.
44         /// </para>
45         /// <para></para>
46         /// </summary>
47         /// <param name="node">
48         /// <para>The node.</para>
49         /// <para></para>
50         /// </param>
51         /// <returns>
52         /// <para>The ref link</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪ GetLinkIndexPartReference(node).LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪ GetLinkIndexPartReference(node).RightAsTarget;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) =>
        ↪ GetLinkIndexPartReference(node).LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) =>
        ↪ GetLinkIndexPartReference(node).RightAsTarget;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪ GetLinkIndexPartReference(node).LeftAsTarget = left;
```

```
125
126         /// <summary>
127         /// <para>
128         /// Sets the right using the specified node.
129         /// </para>
130         /// <para></para>
131         /// </summary>
132         /// <param name="node">
133         /// <para>The node.</para>
134         /// <para></para>
135         /// </param>
136         /// <param name="right">
137         /// <para>The right.</para>
138         /// <para></para>
139         /// </param>
140         [MethodImpl(MethodImplOptions.AggressiveInlining)]
141         protected override void SetRight(TLink node, TLink right) =>
            ↪ GetLinkIndexPartReference(node).RightAsTarget = right;
142
143         /// <summary>
144         /// <para>
145         /// Gets the size using the specified node.
146         /// </para>
147         /// <para></para>
148         /// </summary>
149         /// <param name="node">
150         /// <para>The node.</para>
151         /// <para></para>
152         /// </param>
153         /// <returns>
154         /// <para>The link</para>
155         /// <para></para>
156         /// </returns>
157         [MethodImpl(MethodImplOptions.AggressiveInlining)]
158         protected override TLink GetSize(TLink node) =>
            ↪ GetLinkIndexPartReference(node).SizeAsTarget;
159
160         /// <summary>
161         /// <para>
162         /// Sets the size using the specified node.
163         /// </para>
164         /// <para></para>
165         /// </summary>
166         /// <param name="node">
167         /// <para>The node.</para>
168         /// <para></para>
169         /// </param>
170         /// <param name="size">
171         /// <para>The size.</para>
172         /// <para></para>
173         /// </param>
174         [MethodImpl(MethodImplOptions.AggressiveInlining)]
175         protected override void SetSize(TLink node, TLink size) =>
            ↪ GetLinkIndexPartReference(node).SizeAsTarget = size;
176
177         /// <summary>
178         /// <para>
179         /// Gets the tree root.
180         /// </para>
181         /// <para></para>
182         /// </summary>
183         /// <returns>
184         /// <para>The link</para>
185         /// <para></para>
186         /// </returns>
187         [MethodImpl(MethodImplOptions.AggressiveInlining)]
188         protected override TLink GetTreeRoot() => GetHeaderReference().RootAsTarget;
189
190         /// <summary>
191         /// <para>
192         /// Gets the base part value using the specified link.
193         /// </para>
194         /// <para></para>
195         /// </summary>
196         /// <param name="link">
197         /// <para>The link.</para>
198         /// <para></para>
199         /// </param>
```

```
200         /// <returns>
201         /// <para>The link</para>
202         /// <para></para>
203         /// </returns>
204         [MethodImpl(MethodImplOptions.AggressiveInlining)]
205         protected override TLink GetBasePartValue(TLink link) =>
            ↪ GetLinkDataPartReference(link).Target;
206
207         /// <summary>
208         /// <para>
209         /// Determines whether this instance first is to the left of second.
210         /// </para>
211         /// <para></para>
212         /// </summary>
213         /// <param name="firstSource">
214         /// <para>The first source.</para>
215         /// <para></para>
216         /// </param>
217         /// <param name="firstTarget">
218         /// <para>The first target.</para>
219         /// <para></para>
220         /// </param>
221         /// <param name="secondSource">
222         /// <para>The second source.</para>
223         /// <para></para>
224         /// </param>
225         /// <param name="secondTarget">
226         /// <para>The second target.</para>
227         /// <para></para>
228         /// </param>
229         /// <returns>
230         /// <para>The bool</para>
231         /// <para></para>
232         /// </returns>
233         [MethodImpl(MethodImplOptions.AggressiveInlining)]
234         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget) => LessThan(firstTarget, secondTarget) ||
            ↪ (AreEqual(firstTarget, secondTarget) && LessThan(firstSource, secondSource));
235
236         /// <summary>
237         /// <para>
238         /// Determines whether this instance first is to the right of second.
239         /// </para>
240         /// <para></para>
241         /// </summary>
242         /// <param name="firstSource">
243         /// <para>The first source.</para>
244         /// <para></para>
245         /// </param>
246         /// <param name="firstTarget">
247         /// <para>The first target.</para>
248         /// <para></para>
249         /// </param>
250         /// <param name="secondSource">
251         /// <para>The second source.</para>
252         /// <para></para>
253         /// </param>
254         /// <param name="secondTarget">
255         /// <para>The second target.</para>
256         /// <para></para>
257         /// </param>
258         /// <returns>
259         /// <para>The bool</para>
260         /// <para></para>
261         /// </returns>
262         [MethodImpl(MethodImplOptions.AggressiveInlining)]
263         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget) => GreaterThan(firstTarget, secondTarget) ||
            ↪ (AreEqual(firstTarget, secondTarget) && GreaterThan(firstSource, secondSource));
264
265         /// <summary>
266         /// <para>
267         /// Clears the node using the specified node.
268         /// </para>
269         /// <para></para>
270         /// </summary>
271         /// <param name="node">
```

```
272         /// <para>The node.</para>
273         /// <para></para>
274         /// </param>
275         [MethodImpl(MethodImplOptions.AggressiveInlining)]
276         protected override void ClearNode(TLink node)
277         {
278             ref var link = ref GetLinkIndexPartReference(node);
279             link.LeftAsTarget = Zero;
280             link.RightAsTarget = Zero;
281             link.SizeAsTarget = Zero;
282         }
283     }
284 }
```

1.38 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/InternalLinksRecursionlessSizeBalancedTreeMethod

```
1  using System;
2  using System.Text;
3  using System.Collections.Generic;
4  using System.Runtime.CompilerServices;
5  using Platform.Collections.Methods.Trees;
6  using Platform.Converters;
7  using Platform.Delegates;
8  using static System.Runtime.CompilerServices.Unsafe;
9
10 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
11
12 namespace Platform.Data.Doublets.Memory.Split.Generic
13 {
14     /// <summary>
15     /// <para>
16     /// Represents the internal links recursionless size balanced tree methods base.
17     /// </para>
18     /// <para></para>
19     /// </summary>
20     /// <seealso cref="RecursionlessSizeBalancedTreeMethods{TLink}"/>
21     /// <seealso cref="ILinksTreeMethods{TLink}"/>
22     public unsafe abstract class InternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink> :
       ↪ RecursionlessSizeBalancedTreeMethods<TLink>, ILinksTreeMethods<TLink>
23     {
24         private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
           ↪ UncheckedConverter<TLink, long>.Default;
25
26         /// <summary>
27         /// <para>
28         /// The break.
29         /// </para>
30         /// <para></para>
31         /// </summary>
32         protected readonly TLink Break;
33         /// <summary>
34         /// <para>
35         /// The continue.
36         /// </para>
37         /// <para></para>
38         /// </summary>
39         protected readonly TLink Continue;
40         /// <summary>
41         /// <para>
42         /// The links data parts.
43         /// </para>
44         /// <para></para>
45         /// </summary>
46         protected readonly byte* LinksDataParts;
47         /// <summary>
48         /// <para>
49         /// The links index parts.
50         /// </para>
51         /// <para></para>
52         /// </summary>
53         protected readonly byte* LinksIndexParts;
54         /// <summary>
55         /// <para>
56         /// The header.
57         /// </para>
58         /// <para></para>
59         /// </summary>
60         protected readonly byte* Header;
61
62         /// <summary>
63         /// <para>
```

```
64          /// Initializes a new <see
            ↪  cref="InternalLinksRecursionlessSizeBalancedTreeMethodsBase"/> instance.
65          /// </para>
66          /// <para></para>
67          /// </summary>
68          /// <param name="constants">
69          /// <para>A constants.</para>
70          /// <para></para>
71          /// </param>
72          /// <param name="linksDataParts">
73          /// <para>A links data parts.</para>
74          /// <para></para>
75          /// </param>
76          /// <param name="linksIndexParts">
77          /// <para>A links index parts.</para>
78          /// <para></para>
79          /// </param>
80          /// <param name="header">
81          /// <para>A header.</para>
82          /// <para></para>
83          /// </param>
84          [MethodImpl(MethodImplOptions.AggressiveInlining)]
85          protected InternalLinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<TLink>
            ↪  constants, byte* linksDataParts, byte* linksIndexParts, byte* header)
86          {
87              LinksDataParts = linksDataParts;
88              LinksIndexParts = linksIndexParts;
89              Header = header;
90              Break = constants.Break;
91              Continue = constants.Continue;
92          }
93
94          /// <summary>
95          /// <para>
96          /// Gets the tree root using the specified link.
97          /// </para>
98          /// <para></para>
99          /// </summary>
100         /// <param name="link">
101         /// <para>The link.</para>
102         /// <para></para>
103         /// </param>
104         /// <returns>
105         /// <para>The link</para>
106         /// <para></para>
107         /// </returns>
108         [MethodImpl(MethodImplOptions.AggressiveInlining)]
109         protected abstract TLink GetTreeRoot(TLink link);
110
111         /// <summary>
112         /// <para>
113         /// Gets the base part value using the specified link.
114         /// </para>
115         /// <para></para>
116         /// </summary>
117         /// <param name="link">
118         /// <para>The link.</para>
119         /// <para></para>
120         /// </param>
121         /// <returns>
122         /// <para>The link</para>
123         /// <para></para>
124         /// </returns>
125         [MethodImpl(MethodImplOptions.AggressiveInlining)]
126         protected abstract TLink GetBasePartValue(TLink link);
127
128         /// <summary>
129         /// <para>
130         /// Gets the key part value using the specified link.
131         /// </para>
132         /// <para></para>
133         /// </summary>
134         /// <param name="link">
135         /// <para>The link.</para>
136         /// <para></para>
137         /// </param>
138         /// <returns>
139         /// <para>The link</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetKeyPartValue(TLink link);

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link data part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) => ref
        ↪  AsRef<RawLinkDataPart<TLink>>(LinksDataParts + (RawLinkDataPart<TLink>.SizeInBytes *
        ↪  _addressToInt64Converter.Convert(link)));

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
        ↪  ref AsRef<RawLinkIndexPart<TLink>>(LinksIndexParts +
        ↪  (RawLinkIndexPart<TLink>.SizeInBytes * _addressToInt64Converter.Convert(link)));

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second) =>
        ↪  LessThan(GetKeyPartValue(first), GetKeyPartValue(second));

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
```

```
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second) =>
        ↪ GreaterThan(GetKeyPartValue(first), GetKeyPartValue(second));

        /// <summary>
        /// <para>
        /// Gets the link values using the specified link index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A list of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual IList<TLink>? GetLinkValues(TLink linkIndex)
        {
            ref var link = ref GetLinkDataPartReference(linkIndex);
            return new Link<TLink>(linkIndex, link.Source, link.Target);
        }

        /// <summary>
        /// <para>
        /// The zero.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink this[TLink link, TLink index]
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get
            {
                var root = GetTreeRoot(link);
                if (GreaterOrEqualThan(index, GetSize(root)))
                {
                    return Zero;
                }
                while (!EqualToZero(root))
                {
                    var left = GetLeftOrDefault(root);
                    var leftSize = GetSizeOrZero(left);
                    if (LessThan(index, leftSize))
                    {
                        root = left;
                        continue;
                    }
                    if (AreEqual(index, leftSize))
                    {
                        return root;
                    }
                    root = GetRightOrDefault(root);
                    index = Subtract(index, Increment(leftSize));
                }
                return Zero; // TODO: Impossible situation exception (only if tree structure
                ↪ broken)
            }
        }

        /// <summary>
        /// Выполняет поиск и возвращает индекс связи с указанными Source (началом) и Target
        ↪ (концом).
        /// </summary>
        /// <param name="source">Индекс связи, которая является началом на искомой связи.</param>
        /// <param name="target">Индекс связи, которая является концом на искомой связи.</param>
        /// <returns>Индекс искомой связи.</returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public abstract TLink Search(TLink source, TLink target);

        /// <summary>
```

```
        /// <para>
        /// Searches the core using the specified root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="root">
        /// <para>The root.</para>
        /// <para></para>
        /// </param>
        /// <param name="key">
        /// <para>The key.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The zero.</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected TLink SearchCore(TLink root, TLink key)
        {
            while (!EqualToZero(root))
            {
                var rootKey = GetKeyPartValue(root);
                if (LessThan(key, rootKey)) // node.Key < root.Key
                {
                    root = GetLeftOrDefault(root);
                }
                else if (GreaterThan(key, rootKey)) // node.Key > root.Key
                {
                    root = GetRightOrDefault(root);
                }
                else // node.Key == root.Key
                {
                    return root;
                }
            }
            return Zero;
        }

        // TODO: Return indices range instead of references count
        /// <summary>
        /// <para>
        /// Counts the usages using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink CountUsages(TLink link) => GetSizeOrZero(GetTreeRoot(link));

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified base.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="@base">
        /// <para>The base.</para>
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink EachUsage(TLink @base, ReadHandler<TLink>? handler) => EachUsageCore(@base,
        ↪  GetTreeRoot(@base), handler);
```

```
365
366         // TODO: 1. Move target, handler to separate object. 2. Use stack or walker 3. Use
            ↪  low-level MSIL stack.
367         [MethodImpl(MethodImplOptions.AggressiveInlining)]
368         private TLink EachUsageCore(TLink @base, TLink link, ReadHandler<TLink>? handler)
369         {
370             var @continue = Continue;
371             if (EqualToZero(link))
372             {
373                 return @continue;
374             }
375             var @break = Break;
376             if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
377             {
378                 return @break;
379             }
380             if (AreEqual(handler(GetLinkValues(link)), @break))
381             {
382                 return @break;
383             }
384             if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
385             {
386                 return @break;
387             }
388             return @continue;
389         }
390
391         /// <summary>
392         /// <para>
393         /// Prints the node value using the specified node.
394         /// </para>
395         /// <para></para>
396         /// </summary>
397         /// <param name="node">
398         /// <para>The node.</para>
399         /// <para></para>
400         /// </param>
401         /// <param name="sb">
402         /// <para>The sb.</para>
403         /// <para></para>
404         /// </param>
405         [MethodImpl(MethodImplOptions.AggressiveInlining)]
406         protected override void PrintNodeValue(TLink node, StringBuilder sb)
407         {
408             ref var link = ref GetLinkDataPartReference(node);
409             sb.Append(' ');
410             sb.Append(link.Source);
411             sb.Append('-');
412             sb.Append('>');
413             sb.Append(link.Target);
414         }
415     }
416 }
```

1.39 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/InternalLinksSizeBalancedTreeMethodsBase.cs

```
1  using System;
2  using System.Text;
3  using System.Collections.Generic;
4  using System.Runtime.CompilerServices;
5  using Platform.Collections.Methods.Trees;
6  using Platform.Converters;
7  using Platform.Delegates;
8  using static System.Runtime.CompilerServices.Unsafe;
9
10 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
11
12 namespace Platform.Data.Doublets.Memory.Split.Generic
13 {
14     /// <summary>
15     /// <para>
16     /// Represents the internal links size balanced tree methods base.
17     /// </para>
18     /// <para></para>
19     /// </summary>
20     /// <seealso cref="SizeBalancedTreeMethods{TLink}"/>
21     /// <seealso cref="ILinksTreeMethods{TLink}"/>
22     public unsafe abstract class InternalLinksSizeBalancedTreeMethodsBase<TLink> :
       ↪  SizeBalancedTreeMethods<TLink>, ILinksTreeMethods<TLink>
23     {
```

```
24          private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
            ↪ UncheckedConverter<TLink, long>.Default;
25
26          /// <summary>
27          /// <para>
28          /// The break.
29          /// </para>
30          /// <para></para>
31          /// </summary>
32          protected readonly TLink Break;
33          /// <summary>
34          /// <para>
35          /// The continue.
36          /// </para>
37          /// <para></para>
38          /// </summary>
39          protected readonly TLink Continue;
40          /// <summary>
41          /// <para>
42          /// The links data parts.
43          /// </para>
44          /// <para></para>
45          /// </summary>
46          protected readonly byte* LinksDataParts;
47          /// <summary>
48          /// <para>
49          /// The links index parts.
50          /// </para>
51          /// <para></para>
52          /// </summary>
53          protected readonly byte* LinksIndexParts;
54          /// <summary>
55          /// <para>
56          /// The header.
57          /// </para>
58          /// <para></para>
59          /// </summary>
60          protected readonly byte* Header;
61
62          /// <summary>
63          /// <para>
64          /// Initializes a new <see cref="InternalLinksSizeBalancedTreeMethodsBase"/> instance.
65          /// </para>
66          /// <para></para>
67          /// </summary>
68          /// <param name="constants">
69          /// <para>A constants.</para>
70          /// <para></para>
71          /// </param>
72          /// <param name="linksDataParts">
73          /// <para>A links data parts.</para>
74          /// <para></para>
75          /// </param>
76          /// <param name="linksIndexParts">
77          /// <para>A links index parts.</para>
78          /// <para></para>
79          /// </param>
80          /// <param name="header">
81          /// <para>A header.</para>
82          /// <para></para>
83          /// </param>
84          [MethodImpl(MethodImplOptions.AggressiveInlining)]
85          protected InternalLinksSizeBalancedTreeMethodsBase(LinksConstants<TLink> constants,
            ↪ byte* linksDataParts, byte* linksIndexParts, byte* header)
86          {
87              LinksDataParts = linksDataParts;
88              LinksIndexParts = linksIndexParts;
89              Header = header;
90              Break = constants.Break;
91              Continue = constants.Continue;
92          }
93
94          /// <summary>
95          /// <para>
96          /// Gets the tree root using the specified link.
97          /// </para>
98          /// <para></para>
99          /// </summary>
100         /// <param name="link">
```

```
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetTreeRoot(TLink link);

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetBasePartValue(TLink link);

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetKeyPartValue(TLink link);

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link data part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) => ref
        ↪  AsRef<RawLinkDataPart<TLink>>(LinksDataParts + (RawLinkDataPart<TLink>.SizeInBytes *
        ↪  _addressToInt64Converter.Convert(link)));

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
177         protected virtual ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
            ↪ ref AsRef<RawLinkIndexPart<TLink>>(LinksIndexParts +
            ↪ (RawLinkIndexPart<TLink>.SizeInBytes * _addressToInt64Converter.Convert(link)));
178
179         /// <summary>
180         /// <para>
181         /// Determines whether this instance first is to the left of second.
182         /// </para>
183         /// <para></para>
184         /// </summary>
185         /// <param name="first">
186         /// <para>The first.</para>
187         /// <para></para>
188         /// </param>
189         /// <param name="second">
190         /// <para>The second.</para>
191         /// <para></para>
192         /// </param>
193         /// <returns>
194         /// <para>The bool</para>
195         /// <para></para>
196         /// </returns>
197         [MethodImpl(MethodImplOptions.AggressiveInlining)]
198         protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second) =>
            ↪ LessThan(GetKeyPartValue(first), GetKeyPartValue(second));
199
200         /// <summary>
201         /// <para>
202         /// Determines whether this instance first is to the right of second.
203         /// </para>
204         /// <para></para>
205         /// </summary>
206         /// <param name="first">
207         /// <para>The first.</para>
208         /// <para></para>
209         /// </param>
210         /// <param name="second">
211         /// <para>The second.</para>
212         /// <para></para>
213         /// </param>
214         /// <returns>
215         /// <para>The bool</para>
216         /// <para></para>
217         /// </returns>
218         [MethodImpl(MethodImplOptions.AggressiveInlining)]
219         protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second) =>
            ↪ GreaterThan(GetKeyPartValue(first), GetKeyPartValue(second));
220
221         /// <summary>
222         /// <para>
223         /// Gets the link values using the specified link index.
224         /// </para>
225         /// <para></para>
226         /// </summary>
227         /// <param name="linkIndex">
228         /// <para>The link index.</para>
229         /// <para></para>
230         /// </param>
231         /// <returns>
232         /// <para>A list of t link</para>
233         /// <para></para>
234         /// </returns>
235         [MethodImpl(MethodImplOptions.AggressiveInlining)]
236         protected virtual IList<TLink>? GetLinkValues(TLink linkIndex)
237         {
238             ref var link = ref GetLinkDataPartReference(linkIndex);
239             return new Link<TLink>(linkIndex, link.Source, link.Target);
240         }
241
242         /// <summary>
243         /// <para>
244         /// The zero.
245         /// </para>
246         /// <para></para>
247         /// </summary>
248         public TLink this[TLink link, TLink index]
249         {
250             [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
            get
            {
                var root = GetTreeRoot(link);
                if (GreaterOrEqualThan(index, GetSize(root)))
                {
                    return Zero;
                }
                while (!EqualToZero(root))
                {
                    var left = GetLeftOrDefault(root);
                    var leftSize = GetSizeOrZero(left);
                    if (LessThan(index, leftSize))
                    {
                        root = left;
                        continue;
                    }
                    if (AreEqual(index, leftSize))
                    {
                        return root;
                    }
                    root = GetRightOrDefault(root);
                    index = Subtract(index, Increment(leftSize));
                }
                return Zero; // TODO: Impossible situation exception (only if tree structure
                ↪  broken)
            }
        }

        /// <summary>
        /// Выполняет поиск и возвращает индекс связи с указанными Source (началом) и Target
        ↪  (концом).
        /// </summary>
        /// <param name="source">Индекс связи, которая является началом на искомой связи.</param>
        /// <param name="target">Индекс связи, которая является концом на искомой связи.</param>
        /// <returns>Индекс искомой связи.</returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public abstract TLink Search(TLink source, TLink target);

        /// <summary>
        /// <para>
        /// Searches the core using the specified root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="root">
        /// <para>The root.</para>
        /// <para></para>
        /// </param>
        /// <param name="key">
        /// <para>The key.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The zero.</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected TLink SearchCore(TLink root, TLink key)
        {
            while (!EqualToZero(root))
            {
                var rootKey = GetKeyPartValue(root);
                if (LessThan(key, rootKey)) // node.Key < root.Key
                {
                    root = GetLeftOrDefault(root);
                }
                else if (GreaterThan(key, rootKey)) // node.Key > root.Key
                {
                    root = GetRightOrDefault(root);
                }
                else // node.Key == root.Key
                {
                    return root;
                }
            }
            return Zero;
        }

```

```
        // TODO: Return indices range instead of references count
        /// <summary>
        /// <para>
        /// Counts the usages using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink CountUsages(TLink link) => GetSizeOrZero(GetTreeRoot(link));

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified base.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="@base">
        /// <para>The base.</para>
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink EachUsage(TLink @base, ReadHandler<TLink>? handler) => EachUsageCore(@base,
        ↪  GetTreeRoot(@base), handler);

        // TODO: 1. Move target, handler to separate object. 2. Use stack or walker 3. Use
        ↪  low-level MSIL stack.
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink EachUsageCore(TLink @base, TLink link, ReadHandler<TLink>? handler)
        {
            var @continue = Continue;
            if (EqualToZero(link))
            {
                return @continue;
            }
            var @break = Break;
            if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
            {
                return @break;
            }
            if (AreEqual(handler(GetLinkValues(link)), @break))
            {
                return @break;
            }
            if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
            {
                return @break;
            }
            return @continue;
        }

        /// <summary>
        /// <para>
        /// Prints the node value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="sb">
        /// <para>The sb.</para>
```

```
403         /// <para></para>
404         /// </param>
405         [MethodImpl(MethodImplOptions.AggressiveInlining)]
406         protected override void PrintNodeValue(TLink node, StringBuilder sb)
407         {
408             ref var link = ref GetLinkDataPartReference(node);
409             sb.Append(' ');
410             sb.Append(link.Source);
411             sb.Append('-');
412             sb.Append('>');
413             sb.Append(link.Target);
414         }
415     }
416 }
```

1.40 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/InternalLinksSourcesLinkedListMethods.cs

```
1  using System;
2  using System.Collections.Generic;
3  using System.Runtime.CompilerServices;
4  using Platform.Collections.Methods.Lists;
5  using Platform.Converters;
6  using Platform.Delegates;
7  using static System.Runtime.CompilerServices.Unsafe;
8
9  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
10
11 namespace Platform.Data.Doublets.Memory.Split.Generic
12 {
13     /// <summary>
14     /// <para>
15     /// Represents the internal links sources linked list methods.
16     /// </para>
17     /// <para></para>
18     /// </summary>
19     /// <seealso cref="RelativeCircularDoublyLinkedListMethods{TLink}"/>
20     public unsafe class InternalLinksSourcesLinkedListMethods<TLink> :
       ↪ RelativeCircularDoublyLinkedListMethods<TLink>
21     {
22         private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
           ↪ UncheckedConverter<TLink, long>.Default;
23         private readonly byte* _linksDataParts;
24         private readonly byte* _linksIndexParts;
25         /// <summary>
26         /// <para>
27         /// The break.
28         /// </para>
29         /// <para></para>
30         /// </summary>
31         protected readonly TLink Break;
32         /// <summary>
33         /// <para>
34         /// The continue.
35         /// </para>
36         /// <para></para>
37         /// </summary>
38         protected readonly TLink Continue;
39
40         /// <summary>
41         /// <para>
42         /// Initializes a new <see cref="InternalLinksSourcesLinkedListMethods"/> instance.
43         /// </para>
44         /// <para></para>
45         /// </summary>
46         /// <param name="constants">
47         /// <para>A constants.</para>
48         /// <para></para>
49         /// </param>
50         /// <param name="linksDataParts">
51         /// <para>A links data parts.</para>
52         /// <para></para>
53         /// </param>
54         /// <param name="linksIndexParts">
55         /// <para>A links index parts.</para>
56         /// <para></para>
57         /// </param>
58         [MethodImpl(MethodImplOptions.AggressiveInlining)]
59         public InternalLinksSourcesLinkedListMethods(LinksConstants<TLink> constants, byte*
           ↪ linksDataParts, byte* linksIndexParts)
60         {
```

```
            _linksDataParts = linksDataParts;
            _linksIndexParts = linksIndexParts;
            Break = constants.Break;
            Continue = constants.Continue;
        }

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link data part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) => ref
        ↪  AsRef<RawLinkDataPart<TLink>>(_linksDataParts + (RawLinkDataPart<TLink>.SizeInBytes
        ↪  * _addressToInt64Converter.Convert(link)));

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
        ↪  ref AsRef<RawLinkIndexPart<TLink>>(_linksIndexParts +
        ↪  (RawLinkIndexPart<TLink>.SizeInBytes * _addressToInt64Converter.Convert(link)));

        /// <summary>
        /// <para>
        /// Gets the first using the specified head.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="head">
        /// <para>The head.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetFirst(TLink head) =>
        ↪  GetLinkIndexPartReference(head).RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the last using the specified head.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="head">
        /// <para>The head.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLast(TLink head)
```

```
        {
            var first = GetLinkIndexPartReference(head).RootAsSource;
            if (EqualToZero(first))
            {
                return first;
            }
            else
            {
                return GetPrevious(first);
            }
        }

        /// <summary>
        /// <para>
        /// Gets the previous using the specified element.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="element">
        /// <para>The element.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetPrevious(TLink element) =>
        ↪  GetLinkIndexPartReference(element).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the next using the specified element.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="element">
        /// <para>The element.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetNext(TLink element) =>
        ↪  GetLinkIndexPartReference(element).RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the size using the specified head.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="head">
        /// <para>The head.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink head) =>
        ↪  GetLinkIndexPartReference(head).SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the first using the specified head.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="head">
        /// <para>The head.</para>
        /// <para></para>
        /// </param>
        /// <param name="element">
        /// <para>The element.</para>
```

```
209             /// <para></para>
210             /// </param>
211             [MethodImpl(MethodImplOptions.AggressiveInlining)]
212             protected override void SetFirst(TLink head, TLink element) =>
                ↪  GetLinkIndexPartReference(head).RootAsSource = element;
213
214             /// <summary>
215             /// <para>
216             /// Sets the last using the specified head.
217             /// </para>
218             /// <para></para>
219             /// </summary>
220             /// <param name="head">
221             /// <para>The head.</para>
222             /// <para></para>
223             /// </param>
224             /// <param name="element">
225             /// <para>The element.</para>
226             /// <para></para>
227             /// </param>
228             [MethodImpl(MethodImplOptions.AggressiveInlining)]
229             protected override void SetLast(TLink head, TLink element)
230             {
231                 //var first = GetLinkIndexPartReference(head).RootAsSource;
232                 //if (EqualToZero(first))
233                 //{
234                 //    SetFirst(head, element);
235                 //}
236                 //else
237                 //{
238                 //    SetPrevious(first, element);
239                 //}
240             }
241
242             /// <summary>
243             /// <para>
244             /// Sets the previous using the specified element.
245             /// </para>
246             /// <para></para>
247             /// </summary>
248             /// <param name="element">
249             /// <para>The element.</para>
250             /// <para></para>
251             /// </param>
252             /// <param name="previous">
253             /// <para>The previous.</para>
254             /// <para></para>
255             /// </param>
256             [MethodImpl(MethodImplOptions.AggressiveInlining)]
257             protected override void SetPrevious(TLink element, TLink previous) =>
                ↪  GetLinkIndexPartReference(element).LeftAsSource = previous;
258
259             /// <summary>
260             /// <para>
261             /// Sets the next using the specified element.
262             /// </para>
263             /// <para></para>
264             /// </summary>
265             /// <param name="element">
266             /// <para>The element.</para>
267             /// <para></para>
268             /// </param>
269             /// <param name="next">
270             /// <para>The next.</para>
271             /// <para></para>
272             /// </param>
273             [MethodImpl(MethodImplOptions.AggressiveInlining)]
274             protected override void SetNext(TLink element, TLink next) =>
                ↪  GetLinkIndexPartReference(element).RightAsSource = next;
275
276             /// <summary>
277             /// <para>
278             /// Sets the size using the specified head.
279             /// </para>
280             /// <para></para>
281             /// </summary>
282             /// <param name="head">
283             /// <para>The head.</para>
```

```
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink head, TLink size) =>
        ↪  GetLinkIndexPartReference(head).SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Counts the usages using the specified head.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="head">
        /// <para>The head.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink CountUsages(TLink head) => GetSize(head);

        /// <summary>
        /// <para>
        /// Gets the link values using the specified link index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A list of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual IList<TLink>? GetLinkValues(TLink linkIndex)
        {
            ref var link = ref GetLinkDataPartReference(linkIndex);
            return new Link<TLink>(linkIndex, link.Source, link.Target);
        }

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The continue.</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink EachUsage(TLink source, ReadHandler<TLink>? handler)
        {
            var @continue = Continue;
            var @break = Break;
            var current = GetFirst(source);
            var first = current;
            while (!EqualToZero(current))
            {
                if (AreEqual(handler(GetLinkValues(current)), @break))
                {
                    return @break;
```

```
                }
                current = GetNext(current);
                if (AreEqual(current, first))
                {
                    return @continue;
                }
            }
            return @continue;
        }
    }
}
```

1.41 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/InternalLinksSourcesRecursionlessSizeBalancedTree

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
{
    /// <summary>
    /// <para>
    /// Represents the internal links sources recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="InternalLinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
    public unsafe class InternalLinksSourcesRecursionlessSizeBalancedTreeMethods<TLink> :
    ↪  InternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪  cref="InternalLinksSourcesRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public InternalLinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪  constants, byte* linksDataParts, byte* linksIndexParts, byte* header) :
        ↪  base(constants, linksDataParts, linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪  GetLinkIndexPartReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
```

```
61          /// </para>
62          /// <para></para>
63          /// </summary>
64          /// <param name="node">
65          /// <para>The node.</para>
66          /// <para></para>
67          /// </param>
68          /// <returns>
69          /// <para>The ref link</para>
70          /// <para></para>
71          /// </returns>
72          [MethodImpl(MethodImplOptions.AggressiveInlining)]
73          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ GetLinkIndexPartReference(node).RightAsSource;
74
75          /// <summary>
76          /// <para>
77          /// Gets the left using the specified node.
78          /// </para>
79          /// <para></para>
80          /// </summary>
81          /// <param name="node">
82          /// <para>The node.</para>
83          /// <para></para>
84          /// </param>
85          /// <returns>
86          /// <para>The link</para>
87          /// <para></para>
88          /// </returns>
89          [MethodImpl(MethodImplOptions.AggressiveInlining)]
90          protected override TLink GetLeft(TLink node) =>
            ↪ GetLinkIndexPartReference(node).LeftAsSource;
91
92          /// <summary>
93          /// <para>
94          /// Gets the right using the specified node.
95          /// </para>
96          /// <para></para>
97          /// </summary>
98          /// <param name="node">
99          /// <para>The node.</para>
100         /// <para></para>
101         /// </param>
102         /// <returns>
103         /// <para>The link</para>
104         /// <para></para>
105         /// </returns>
106         [MethodImpl(MethodImplOptions.AggressiveInlining)]
107         protected override TLink GetRight(TLink node) =>
            ↪ GetLinkIndexPartReference(node).RightAsSource;
108
109         /// <summary>
110         /// <para>
111         /// Sets the left using the specified node.
112         /// </para>
113         /// <para></para>
114         /// </summary>
115         /// <param name="node">
116         /// <para>The node.</para>
117         /// <para></para>
118         /// </param>
119         /// <param name="left">
120         /// <para>The left.</para>
121         /// <para></para>
122         /// </param>
123         [MethodImpl(MethodImplOptions.AggressiveInlining)]
124         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkIndexPartReference(node).LeftAsSource = left;
125
126         /// <summary>
127         /// <para>
128         /// Sets the right using the specified node.
129         /// </para>
130         /// <para></para>
131         /// </summary>
132         /// <param name="node">
133         /// <para>The node.</para>
134         /// <para></para>
```

```
135             /// </param>
136             /// <param name="right">
137             /// <para>The right.</para>
138             /// <para></para>
139             /// </param>
140             [MethodImpl(MethodImplOptions.AggressiveInlining)]
141             protected override void SetRight(TLink node, TLink right) =>
                ↪ GetLinkIndexPartReference(node).RightAsSource = right;
142
143             /// <summary>
144             /// <para>
145             /// Gets the size using the specified node.
146             /// </para>
147             /// <para></para>
148             /// </summary>
149             /// <param name="node">
150             /// <para>The node.</para>
151             /// <para></para>
152             /// </param>
153             /// <returns>
154             /// <para>The link</para>
155             /// <para></para>
156             /// </returns>
157             [MethodImpl(MethodImplOptions.AggressiveInlining)]
158             protected override TLink GetSize(TLink node) =>
                ↪ GetLinkIndexPartReference(node).SizeAsSource;
159
160             /// <summary>
161             /// <para>
162             /// Sets the size using the specified node.
163             /// </para>
164             /// <para></para>
165             /// </summary>
166             /// <param name="node">
167             /// <para>The node.</para>
168             /// <para></para>
169             /// </param>
170             /// <param name="size">
171             /// <para>The size.</para>
172             /// <para></para>
173             /// </param>
174             [MethodImpl(MethodImplOptions.AggressiveInlining)]
175             protected override void SetSize(TLink node, TLink size) =>
                ↪ GetLinkIndexPartReference(node).SizeAsSource = size;
176
177             /// <summary>
178             /// <para>
179             /// Gets the tree root using the specified link.
180             /// </para>
181             /// <para></para>
182             /// </summary>
183             /// <param name="link">
184             /// <para>The link.</para>
185             /// <para></para>
186             /// </param>
187             /// <returns>
188             /// <para>The link</para>
189             /// <para></para>
190             /// </returns>
191             [MethodImpl(MethodImplOptions.AggressiveInlining)]
192             protected override TLink GetTreeRoot(TLink link) =>
                ↪ GetLinkIndexPartReference(link).RootAsSource;
193
194             /// <summary>
195             /// <para>
196             /// Gets the base part value using the specified link.
197             /// </para>
198             /// <para></para>
199             /// </summary>
200             /// <param name="link">
201             /// <para>The link.</para>
202             /// <para></para>
203             /// </param>
204             /// <returns>
205             /// <para>The link</para>
206             /// <para></para>
207             /// </returns>
208             [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
209         protected override TLink GetBasePartValue(TLink link) =>
            ↪ GetLinkDataPartReference(link).Source;
210
211         /// <summary>
212         /// <para>
213         /// Gets the key part value using the specified link.
214         /// </para>
215         /// <para></para>
216         /// </summary>
217         /// <param name="link">
218         /// <para>The link.</para>
219         /// <para></para>
220         /// </param>
221         /// <returns>
222         /// <para>The link</para>
223         /// <para></para>
224         /// </returns>
225         [MethodImpl(MethodImplOptions.AggressiveInlining)]
226         protected override TLink GetKeyPartValue(TLink link) =>
            ↪ GetLinkDataPartReference(link).Target;
227
228         /// <summary>
229         /// <para>
230         /// Clears the node using the specified node.
231         /// </para>
232         /// <para></para>
233         /// </summary>
234         /// <param name="node">
235         /// <para>The node.</para>
236         /// <para></para>
237         /// </param>
238         [MethodImpl(MethodImplOptions.AggressiveInlining)]
239         protected override void ClearNode(TLink node)
240         {
241             ref var link = ref GetLinkIndexPartReference(node);
242             link.LeftAsSource = Zero;
243             link.RightAsSource = Zero;
244             link.SizeAsSource = Zero;
245         }
246
247         /// <summary>
248         /// <para>
249         /// Searches the source.
250         /// </para>
251         /// <para></para>
252         /// </summary>
253         /// <param name="source">
254         /// <para>The source.</para>
255         /// <para></para>
256         /// </param>
257         /// <param name="target">
258         /// <para>The target.</para>
259         /// <para></para>
260         /// </param>
261         /// <returns>
262         /// <para>The link</para>
263         /// <para></para>
264         /// </returns>
265         public override TLink Search(TLink source, TLink target) =>
            ↪ SearchCore(GetTreeRoot(source), target);
266     }
267 }
```

1.42 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/InternalLinksSourcesSizeBalancedTreeMethods.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.Data.Doublets.Memory.Split.Generic
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the internal links sources size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="InternalLinksSizeBalancedTreeMethodsBase{TLink}"/>
14     public unsafe class InternalLinksSourcesSizeBalancedTreeMethods<TLink> :
        ↪ InternalLinksSizeBalancedTreeMethodsBase<TLink>
```

```
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="InternalLinksSourcesSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public InternalLinksSourcesSizeBalancedTreeMethods(LinksConstants<TLink> constants,
        ↪  byte* linksDataParts, byte* linksIndexParts, byte* header) : base(constants,
        ↪  linksDataParts, linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪  GetLinkIndexPartReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  GetLinkIndexPartReference(node).RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
```

```
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) =>
        ↪  GetLinkIndexPartReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) =>
        ↪  GetLinkIndexPartReference(node).RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  GetLinkIndexPartReference(node).LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  GetLinkIndexPartReference(node).RightAsSource = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) =>
        ↪  GetLinkIndexPartReference(node).SizeAsSource;

```

```
160         /// <summary>
161         /// <para>
162         /// Sets the size using the specified node.
163         /// </para>
164         /// <para></para>
165         /// </summary>
166         /// <param name="node">
167         /// <para>The node.</para>
168         /// <para></para>
169         /// </param>
170         /// <param name="size">
171         /// <para>The size.</para>
172         /// <para></para>
173         /// </param>
174         [MethodImpl(MethodImplOptions.AggressiveInlining)]
175         protected override void SetSize(TLink node, TLink size) =>
            ↪ GetLinkIndexPartReference(node).SizeAsSource = size;
176
177         /// <summary>
178         /// <para>
179         /// Gets the tree root using the specified link.
180         /// </para>
181         /// <para></para>
182         /// </summary>
183         /// <param name="link">
184         /// <para>The link.</para>
185         /// <para></para>
186         /// </param>
187         /// <returns>
188         /// <para>The link</para>
189         /// <para></para>
190         /// </returns>
191         [MethodImpl(MethodImplOptions.AggressiveInlining)]
192         protected override TLink GetTreeRoot(TLink link) =>
            ↪ GetLinkIndexPartReference(link).RootAsSource;
193
194         /// <summary>
195         /// <para>
196         /// Gets the base part value using the specified link.
197         /// </para>
198         /// <para></para>
199         /// </summary>
200         /// <param name="link">
201         /// <para>The link.</para>
202         /// <para></para>
203         /// </param>
204         /// <returns>
205         /// <para>The link</para>
206         /// <para></para>
207         /// </returns>
208         [MethodImpl(MethodImplOptions.AggressiveInlining)]
209         protected override TLink GetBasePartValue(TLink link) =>
            ↪ GetLinkDataPartReference(link).Source;
210
211         /// <summary>
212         /// <para>
213         /// Gets the key part value using the specified link.
214         /// </para>
215         /// <para></para>
216         /// </summary>
217         /// <param name="link">
218         /// <para>The link.</para>
219         /// <para></para>
220         /// </param>
221         /// <returns>
222         /// <para>The link</para>
223         /// <para></para>
224         /// </returns>
225         [MethodImpl(MethodImplOptions.AggressiveInlining)]
226         protected override TLink GetKeyPartValue(TLink link) =>
            ↪ GetLinkDataPartReference(link).Target;
227
228         /// <summary>
229         /// <para>
230         /// Clears the node using the specified node.
231         /// </para>
232         /// <para></para>
233         /// </summary>
```

```
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref GetLinkIndexPartReference(node);
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        public override TLink Search(TLink source, TLink target) =>
        ↪  SearchCore(GetTreeRoot(source), target);
    }
}
```

1.43 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/InternalLinksTargetsRecursionlessSizeBalancedTree

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
{
    /// <summary>
    /// <para>
    /// Represents the internal links targets recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="InternalLinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
    public unsafe class InternalLinksTargetsRecursionlessSizeBalancedTreeMethods<TLink> :
    ↪  InternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪  cref="InternalLinksTargetsRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
39          public InternalLinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
            ↪  constants, byte* linksDataParts, byte* linksIndexParts, byte* header) :
            ↪  base(constants, linksDataParts, linksIndexParts, header) { }
40
41          /// <summary>
42          /// <para>
43          /// Gets the left reference using the specified node.
44          /// </para>
45          /// <para></para>
46          /// </summary>
47          /// <param name="node">
48          /// <para>The node.</para>
49          /// <para></para>
50          /// </param>
51          /// <returns>
52          /// <para>The ref link</para>
53          /// <para></para>
54          /// </returns>
55          [MethodImpl(MethodImplOptions.AggressiveInlining)]
56          protected override ref TLink GetLeftReference(TLink node) => ref
            ↪  GetLinkIndexPartReference(node).LeftAsTarget;
57
58          /// <summary>
59          /// <para>
60          /// Gets the right reference using the specified node.
61          /// </para>
62          /// <para></para>
63          /// </summary>
64          /// <param name="node">
65          /// <para>The node.</para>
66          /// <para></para>
67          /// </param>
68          /// <returns>
69          /// <para>The ref link</para>
70          /// <para></para>
71          /// </returns>
72          [MethodImpl(MethodImplOptions.AggressiveInlining)]
73          protected override ref TLink GetRightReference(TLink node) => ref
            ↪  GetLinkIndexPartReference(node).RightAsTarget;
74
75          /// <summary>
76          /// <para>
77          /// Gets the left using the specified node.
78          /// </para>
79          /// <para></para>
80          /// </summary>
81          /// <param name="node">
82          /// <para>The node.</para>
83          /// <para></para>
84          /// </param>
85          /// <returns>
86          /// <para>The link</para>
87          /// <para></para>
88          /// </returns>
89          [MethodImpl(MethodImplOptions.AggressiveInlining)]
90          protected override TLink GetLeft(TLink node) =>
            ↪  GetLinkIndexPartReference(node).LeftAsTarget;
91
92          /// <summary>
93          /// <para>
94          /// Gets the right using the specified node.
95          /// </para>
96          /// <para></para>
97          /// </summary>
98          /// <param name="node">
99          /// <para>The node.</para>
100         /// <para></para>
101         /// </param>
102         /// <returns>
103         /// <para>The link</para>
104         /// <para></para>
105         /// </returns>
106         [MethodImpl(MethodImplOptions.AggressiveInlining)]
107         protected override TLink GetRight(TLink node) =>
            ↪  GetLinkIndexPartReference(node).RightAsTarget;
108
109         /// <summary>
```

```
110         /// <para>
111         /// Sets the left using the specified node.
112         /// </para>
113         /// <para></para>
114         /// </summary>
115         /// <param name="node">
116         /// <para>The node.</para>
117         /// <para></para>
118         /// </param>
119         /// <param name="left">
120         /// <para>The left.</para>
121         /// <para></para>
122         /// </param>
123         [MethodImpl(MethodImplOptions.AggressiveInlining)]
124         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkIndexPartReference(node).LeftAsTarget = left;
125
126         /// <summary>
127         /// <para>
128         /// Sets the right using the specified node.
129         /// </para>
130         /// <para></para>
131         /// </summary>
132         /// <param name="node">
133         /// <para>The node.</para>
134         /// <para></para>
135         /// </param>
136         /// <param name="right">
137         /// <para>The right.</para>
138         /// <para></para>
139         /// </param>
140         [MethodImpl(MethodImplOptions.AggressiveInlining)]
141         protected override void SetRight(TLink node, TLink right) =>
            ↪ GetLinkIndexPartReference(node).RightAsTarget = right;
142
143         /// <summary>
144         /// <para>
145         /// Gets the size using the specified node.
146         /// </para>
147         /// <para></para>
148         /// </summary>
149         /// <param name="node">
150         /// <para>The node.</para>
151         /// <para></para>
152         /// </param>
153         /// <returns>
154         /// <para>The link</para>
155         /// <para></para>
156         /// </returns>
157         [MethodImpl(MethodImplOptions.AggressiveInlining)]
158         protected override TLink GetSize(TLink node) =>
            ↪ GetLinkIndexPartReference(node).SizeAsTarget;
159
160         /// <summary>
161         /// <para>
162         /// Sets the size using the specified node.
163         /// </para>
164         /// <para></para>
165         /// </summary>
166         /// <param name="node">
167         /// <para>The node.</para>
168         /// <para></para>
169         /// </param>
170         /// <param name="size">
171         /// <para>The size.</para>
172         /// <para></para>
173         /// </param>
174         [MethodImpl(MethodImplOptions.AggressiveInlining)]
175         protected override void SetSize(TLink node, TLink size) =>
            ↪ GetLinkIndexPartReference(node).SizeAsTarget = size;
176
177         /// <summary>
178         /// <para>
179         /// Gets the tree root using the specified link.
180         /// </para>
181         /// <para></para>
182         /// </summary>
183         /// <param name="link">
```

```
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot(TLink link) =>
        ↪ GetLinkIndexPartReference(link).RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink link) =>
        ↪ GetLinkDataPartReference(link).Target;

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetKeyPartValue(TLink link) =>
        ↪ GetLinkDataPartReference(link).Source;

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref GetLinkIndexPartReference(node);
            link.LeftAsTarget = Zero;
            link.RightAsTarget = Zero;
            link.SizeAsTarget = Zero;
        }

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
```

```
259         /// <para></para>
260         /// </param>
261         /// <returns>
262         /// <para>The link</para>
263         /// <para></para>
264         /// </returns>
265         public override TLink Search(TLink source, TLink target) =>
            ↪ SearchCore(GetTreeRoot(target), source);
266     }
267 }
```

1.44 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/InternalLinksTargetsSizeBalancedTreeMethods.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.Data.Doublets.Memory.Split.Generic
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the internal links targets size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="InternalLinksSizeBalancedTreeMethodsBase{TLink}"/>
14     public unsafe class InternalLinksTargetsSizeBalancedTreeMethods<TLink> :
        ↪ InternalLinksSizeBalancedTreeMethodsBase<TLink>
15     {
16         /// <summary>
17         /// <para>
18         /// Initializes a new <see cref="InternalLinksTargetsSizeBalancedTreeMethods"/> instance.
19         /// </para>
20         /// <para></para>
21         /// </summary>
22         /// <param name="constants">
23         /// <para>A constants.</para>
24         /// <para></para>
25         /// </param>
26         /// <param name="linksDataParts">
27         /// <para>A links data parts.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="linksIndexParts">
31         /// <para>A links index parts.</para>
32         /// <para></para>
33         /// </param>
34         /// <param name="header">
35         /// <para>A header.</para>
36         /// <para></para>
37         /// </param>
38         [MethodImpl(MethodImplOptions.AggressiveInlining)]
39         public InternalLinksTargetsSizeBalancedTreeMethods(LinksConstants<TLink> constants,
            ↪ byte* linksDataParts, byte* linksIndexParts, byte* header) : base(constants,
            ↪ linksDataParts, linksIndexParts, header) { }
40
41         /// <summary>
42         /// <para>
43         /// Gets the left reference using the specified node.
44         /// </para>
45         /// <para></para>
46         /// </summary>
47         /// <param name="node">
48         /// <para>The node.</para>
49         /// <para></para>
50         /// </param>
51         /// <returns>
52         /// <para>The ref link</para>
53         /// <para></para>
54         /// </returns>
55         [MethodImpl(MethodImplOptions.AggressiveInlining)]
56         protected override ref TLink GetLeftReference(TLink node) => ref
            ↪ GetLinkIndexPartReference(node).LeftAsTarget;
57
58         /// <summary>
59         /// <para>
60         /// Gets the right reference using the specified node.
61         /// </para>
62         /// <para></para>
```

```
63          /// </summary>
64          /// <param name="node">
65          /// <para>The node.</para>
66          /// <para></para>
67          /// </param>
68          /// <returns>
69          /// <para>The ref link</para>
70          /// <para></para>
71          /// </returns>
72          [MethodImpl(MethodImplOptions.AggressiveInlining)]
73          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ GetLinkIndexPartReference(node).RightAsTarget;
74
75          /// <summary>
76          /// <para>
77          /// Gets the left using the specified node.
78          /// </para>
79          /// <para></para>
80          /// </summary>
81          /// <param name="node">
82          /// <para>The node.</para>
83          /// <para></para>
84          /// </param>
85          /// <returns>
86          /// <para>The link</para>
87          /// <para></para>
88          /// </returns>
89          [MethodImpl(MethodImplOptions.AggressiveInlining)]
90          protected override TLink GetLeft(TLink node) =>
            ↪ GetLinkIndexPartReference(node).LeftAsTarget;
91
92          /// <summary>
93          /// <para>
94          /// Gets the right using the specified node.
95          /// </para>
96          /// <para></para>
97          /// </summary>
98          /// <param name="node">
99          /// <para>The node.</para>
100         /// <para></para>
101         /// </param>
102         /// <returns>
103         /// <para>The link</para>
104         /// <para></para>
105         /// </returns>
106         [MethodImpl(MethodImplOptions.AggressiveInlining)]
107         protected override TLink GetRight(TLink node) =>
            ↪ GetLinkIndexPartReference(node).RightAsTarget;
108
109         /// <summary>
110         /// <para>
111         /// Sets the left using the specified node.
112         /// </para>
113         /// <para></para>
114         /// </summary>
115         /// <param name="node">
116         /// <para>The node.</para>
117         /// <para></para>
118         /// </param>
119         /// <param name="left">
120         /// <para>The left.</para>
121         /// <para></para>
122         /// </param>
123         [MethodImpl(MethodImplOptions.AggressiveInlining)]
124         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkIndexPartReference(node).LeftAsTarget = left;
125
126         /// <summary>
127         /// <para>
128         /// Sets the right using the specified node.
129         /// </para>
130         /// <para></para>
131         /// </summary>
132         /// <param name="node">
133         /// <para>The node.</para>
134         /// <para></para>
135         /// </param>
136         /// <param name="right">
```

```
137             /// <para>The right.</para>
138             /// <para></para>
139             /// </param>
140             [MethodImpl(MethodImplOptions.AggressiveInlining)]
141             protected override void SetRight(TLink node, TLink right) =>
                ↪ GetLinkIndexPartReference(node).RightAsTarget = right;
142
143             /// <summary>
144             /// <para>
145             /// Gets the size using the specified node.
146             /// </para>
147             /// <para></para>
148             /// </summary>
149             /// <param name="node">
150             /// <para>The node.</para>
151             /// <para></para>
152             /// </param>
153             /// <returns>
154             /// <para>The link</para>
155             /// <para></para>
156             /// </returns>
157             [MethodImpl(MethodImplOptions.AggressiveInlining)]
158             protected override TLink GetSize(TLink node) =>
                ↪ GetLinkIndexPartReference(node).SizeAsTarget;
159
160             /// <summary>
161             /// <para>
162             /// Sets the size using the specified node.
163             /// </para>
164             /// <para></para>
165             /// </summary>
166             /// <param name="node">
167             /// <para>The node.</para>
168             /// <para></para>
169             /// </param>
170             /// <param name="size">
171             /// <para>The size.</para>
172             /// <para></para>
173             /// </param>
174             [MethodImpl(MethodImplOptions.AggressiveInlining)]
175             protected override void SetSize(TLink node, TLink size) =>
                ↪ GetLinkIndexPartReference(node).SizeAsTarget = size;
176
177             /// <summary>
178             /// <para>
179             /// Gets the tree root using the specified link.
180             /// </para>
181             /// <para></para>
182             /// </summary>
183             /// <param name="link">
184             /// <para>The link.</para>
185             /// <para></para>
186             /// </param>
187             /// <returns>
188             /// <para>The link</para>
189             /// <para></para>
190             /// </returns>
191             [MethodImpl(MethodImplOptions.AggressiveInlining)]
192             protected override TLink GetTreeRoot(TLink link) =>
                ↪ GetLinkIndexPartReference(link).RootAsTarget;
193
194             /// <summary>
195             /// <para>
196             /// Gets the base part value using the specified link.
197             /// </para>
198             /// <para></para>
199             /// </summary>
200             /// <param name="link">
201             /// <para>The link.</para>
202             /// <para></para>
203             /// </param>
204             /// <returns>
205             /// <para>The link</para>
206             /// <para></para>
207             /// </returns>
208             [MethodImpl(MethodImplOptions.AggressiveInlining)]
209             protected override TLink GetBasePartValue(TLink link) =>
                ↪ GetLinkDataPartReference(link).Target;
```

```
210
211         /// <summary>
212         /// <para>
213         /// Gets the key part value using the specified link.
214         /// </para>
215         /// <para></para>
216         /// </summary>
217         /// <param name="link">
218         /// <para>The link.</para>
219         /// <para></para>
220         /// </param>
221         /// <returns>
222         /// <para>The link</para>
223         /// <para></para>
224         /// </returns>
225         [MethodImpl(MethodImplOptions.AggressiveInlining)]
226         protected override TLink GetKeyPartValue(TLink link) =>
            ↪ GetLinkDataPartReference(link).Source;
227
228         /// <summary>
229         /// <para>
230         /// Clears the node using the specified node.
231         /// </para>
232         /// <para></para>
233         /// </summary>
234         /// <param name="node">
235         /// <para>The node.</para>
236         /// <para></para>
237         /// </param>
238         [MethodImpl(MethodImplOptions.AggressiveInlining)]
239         protected override void ClearNode(TLink node)
240         {
241             ref var link = ref GetLinkIndexPartReference(node);
242             link.LeftAsTarget = Zero;
243             link.RightAsTarget = Zero;
244             link.SizeAsTarget = Zero;
245         }
246
247         /// <summary>
248         /// <para>
249         /// Searches the source.
250         /// </para>
251         /// <para></para>
252         /// </summary>
253         /// <param name="source">
254         /// <para>The source.</para>
255         /// <para></para>
256         /// </param>
257         /// <param name="target">
258         /// <para>The target.</para>
259         /// <para></para>
260         /// </param>
261         /// <returns>
262         /// <para>The link</para>
263         /// <para></para>
264         /// </returns>
265         public override TLink Search(TLink source, TLink target) =>
            ↪ SearchCore(GetTreeRoot(target), source);
266     }
267 }
```

1.45 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/SplitMemoryLinks.cs

```
1  using System;
2  using System.Runtime.CompilerServices;
3  using Platform.Singletons;
4  using Platform.Memory;
5  using static System.Runtime.CompilerServices.Unsafe;
6
7  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
8
9  namespace Platform.Data.Doublets.Memory.Split.Generic
10 {
11     /// <summary>
12     /// <para>
13     /// Represents the split memory links.
14     /// </para>
15     /// <para></para>
16     /// </summary>
17     /// <seealso cref="SplitMemoryLinksBase{TLink}"/>
```

```
18      public unsafe class SplitMemoryLinks<TLink> : SplitMemoryLinksBase<TLink>
19      {
20          private readonly Func<ILinksTreeMethods<TLink>> _createInternalSourceTreeMethods;
21          private readonly Func<ILinksTreeMethods<TLink>> _createExternalSourceTreeMethods;
22          private readonly Func<ILinksTreeMethods<TLink>> _createInternalTargetTreeMethods;
23          private readonly Func<ILinksTreeMethods<TLink>> _createExternalTargetTreeMethods;
24          private byte* _header;
25          private byte* _linksDataParts;
26          private byte* _linksIndexParts;
27
28          /// <summary>
29          /// <para>
30          /// Initializes a new <see cref="SplitMemoryLinks"/> instance.
31          /// </para>
32          /// <para></para>
33          /// </summary>
34          /// <param name="dataMemory">
35          /// <para>A data memory.</para>
36          /// <para></para>
37          /// </param>
38          /// <param name="indexMemory">
39          /// <para>A index memory.</para>
40          /// <para></para>
41          /// </param>
42          [MethodImpl(MethodImplOptions.AggressiveInlining)]
43          public SplitMemoryLinks(string dataMemory, string indexMemory) : this(new
            ↪  FileMappedResizableDirectMemory(dataMemory), new
            ↪  FileMappedResizableDirectMemory(indexMemory)) { }
44
45          /// <summary>
46          /// <para>
47          /// Initializes a new <see cref="SplitMemoryLinks"/> instance.
48          /// </para>
49          /// <para></para>
50          /// </summary>
51          /// <param name="dataMemory">
52          /// <para>A data memory.</para>
53          /// <para></para>
54          /// </param>
55          /// <param name="indexMemory">
56          /// <para>A index memory.</para>
57          /// <para></para>
58          /// </param>
59          [MethodImpl(MethodImplOptions.AggressiveInlining)]
60          public SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪  indexMemory) : this(dataMemory, indexMemory, DefaultLinksSizeStep) { }
61
62          /// <summary>
63          /// <para>
64          /// Initializes a new <see cref="SplitMemoryLinks"/> instance.
65          /// </para>
66          /// <para></para>
67          /// </summary>
68          /// <param name="dataMemory">
69          /// <para>A data memory.</para>
70          /// <para></para>
71          /// </param>
72          /// <param name="indexMemory">
73          /// <para>A index memory.</para>
74          /// <para></para>
75          /// </param>
76          /// <param name="memoryReservationStep">
77          /// <para>A memory reservation step.</para>
78          /// <para></para>
79          /// </param>
80          [MethodImpl(MethodImplOptions.AggressiveInlining)]
81          public SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪  indexMemory, long memoryReservationStep) : this(dataMemory, indexMemory,
            ↪  memoryReservationStep, Default<LinksConstants<TLink>>.Instance,
            ↪  IndexTreeType.Default, useLinkedList: true) { }
82
83          /// <summary>
84          /// <para>
85          /// Initializes a new <see cref="SplitMemoryLinks"/> instance.
86          /// </para>
87          /// <para></para>
88          /// </summary>
89          /// <param name="dataMemory">
```

```
90          /// <para>A data memory.</para>
91          /// <para></para>
92          /// </param>
93          /// <param name="indexMemory">
94          /// <para>A index memory.</para>
95          /// <para></para>
96          /// </param>
97          /// <param name="memoryReservationStep">
98          /// <para>A memory reservation step.</para>
99          /// <para></para>
100         /// </param>
101         /// <param name="constants">
102         /// <para>A constants.</para>
103         /// <para></para>
104         /// </param>
105         [MethodImpl(MethodImplOptions.AggressiveInlining)]
106         public SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪ indexMemory, long memoryReservationStep, LinksConstants<TLink> constants) :
            ↪ this(dataMemory, indexMemory, memoryReservationStep, constants,
            ↪ IndexTreeType.Default, useLinkedList: true) { }
107
108         /// <summary>
109         /// <para>
110         /// Initializes a new <see cref="SplitMemoryLinks"/> instance.
111         /// </para>
112         /// <para></para>
113         /// </summary>
114         /// <param name="dataMemory">
115         /// <para>A data memory.</para>
116         /// <para></para>
117         /// </param>
118         /// <param name="indexMemory">
119         /// <para>A index memory.</para>
120         /// <para></para>
121         /// </param>
122         /// <param name="memoryReservationStep">
123         /// <para>A memory reservation step.</para>
124         /// <para></para>
125         /// </param>
126         /// <param name="constants">
127         /// <para>A constants.</para>
128         /// <para></para>
129         /// </param>
130         /// <param name="indexTreeType">
131         /// <para>A index tree type.</para>
132         /// <para></para>
133         /// </param>
134         /// <param name="useLinkedList">
135         /// <para>A use linked list.</para>
136         /// <para></para>
137         /// </param>
138         [MethodImpl(MethodImplOptions.AggressiveInlining)]
139         public SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪ indexMemory, long memoryReservationStep, LinksConstants<TLink> constants,
            ↪ IndexTreeType indexTreeType, bool useLinkedList) : base(dataMemory, indexMemory,
            ↪ memoryReservationStep, constants, useLinkedList)
140         {
141             if (indexTreeType == IndexTreeType.SizeBalancedTree)
142             {
143                 _createInternalSourceTreeMethods = () => new
                    ↪ InternalLinksSourcesSizeBalancedTreeMethods<TLink>(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
144                 _createExternalSourceTreeMethods = () => new
                    ↪ ExternalLinksSourcesSizeBalancedTreeMethods<TLink>(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
145                 _createInternalTargetTreeMethods = () => new
                    ↪ InternalLinksTargetsSizeBalancedTreeMethods<TLink>(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
146                 _createExternalTargetTreeMethods = () => new
                    ↪ ExternalLinksTargetsSizeBalancedTreeMethods<TLink>(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
147             }
148             else
149             {
150                 _createInternalSourceTreeMethods = () => new
                    ↪ InternalLinksSourcesRecursionlessSizeBalancedTreeMethods<TLink>(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
```

```
151                 _createExternalSourceTreeMethods = () => new
                    ↪  ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods<TLink>(Constants,
                    ↪  _linksDataParts, _linksIndexParts, _header);
152                 _createInternalTargetTreeMethods = () => new
                    ↪  InternalLinksTargetsRecursionlessSizeBalancedTreeMethods<TLink>(Constants,
                    ↪  _linksDataParts, _linksIndexParts, _header);
153                 _createExternalTargetTreeMethods = () => new
                    ↪  ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods<TLink>(Constants,
                    ↪  _linksDataParts, _linksIndexParts, _header);
154             }
155             Init(dataMemory, indexMemory);
156         }
157
158         /// <summary>
159         /// <para>
160         /// Sets the pointers using the specified data memory.
161         /// </para>
162         /// <para></para>
163         /// </summary>
164         /// <param name="dataMemory">
165         /// <para>The data memory.</para>
166         /// <para></para>
167         /// </param>
168         /// <param name="indexMemory">
169         /// <para>The index memory.</para>
170         /// <para></para>
171         /// </param>
172         [MethodImpl(MethodImplOptions.AggressiveInlining)]
173         protected override void SetPointers(IResizableDirectMemory dataMemory,
            ↪  IResizableDirectMemory indexMemory)
174         {
175             _linksDataParts = (byte*)dataMemory.Pointer;
176             _linksIndexParts = (byte*)indexMemory.Pointer;
177             _header = _linksIndexParts;
178             if (_useLinkedList)
179             {
180                 InternalSourcesListMethods = new
                    ↪  InternalLinksSourcesLinkedListMethods<TLink>(Constants, _linksDataParts,
                    ↪  _linksIndexParts);
181             }
182             else
183             {
184                 InternalSourcesTreeMethods = _createInternalSourceTreeMethods();
185             }
186             ExternalSourcesTreeMethods = _createExternalSourceTreeMethods();
187             InternalTargetsTreeMethods = _createInternalTargetTreeMethods();
188             ExternalTargetsTreeMethods = _createExternalTargetTreeMethods();
189             UnusedLinksListMethods = new UnusedLinksListMethods<TLink>(_linksDataParts, _header);
190         }
191
192         /// <summary>
193         /// <para>
194         /// Resets the pointers.
195         /// </para>
196         /// <para></para>
197         /// </summary>
198         [MethodImpl(MethodImplOptions.AggressiveInlining)]
199         protected override void ResetPointers()
200         {
201             base.ResetPointers();
202             _linksDataParts = null;
203             _linksIndexParts = null;
204             _header = null;
205         }
206
207         /// <summary>
208         /// <para>
209         /// Gets the header reference.
210         /// </para>
211         /// <para></para>
212         /// </summary>
213         /// <returns>
214         /// <para>A ref links header of t link</para>
215         /// <para></para>
216         /// </returns>
217         [MethodImpl(MethodImplOptions.AggressiveInlining)]
218         protected override ref LinksHeader<TLink> GetHeaderReference() => ref
            ↪  AsRef<LinksHeader<TLink>>(_header);
```

```
219
220             /// <summary>
221             /// <para>
222             /// Gets the link data part reference using the specified link index.
223             /// </para>
224             /// <para></para>
225             /// </summary>
226             /// <param name="linkIndex">
227             /// <para>The link index.</para>
228             /// <para></para>
229             /// </param>
230             /// <returns>
231             /// <para>A ref raw link data part of t link</para>
232             /// <para></para>
233             /// </returns>
234             [MethodImpl(MethodImplOptions.AggressiveInlining)]
235             protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink linkIndex)
                ↪  => ref AsRef<RawLinkDataPart<TLink>>(_linksDataParts + (LinkDataPartSizeInBytes *
                ↪  ConvertToInt64(linkIndex)));
236
237             /// <summary>
238             /// <para>
239             /// Gets the link index part reference using the specified link index.
240             /// </para>
241             /// <para></para>
242             /// </summary>
243             /// <param name="linkIndex">
244             /// <para>The link index.</para>
245             /// <para></para>
246             /// </param>
247             /// <returns>
248             /// <para>A ref raw link index part of t link</para>
249             /// <para></para>
250             /// </returns>
251             [MethodImpl(MethodImplOptions.AggressiveInlining)]
252             protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink
                ↪  linkIndex) => ref AsRef<RawLinkIndexPart<TLink>>(_linksIndexParts +
                ↪  (LinkIndexPartSizeInBytes * ConvertToInt64(linkIndex)));
253         }
254     }
```

1.46 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/SplitMemoryLinksBase.cs

```
1   using System;
2   using System.Collections.Generic;
3   using System.Runtime.CompilerServices;
4   using Platform.Disposables;
5   using Platform.Singletons;
6   using Platform.Converters;
7   using Platform.Numbers;
8   using Platform.Memory;
9   using Platform.Data.Exceptions;
10  using Platform.Delegates;
11
12  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
13
14  namespace Platform.Data.Doublets.Memory.Split.Generic
15  {
16      /// <summary>
17      /// <para>
18      /// Represents the split memory links base.
19      /// </para>
20      /// <para></para>
21      /// </summary>
22      /// <seealso cref="DisposableBase"/>
23      /// <seealso cref="ILinks{TLink}"/>
24      public abstract class SplitMemoryLinksBase<TLink> : DisposableBase, ILinks<TLink>
25      {
26          private static readonly EqualityComparer<TLink> _equalityComparer =
                ↪  EqualityComparer<TLink>.Default;
27          private static readonly Comparer<TLink> _comparer = Comparer<TLink>.Default;
28          private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
                ↪  UncheckedConverter<TLink, long>.Default;
29          private static readonly UncheckedConverter<long, TLink> _int64ToAddressConverter =
                ↪  UncheckedConverter<long, TLink>.Default;
30          private static readonly TLink _zero = default;
31          private static readonly TLink _one = Arithmetic.Increment(_zero);
32
33          /// <summary>Возвращает размер одной связи в байтах.</summary>
34          /// <remarks>
```

```
        /// Используется только во вне класса, не рекомедуется использовать внутри.
        /// Так как во вне не обязательно будет доступен unsafe C#.
        /// </remarks>
        public static readonly long LinkDataPartSizeInBytes = RawLinkDataPart<TLink>.SizeInBytes;

        /// <summary>
        /// <para>
        /// The size in bytes.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly long LinkIndexPartSizeInBytes =
        ↪  RawLinkIndexPart<TLink>.SizeInBytes;

        /// <summary>
        /// <para>
        /// The size in bytes.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly long LinkHeaderSizeInBytes = LinksHeader<TLink>.SizeInBytes;

        /// <summary>
        /// <para>
        /// The default links size step.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly long DefaultLinksSizeStep = 1 * 1024 * 1024;

        /// <summary>
        /// <para>
        /// The data memory.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly IResizableDirectMemory _dataMemory;
        /// <summary>
        /// <para>
        /// The index memory.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly IResizableDirectMemory _indexMemory;
        /// <summary>
        /// <para>
        /// The use linked list.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly bool _useLinkedList;
        /// <summary>
        /// <para>
        /// The data memory reservation step in bytes.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly long _dataMemoryReservationStepInBytes;
        /// <summary>
        /// <para>
        /// The index memory reservation step in bytes.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly long _indexMemoryReservationStepInBytes;

        /// <summary>
        /// <para>
        /// The internal sources list methods.
        /// </para>
        /// <para></para>
        /// </summary>
        protected InternalLinksSourcesLinkedListMethods<TLink> InternalSourcesListMethods;
        /// <summary>
        /// <para>
        /// The internal sources tree methods.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
113         protected ILinksTreeMethods<TLink> InternalSourcesTreeMethods;
114         /// <summary>
115         /// <para>
116         /// The external sources tree methods.
117         /// </para>
118         /// <para></para>
119         /// </summary>
120         protected ILinksTreeMethods<TLink> ExternalSourcesTreeMethods;
121         /// <summary>
122         /// <para>
123         /// The internal targets tree methods.
124         /// </para>
125         /// <para></para>
126         /// </summary>
127         protected ILinksTreeMethods<TLink> InternalTargetsTreeMethods;
128         /// <summary>
129         /// <para>
130         /// The external targets tree methods.
131         /// </para>
132         /// <para></para>
133         /// </summary>
134         protected ILinksTreeMethods<TLink> ExternalTargetsTreeMethods;
135         // TODO: Возможно чтобы гарантированно проверять на то, является ли связь удалённой,
            ↪  нужно использовать не список а дерево, так как так можно быстрее проверить на
            ↪  наличие связи внутри
136         /// <summary>
137         /// <para>
138         /// The unused links list methods.
139         /// </para>
140         /// <para></para>
141         /// </summary>
142         protected ILinksListMethods<TLink> UnusedLinksListMethods;
143
144         /// <summary>
145         /// Возвращает общее число связей находящихся в хранилище.
146         /// </summary>
147         protected virtual TLink Total
148         {
149             [MethodImpl(MethodImplOptions.AggressiveInlining)]
150             get
151             {
152                 ref var header = ref GetHeaderReference();
153                 return Subtract(header.AllocatedLinks, header.FreeLinks);
154             }
155         }
156
157         /// <summary>
158         /// <para>
159         /// Gets the constants value.
160         /// </para>
161         /// <para></para>
162         /// </summary>
163         public virtual LinksConstants<TLink> Constants
164         {
165             [MethodImpl(MethodImplOptions.AggressiveInlining)]
166             get;
167         }
168
169         /// <summary>
170         /// <para>
171         /// Initializes a new <see cref="SplitMemoryLinksBase"/> instance.
172         /// </para>
173         /// <para></para>
174         /// </summary>
175         /// <param name="dataMemory">
176         /// <para>A data memory.</para>
177         /// <para></para>
178         /// </param>
179         /// <param name="indexMemory">
180         /// <para>A index memory.</para>
181         /// <para></para>
182         /// </param>
183         /// <param name="memoryReservationStep">
184         /// <para>A memory reservation step.</para>
185         /// <para></para>
186         /// </param>
187         /// <param name="constants">
188         /// <para>A constants.</para>
189         /// <para></para>
```

```
        /// </param>
        /// <param name="useLinkedList">
        /// <para>A use linked list.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected SplitMemoryLinksBase(IResizableDirectMemory dataMemory, IResizableDirectMemory
        ↪  indexMemory, long memoryReservationStep, LinksConstants<TLink> constants, bool
        ↪  useLinkedList)
        {
            _dataMemory = dataMemory;
            _indexMemory = indexMemory;
            _dataMemoryReservationStepInBytes = memoryReservationStep * LinkDataPartSizeInBytes;
            _indexMemoryReservationStepInBytes = memoryReservationStep *
            ↪  LinkIndexPartSizeInBytes;
            _useLinkedList = useLinkedList;
            Constants = constants;
        }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="SplitMemoryLinksBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="dataMemory">
        /// <para>A data memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="indexMemory">
        /// <para>A index memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="memoryReservationStep">
        /// <para>A memory reservation step.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected SplitMemoryLinksBase(IResizableDirectMemory dataMemory, IResizableDirectMemory
        ↪  indexMemory, long memoryReservationStep) : this(dataMemory, indexMemory,
        ↪  memoryReservationStep, Default<LinksConstants<TLink>>.Instance, useLinkedList: true)
        ↪  { }

        /// <summary>
        /// <para>
        /// Inits the data memory.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="dataMemory">
        /// <para>The data memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="indexMemory">
        /// <para>The index memory.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual void Init(IResizableDirectMemory dataMemory, IResizableDirectMemory
        ↪  indexMemory)
        {
            // Read allocated links from header
            if (indexMemory.ReservedCapacity < LinkHeaderSizeInBytes)
            {
                indexMemory.ReservedCapacity = LinkHeaderSizeInBytes;
            }
            SetPointers(dataMemory, indexMemory);
            ref var header = ref GetHeaderReference();
            var allocatedLinks = ConvertToInt64(header.AllocatedLinks);
            // Adjust reserved capacity
            var minimumDataReservedCapacity = allocatedLinks * LinkDataPartSizeInBytes;
            if (minimumDataReservedCapacity < dataMemory.UsedCapacity)
            {
                minimumDataReservedCapacity = dataMemory.UsedCapacity;
            }
            if (minimumDataReservedCapacity < _dataMemoryReservationStepInBytes)
            {
                minimumDataReservedCapacity = _dataMemoryReservationStepInBytes;
```

```
            }
            var minimumIndexReservedCapacity = allocatedLinks * LinkDataPartSizeInBytes;
            if (minimumIndexReservedCapacity < indexMemory.UsedCapacity)
            {
                minimumIndexReservedCapacity = indexMemory.UsedCapacity;
            }
            if (minimumIndexReservedCapacity < _indexMemoryReservationStepInBytes)
            {
                minimumIndexReservedCapacity = _indexMemoryReservationStepInBytes;
            }
            // Check for alignment
            if (minimumDataReservedCapacity % _dataMemoryReservationStepInBytes > 0)
            {
                minimumDataReservedCapacity = ((minimumDataReservedCapacity /
                ↪  _dataMemoryReservationStepInBytes) * _dataMemoryReservationStepInBytes) +
                ↪  _dataMemoryReservationStepInBytes;
            }
            if (minimumIndexReservedCapacity % _indexMemoryReservationStepInBytes > 0)
            {
                minimumIndexReservedCapacity = ((minimumIndexReservedCapacity /
                ↪  _indexMemoryReservationStepInBytes) * _indexMemoryReservationStepInBytes) +
                ↪  _indexMemoryReservationStepInBytes;
            }
            if (dataMemory.ReservedCapacity != minimumDataReservedCapacity)
            {
                dataMemory.ReservedCapacity = minimumDataReservedCapacity;
            }
            if (indexMemory.ReservedCapacity != minimumIndexReservedCapacity)
            {
                indexMemory.ReservedCapacity = minimumIndexReservedCapacity;
            }
            SetPointers(dataMemory, indexMemory);
            header = ref GetHeaderReference();
            // Ensure correctness _memory.UsedCapacity over _header->AllocatedLinks
            // Гарантия корректности _memory.UsedCapacity относительно _header->AllocatedLinks
            dataMemory.UsedCapacity = (ConvertToInt64(header.AllocatedLinks) *
            ↪  LinkDataPartSizeInBytes) + LinkDataPartSizeInBytes; // First link is read only
            ↪  zero link.
            indexMemory.UsedCapacity = (ConvertToInt64(header.AllocatedLinks) *
            ↪  LinkIndexPartSizeInBytes) + LinkHeaderSizeInBytes;
            // Ensure correctness _memory.ReservedLinks over _header->ReservedCapacity
            // Гарантия корректности _header->ReservedLinks относительно _memory.ReservedCapacity
            header.ReservedLinks = ConvertToAddress((dataMemory.ReservedCapacity -
            ↪  LinkDataPartSizeInBytes) / LinkDataPartSizeInBytes);
        }

        /// <summary>
        /// <para>
        /// Counts the substitution.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <exception cref="NotSupportedException">
        /// <para>Другие размеры и способы ограничений не поддерживаются.</para>
        /// <para></para>
        /// </exception>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public virtual TLink Count(IList<TLink>? restriction)
        {
            // Если нет ограничений, тогда возвращаем общее число связей находящихся в хранилище.
            if (restriction.Count == 0)
            {
                return Total;
            }
            var constants = Constants;
            var any = constants.Any;
            var index = restriction[constants.IndexPart];
            if (restriction.Count == 1)
            {
                if (AreEqual(index, any))
```

```
331                 {
332                     return Total;
333                 }
334                 return Exists(index) ? GetOne() : GetZero();
335             }
336             if (restriction.Count == 2)
337             {
338                 var value = restriction[1];
339                 if (AreEqual(index, any))
340                 {
341                     if (AreEqual(value, any))
342                     {
343                         return Total; // Any - как отсутствие ограничения
344                     }
345                     var externalReferencesRange = constants.ExternalReferencesRange;
346                     if (externalReferencesRange.HasValue &&
                        ↪ externalReferencesRange.Value.Contains(value))
347                     {
348                         return Add(ExternalSourcesTreeMethods.CountUsages(value),
                            ↪ ExternalTargetsTreeMethods.CountUsages(value));
349                     }
350                     else
351                     {
352                         if (_useLinkedList)
353                         {
354                             return Add(InternalSourcesListMethods.CountUsages(value),
                                ↪ InternalTargetsTreeMethods.CountUsages(value));
355                         }
356                         else
357                         {
358                             return Add(InternalSourcesTreeMethods.CountUsages(value),
                                ↪ InternalTargetsTreeMethods.CountUsages(value));
359                         }
360                     }
361                 }
362                 else
363                 {
364                     if (!Exists(index))
365                     {
366                         return GetZero();
367                     }
368                     if (AreEqual(value, any))
369                     {
370                         return GetOne();
371                     }
372                     ref var storedLinkValue = ref GetLinkDataPartReference(index);
373                     if (AreEqual(storedLinkValue.Source, value) ||
                        ↪ AreEqual(storedLinkValue.Target, value))
374                     {
375                         return GetOne();
376                     }
377                     return GetZero();
378                 }
379             }
380             if (restriction.Count == 3)
381             {
382                 var externalReferencesRange = constants.ExternalReferencesRange;
383                 var source = restriction[constants.SourcePart];
384                 var target = restriction[constants.TargetPart];
385                 if (AreEqual(index, any))
386                 {
387                     if (AreEqual(source, any) && AreEqual(target, any))
388                     {
389                         return Total;
390                     }
391                     else if (AreEqual(source, any))
392                     {
393                         if (externalReferencesRange.HasValue &&
                            ↪ externalReferencesRange.Value.Contains(target))
394                         {
395                             return ExternalTargetsTreeMethods.CountUsages(target);
396                         }
397                         else
398                         {
399                             return InternalTargetsTreeMethods.CountUsages(target);
400                         }
401                     }
402                     else if (AreEqual(target, any))
```

```
403                     {
404                         if (externalReferencesRange.HasValue &&
                            ↪  externalReferencesRange.Value.Contains(source))
405                         {
406                             return ExternalSourcesTreeMethods.CountUsages(source);
407                         }
408                         else
409                         {
410                             if (_useLinkedList)
411                             {
412                                 return InternalSourcesListMethods.CountUsages(source);
413                             }
414                             else
415                             {
416                                 return InternalSourcesTreeMethods.CountUsages(source);
417                             }
418                         }
419                     }
420                     else //if(source != Any && target != Any)
421                     {
422                         // Эквивалент Exists(source, target) => Count(Any, source, target) > 0
423                         TLink link;
424                         if (externalReferencesRange.HasValue)
425                         {
426                             if (externalReferencesRange.Value.Contains(source) &&
                                ↪  externalReferencesRange.Value.Contains(target))
427                             {
428                                 link = ExternalSourcesTreeMethods.Search(source, target);
429                             }
430                             else if (externalReferencesRange.Value.Contains(source))
431                             {
432                                 link = InternalTargetsTreeMethods.Search(source, target);
433                             }
434                             else if (externalReferencesRange.Value.Contains(target))
435                             {
436                                 if (_useLinkedList)
437                                 {
438                                     link = ExternalSourcesTreeMethods.Search(source, target);
439                                 }
440                                 else
441                                 {
442                                     link = InternalSourcesTreeMethods.Search(source, target);
443                                 }
444                             }
445                             else
446                             {
447                                 if (_useLinkedList ||
                                    ↪  GreaterThan(InternalSourcesTreeMethods.CountUsages(source),
                                    ↪  InternalTargetsTreeMethods.CountUsages(target)))
448                                 {
449                                     link = InternalTargetsTreeMethods.Search(source, target);
450                                 }
451                                 else
452                                 {
453                                     link = InternalSourcesTreeMethods.Search(source, target);
454                                 }
455                             }
456                         }
457                         else
458                         {
459                             if (_useLinkedList ||
                                ↪  GreaterThan(InternalSourcesTreeMethods.CountUsages(source),
                                ↪  InternalTargetsTreeMethods.CountUsages(target)))
460                             {
461                                 link = InternalTargetsTreeMethods.Search(source, target);
462                             }
463                             else
464                             {
465                                 link = InternalSourcesTreeMethods.Search(source, target);
466                             }
467                         }
468                         return AreEqual(link, constants.Null) ? GetZero() : GetOne();
469                     }
470                 }
471                 else
472                 {
473                     if (!Exists(index))
474                     {
```

```
                    return GetZero();
                }
                if (AreEqual(source, any) && AreEqual(target, any))
                {
                    return GetOne();
                }
                ref var storedLinkValue = ref GetLinkDataPartReference(index);
                if (!AreEqual(source, any) && !AreEqual(target, any))
                {
                    if (AreEqual(storedLinkValue.Source, source) &&
                    ↪  AreEqual(storedLinkValue.Target, target))
                    {
                        return GetOne();
                    }
                    return GetZero();
                }
                var value = default(TLink);
                if (AreEqual(source, any))
                {
                    value = target;
                }
                if (AreEqual(target, any))
                {
                    value = source;
                }
                if (AreEqual(storedLinkValue.Source, value) ||
                ↪  AreEqual(storedLinkValue.Target, value))
                {
                    return GetOne();
                }
                return GetZero();
            }
        }
        throw new NotSupportedException("Другие размеры и способы ограничений не
        ↪  поддерживаются.");
    }

    /// <summary>
    /// <para>
    /// Eaches the handler.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <param name="handler">
    /// <para>The handler.</para>
    /// <para></para>
    /// </param>
    /// <param name="restriction">
    /// <para>The substitution.</para>
    /// <para></para>
    /// </param>
    /// <exception cref="NotSupportedException">
    /// <para>Другие размеры и способы ограничений не поддерживаются.</para>
    /// <para></para>
    /// </exception>
    /// <returns>
    /// <para>The link</para>
    /// <para></para>
    /// </returns>
    [MethodImpl(MethodImplOptions.AggressiveInlining)]
    public virtual TLink Each(IList<TLink> restriction, ReadHandler<TLink>? handler)
    {
        var constants = Constants;
        var @break = constants.Break;
        if (restriction.Count == 0)
        {
            for (var link = GetOne(); LessOrEqualThan(link,
            ↪  GetHeaderReference().AllocatedLinks); link = Increment(link))
            {
                if (Exists(link) && AreEqual(handler(GetLinkStruct(link)), @break))
                {
                    return @break;
                }
            }
            return @break;
        }
        var @continue = constants.Continue;
        var any = constants.Any;
```

```
549                 var index = restriction[constants.IndexPart];
550                 if (restriction.Count == 1)
551                 {
552                     if (AreEqual(index, any))
553                     {
554                         return Each(Array.Empty<TLink>(), handler);
555                     }
556                     if (!Exists(index))
557                     {
558                         return @continue;
559                     }
560                     return handler(GetLinkStruct(index));
561                 }
562                 if (restriction.Count == 2)
563                 {
564                     var value = restriction[1];
565                     if (AreEqual(index, any))
566                     {
567                         if (AreEqual(value, any))
568                         {
569                             return Each(Array.Empty<TLink>(), handler);
570                         }
571                         if (AreEqual(Each(new Link<TLink>(index, value, any), handler), @break))
572                         {
573                             return @break;
574                         }
575                         return Each(new Link<TLink>(index, any, value), handler);
576                     }
577                     else
578                     {
579                         if (!Exists(index))
580                         {
581                             return @continue;
582                         }
583                         if (AreEqual(value, any))
584                         {
585                             return handler(GetLinkStruct(index));
586                         }
587                         ref var storedLinkValue = ref GetLinkDataPartReference(index);
588                         if (AreEqual(storedLinkValue.Source, value) ||
589                             AreEqual(storedLinkValue.Target, value))
590                         {
591                             return handler(GetLinkStruct(index));
592                         }
593                         return @continue;
594                     }
595                 }
596                 if (restriction.Count == 3)
597                 {
598                     var externalReferencesRange = constants.ExternalReferencesRange;
599                     var source = restriction[constants.SourcePart];
600                     var target = restriction[constants.TargetPart];
601                     if (AreEqual(index, any))
602                     {
603                         if (AreEqual(source, any) && AreEqual(target, any))
604                         {
605                             return Each(Array.Empty<TLink>(), handler);
606                         }
607                         else if (AreEqual(source, any))
608                         {
609                             if (externalReferencesRange.HasValue &&
                                ↪  externalReferencesRange.Value.Contains(target))
610                             {
611                                 return ExternalTargetsTreeMethods.EachUsage(target, handler);
612                             }
613                             else
614                             {
615                                 return InternalTargetsTreeMethods.EachUsage(target, handler);
616                             }
617                         }
618                         else if (AreEqual(target, any))
619                         {
620                             if (externalReferencesRange.HasValue &&
                                ↪  externalReferencesRange.Value.Contains(source))
621                             {
622                                 return ExternalSourcesTreeMethods.EachUsage(source, handler);
623                             }
624                             else
```

```
                    {
                        if (_useLinkedList)
                        {
                            return InternalSourcesListMethods.EachUsage(source, handler);
                        }
                        else
                        {
                            return InternalSourcesTreeMethods.EachUsage(source, handler);
                        }
                    }
                }
                else //if(source != Any && target != Any)
                {
                    TLink link;
                    if (externalReferencesRange.HasValue)
                    {
                        if (externalReferencesRange.Value.Contains(source) &&
                        ↪  externalReferencesRange.Value.Contains(target))
                        {
                            link = ExternalSourcesTreeMethods.Search(source, target);
                        }
                        else if (externalReferencesRange.Value.Contains(source))
                        {
                            link = InternalTargetsTreeMethods.Search(source, target);
                        }
                        else if (externalReferencesRange.Value.Contains(target))
                        {
                            if (_useLinkedList)
                            {
                                link = ExternalSourcesTreeMethods.Search(source, target);
                            }
                            else
                            {
                                link = InternalSourcesTreeMethods.Search(source, target);
                            }
                        }
                        else
                        {
                            if (_useLinkedList ||
                            ↪  GreaterThan(InternalSourcesTreeMethods.CountUsages(source),
                            ↪  InternalTargetsTreeMethods.CountUsages(target)))
                            {
                                link = InternalTargetsTreeMethods.Search(source, target);
                            }
                            else
                            {
                                link = InternalSourcesTreeMethods.Search(source, target);
                            }
                        }
                    }
                    else
                    {
                        if (_useLinkedList ||
                        ↪  GreaterThan(InternalSourcesTreeMethods.CountUsages(source),
                        ↪  InternalTargetsTreeMethods.CountUsages(target)))
                        {
                            link = InternalTargetsTreeMethods.Search(source, target);
                        }
                        else
                        {
                            link = InternalSourcesTreeMethods.Search(source, target);
                        }
                    }
                    return AreEqual(link, constants.Null) ? @continue :
                    ↪  handler(GetLinkStruct(link));
                }
            }
            else
            {
                if (!Exists(index))
                {
                    return @continue;
                }
                if (AreEqual(source, any) && AreEqual(target, any))
                {
                    return handler(GetLinkStruct(index));
                }
                ref var storedLinkValue = ref GetLinkDataPartReference(index);
```

```
                    if (!AreEqual(source, any) && !AreEqual(target, any))
                    {
                        if (AreEqual(storedLinkValue.Source, source) &&
                            AreEqual(storedLinkValue.Target, target))
                        {
                            return handler(GetLinkStruct(index));
                        }
                        return @continue;
                    }
                    var value = default(TLink);
                    if (AreEqual(source, any))
                    {
                        value = target;
                    }
                    if (AreEqual(target, any))
                    {
                        value = source;
                    }
                    if (AreEqual(storedLinkValue.Source, value) ||
                        AreEqual(storedLinkValue.Target, value))
                    {
                        return handler(GetLinkStruct(index));
                    }
                    return @continue;
                }
            }
            throw new NotSupportedException("Другие размеры и способы ограничений не
            ↪  поддерживаются.");
        }

        /// <remarks>
        /// TODO: Возможно можно перемещать значения, если указан индекс, но значение существует
        ↪  в другом месте (но не в менеджере памяти, а в логике Links)
        /// </remarks>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public virtual TLink Update(IList<TLink> restriction, IList<TLink> substitution,
        ↪  WriteHandler<TLink> handler)
        {
            var constants = Constants;
            var @null = constants.Null;
            var externalReferencesRange = constants.ExternalReferencesRange;
            var linkIndex = restriction[constants.IndexPart];
            var before = GetLinkStruct(linkIndex);
            ref var link = ref GetLinkDataPartReference(linkIndex);
            var source = link.Source;
            var target = link.Target;
            ref var header = ref GetHeaderReference();
            ref var rootAsSource = ref header.RootAsSource;
            ref var rootAsTarget = ref header.RootAsTarget;
            // Будет корректно работать только в том случае, если пространство выделенной связи
            ↪  предварительно заполнено нулями
            if (!AreEqual(source, @null))
            {
                if (externalReferencesRange.HasValue &&
                ↪  externalReferencesRange.Value.Contains(source))
                {
                    ExternalSourcesTreeMethods.Detach(ref rootAsSource, linkIndex);
                }
                else
                {
                    if (_useLinkedList)
                    {
                        InternalSourcesListMethods.Detach(source, linkIndex);
                    }
                    else
                    {
                        InternalSourcesTreeMethods.Detach(ref
                        ↪  GetLinkIndexPartReference(source).RootAsSource, linkIndex);
                    }
                }
            }
            if (!AreEqual(target, @null))
            {
                if (externalReferencesRange.HasValue &&
                ↪  externalReferencesRange.Value.Contains(target))
                {
                    ExternalTargetsTreeMethods.Detach(ref rootAsTarget, linkIndex);
                }
```

```
768                 else
769                 {
770                     InternalTargetsTreeMethods.Detach(ref
                        ↪  GetLinkIndexPartReference(target).RootAsTarget, linkIndex);
771                 }
772             }
773             source = link.Source = substitution[constants.SourcePart];
774             target = link.Target = substitution[constants.TargetPart];
775             if (!AreEqual(source, @null))
776             {
777                 if (externalReferencesRange.HasValue &&
                    ↪  externalReferencesRange.Value.Contains(source))
778                 {
779                     ExternalSourcesTreeMethods.Attach(ref rootAsSource, linkIndex);
780                 }
781                 else
782                 {
783                     if (_useLinkedList)
784                     {
785                         InternalSourcesListMethods.AttachAsLast(source, linkIndex);
786                     }
787                     else
788                     {
789                         InternalSourcesTreeMethods.Attach(ref
                            ↪  GetLinkIndexPartReference(source).RootAsSource, linkIndex);
790                     }
791                 }
792             }
793             if (!AreEqual(target, @null))
794             {
795                 if (externalReferencesRange.HasValue &&
                    ↪  externalReferencesRange.Value.Contains(target))
796                 {
797                     ExternalTargetsTreeMethods.Attach(ref rootAsTarget, linkIndex);
798                 }
799                 else
800                 {
801                     InternalTargetsTreeMethods.Attach(ref
                        ↪  GetLinkIndexPartReference(target).RootAsTarget, linkIndex);
802                 }
803             }
804             return handler != null ? handler(before, new Link<TLink>(linkIndex, source, target))
                ↪  : Constants.Continue;
805         }
806
807         /// <remarks>
808         /// TODO: Возможно нужно будет заполнение нулями, если внешнее API ими не заполняет
                ↪  пространство
809         /// </remarks>
810         [MethodImpl(MethodImplOptions.AggressiveInlining)]
811         public virtual TLink Create(IList<TLink> substitution, WriteHandler<TLink> handler)
812         {
813             ref var header = ref GetHeaderReference();
814             var freeLink = header.FirstFreeLink;
815             if (!AreEqual(freeLink, Constants.Null))
816             {
817                 UnusedLinksListMethods.Detach(freeLink);
818             }
819             else
820             {
821                 var maximumPossibleInnerReference = Constants.InternalReferencesRange.Maximum;
822                 if (GreaterThan(header.AllocatedLinks, maximumPossibleInnerReference))
823                 {
824                     throw new LinksLimitReachedException<TLink>(maximumPossibleInnerReference);
825                 }
826                 if (GreaterOrEqualThan(header.AllocatedLinks, Decrement(header.ReservedLinks)))
827                 {
828                     _dataMemory.ReservedCapacity += _dataMemoryReservationStepInBytes;
829                     _indexMemory.ReservedCapacity += _indexMemoryReservationStepInBytes;
830                     SetPointers(_dataMemory, _indexMemory);
831                     header = ref GetHeaderReference();
832                     header.ReservedLinks = ConvertToAddress(_dataMemory.ReservedCapacity /
                        ↪  LinkDataPartSizeInBytes);
833                 }
834                 freeLink = header.AllocatedLinks = Increment(header.AllocatedLinks);
835                 _dataMemory.UsedCapacity += LinkDataPartSizeInBytes;
836                 _indexMemory.UsedCapacity += LinkIndexPartSizeInBytes;
837             }
```

```
838             return handler != null ? handler(null, GetLinkStruct(freeLink)) : Constants.Continue;
839         }
840 
841         /// <summary>
842         /// <para>
843         /// Deletes the substitution.
844         /// </para>
845         /// <para></para>
846         /// </summary>
847         /// <param name="restriction">
848         /// <para>The substitution.</para>
849         /// <para></para>
850         /// </param>
851         [MethodImpl(MethodImplOptions.AggressiveInlining)]
852         public virtual TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
853         {
854             ref var header = ref GetHeaderReference();
855             var link = restriction[Constants.IndexPart];
856             var before = GetLinkStruct(link);
857             if (LessThan(link, header.AllocatedLinks))
858             {
859                 UnusedLinksListMethods.AttachAsFirst(link);
860             }
861             else if (AreEqual(link, header.AllocatedLinks))
862             {
863                 header.AllocatedLinks = Decrement(header.AllocatedLinks);
864                 _dataMemory.UsedCapacity -= LinkDataPartSizeInBytes;
865                 _indexMemory.UsedCapacity -= LinkIndexPartSizeInBytes;
866                 // Убираем все связи, находящиеся в списке свободных в конце файла, до тех пор,
                    ↪  пока не дойдём до первой существующей связи
867                 // Позволяет оптимизировать количество выделенных связей (AllocatedLinks)
868                 while (GreaterThan(header.AllocatedLinks, GetZero()) &&
                    ↪  IsUnusedLink(header.AllocatedLinks))
869                 {
870                     UnusedLinksListMethods.Detach(header.AllocatedLinks);
871                     header.AllocatedLinks = Decrement(header.AllocatedLinks);
872                     _dataMemory.UsedCapacity -= LinkDataPartSizeInBytes;
873                     _indexMemory.UsedCapacity -= LinkIndexPartSizeInBytes;
874                 }
875             }
876             return handler != null ? handler(before, null) : Constants.Continue;
877         }
878 
879         /// <summary>
880         /// <para>
881         /// Gets the link struct using the specified link index.
882         /// </para>
883         /// <para></para>
884         /// </summary>
885         /// <param name="linkIndex">
886         /// <para>The link index.</para>
887         /// <para></para>
888         /// </param>
889         /// <returns>
890         /// <para>A list of t link</para>
891         /// <para></para>
892         /// </returns>
893         [MethodImpl(MethodImplOptions.AggressiveInlining)]
894         public IList<TLink> GetLinkStruct(TLink linkIndex)
895         {
896             ref var link = ref GetLinkDataPartReference(linkIndex);
897             return new Link<TLink>(linkIndex, link.Source, link.Target);
898         }
899 
900         /// <remarks>
901         /// TODO: Возможно это должно быть событием, вызываемым из IMemory, в том случае, если
            ↪  адрес реально поменялся
902         ///
903         /// Указатель this.links может быть в том же месте,
904         /// так как 0-я связь не используется и имеет такой же размер как Header,
905         /// поэтому header размещается в том же месте, что и 0-я связь
906         /// </remarks>
907         [MethodImpl(MethodImplOptions.AggressiveInlining)]
908         protected abstract void SetPointers(IResizableDirectMemory dataMemory,
            ↪  IResizableDirectMemory indexMemory);
909 
910         /// <summary>
911         /// <para>
```

```
912         /// Resets the pointers.
913         /// </para>
914         /// <para></para>
915         /// </summary>
916         [MethodImpl(MethodImplOptions.AggressiveInlining)]
917         protected virtual void ResetPointers()
918         {
919             InternalSourcesListMethods = null;
920             InternalSourcesTreeMethods = null;
921             ExternalSourcesTreeMethods = null;
922             InternalTargetsTreeMethods = null;
923             ExternalTargetsTreeMethods = null;
924             UnusedLinksListMethods = null;
925         }
926 
927         /// <summary>
928         /// <para>
929         /// Gets the header reference.
930         /// </para>
931         /// <para></para>
932         /// </summary>
933         /// <returns>
934         /// <para>A ref links header of t link</para>
935         /// <para></para>
936         /// </returns>
937         [MethodImpl(MethodImplOptions.AggressiveInlining)]
938         protected abstract ref LinksHeader<TLink> GetHeaderReference();
939 
940         /// <summary>
941         /// <para>
942         /// Gets the link data part reference using the specified link index.
943         /// </para>
944         /// <para></para>
945         /// </summary>
946         /// <param name="linkIndex">
947         /// <para>The link index.</para>
948         /// <para></para>
949         /// </param>
950         /// <returns>
951         /// <para>A ref raw link data part of t link</para>
952         /// <para></para>
953         /// </returns>
954         [MethodImpl(MethodImplOptions.AggressiveInlining)]
955         protected abstract ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink linkIndex);
956 
957         /// <summary>
958         /// <para>
959         /// Gets the link index part reference using the specified link index.
960         /// </para>
961         /// <para></para>
962         /// </summary>
963         /// <param name="linkIndex">
964         /// <para>The link index.</para>
965         /// <para></para>
966         /// </param>
967         /// <returns>
968         /// <para>A ref raw link index part of t link</para>
969         /// <para></para>
970         /// </returns>
971         [MethodImpl(MethodImplOptions.AggressiveInlining)]
972         protected abstract ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink
             ↪ linkIndex);
973 
974         /// <summary>
975         /// <para>
976         /// Determines whether this instance exists.
977         /// </para>
978         /// <para></para>
979         /// </summary>
980         /// <param name="link">
981         /// <para>The link.</para>
982         /// <para></para>
983         /// </param>
984         /// <returns>
985         /// <para>The bool</para>
986         /// <para></para>
987         /// </returns>
988         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
        protected virtual bool Exists(TLink link)
            => GreaterOrEqualThan(link, Constants.InternalReferencesRange.Minimum)
            && LessOrEqualThan(link, GetHeaderReference().AllocatedLinks)
            && !IsUnusedLink(link);

        /// <summary>
        /// <para>
        /// Determines whether this instance is unused link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual bool IsUnusedLink(TLink linkIndex)
        {
            if (!AreEqual(GetHeaderReference().FirstFreeLink, linkIndex)) // May be this check
            ↪  is not needed
            {
                // TODO: Reduce access to memory in different location (should be enough to use
                ↪  just linkIndexPart)
                ref var linkDataPart = ref GetLinkDataPartReference(linkIndex);
                ref var linkIndexPart = ref GetLinkIndexPartReference(linkIndex);
                return AreEqual(linkIndexPart.SizeAsTarget, default) &&
                ↪  !AreEqual(linkDataPart.Source, default);
            }
            else
            {
                return true;
            }
        }

        /// <summary>
        /// <para>
        /// Gets the one.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink GetOne() => _one;

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink GetZero() => default;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
```

```
1064            /// <returns>
1065            /// <para>The bool</para>
1066            /// <para></para>
1067            /// </returns>
1068            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1069            protected virtual bool AreEqual(TLink first, TLink second) =>
                ↪ _equalityComparer.Equals(first, second);
1070
1071            /// <summary>
1072            /// <para>
1073            /// Determines whether this instance less than.
1074            /// </para>
1075            /// <para></para>
1076            /// </summary>
1077            /// <param name="first">
1078            /// <para>The first.</para>
1079            /// <para></para>
1080            /// </param>
1081            /// <param name="second">
1082            /// <para>The second.</para>
1083            /// <para></para>
1084            /// </param>
1085            /// <returns>
1086            /// <para>The bool</para>
1087            /// <para></para>
1088            /// </returns>
1089            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1090            protected virtual bool LessThan(TLink first, TLink second) => _comparer.Compare(first,
                ↪ second) < 0;
1091
1092            /// <summary>
1093            /// <para>
1094            /// Determines whether this instance less or equal than.
1095            /// </para>
1096            /// <para></para>
1097            /// </summary>
1098            /// <param name="first">
1099            /// <para>The first.</para>
1100            /// <para></para>
1101            /// </param>
1102            /// <param name="second">
1103            /// <para>The second.</para>
1104            /// <para></para>
1105            /// </param>
1106            /// <returns>
1107            /// <para>The bool</para>
1108            /// <para></para>
1109            /// </returns>
1110            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1111            protected virtual bool LessOrEqualThan(TLink first, TLink second) =>
                ↪ _comparer.Compare(first, second) <= 0;
1112
1113            /// <summary>
1114            /// <para>
1115            /// Determines whether this instance greater than.
1116            /// </para>
1117            /// <para></para>
1118            /// </summary>
1119            /// <param name="first">
1120            /// <para>The first.</para>
1121            /// <para></para>
1122            /// </param>
1123            /// <param name="second">
1124            /// <para>The second.</para>
1125            /// <para></para>
1126            /// </param>
1127            /// <returns>
1128            /// <para>The bool</para>
1129            /// <para></para>
1130            /// </returns>
1131            [MethodImpl(MethodImplOptions.AggressiveInlining)]
1132            protected virtual bool GreaterThan(TLink first, TLink second) =>
                ↪ _comparer.Compare(first, second) > 0;
1133
1134            /// <summary>
1135            /// <para>
1136            /// Determines whether this instance greater or equal than.
1137            /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual bool GreaterOrEqualThan(TLink first, TLink second) =>
        ↪  _comparer.Compare(first, second) >= 0;

        /// <summary>
        /// <para>
        /// Converts the to int 64 using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The long</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual long ConvertToInt64(TLink value) =>
        ↪  _addressToInt64Converter.Convert(value);

        /// <summary>
        /// <para>
        /// Converts the to address using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink ConvertToAddress(long value) =>
        ↪  _int64ToAddressConverter.Convert(value);

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink Add(TLink first, TLink second) => Arithmetic<TLink>.Add(first,
        ↪  second);

        /// <summary>
        /// <para>
```

```
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink Subtract(TLink first, TLink second) =>
        ↪  Arithmetic<TLink>.Subtract(first, second);

        /// <summary>
        /// <para>
        /// Increments the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink Increment(TLink link) => Arithmetic<TLink>.Increment(link);

        /// <summary>
        /// <para>
        /// Decrements the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink Decrement(TLink link) => Arithmetic<TLink>.Decrement(link);

        #region Disposable

        /// <summary>
        /// <para>
        /// Gets the allow multiple dispose calls value.
        /// </para>
        /// <para></para>
        /// </summary>
        protected override bool AllowMultipleDisposeCalls
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get => true;
        }

        /// <summary>
        /// <para>
        /// Disposes the manual.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="manual">
        /// <para>The manual.</para>
        /// <para></para>
        /// </param>
```

```
        /// <param name="wasDisposed">
        /// <para>The was disposed.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void Dispose(bool manual, bool wasDisposed)
        {
            if (!wasDisposed)
            {
                ResetPointers();
                _dataMemory.DisposeIfPossible();
                _indexMemory.DisposeIfPossible();
            }
        }

        #endregion
    }
}
```

1.47 ./csharp/Platform.Data.Doublets/Memory/Split/Generic/UnusedLinksListMethods.cs

```
using System.Runtime.CompilerServices;
using Platform.Collections.Methods.Lists;
using Platform.Converters;
using static System.Runtime.CompilerServices.Unsafe;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
{
    /// <summary>
    /// <para>
    /// Represents the unused links list methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="AbsoluteCircularDoublyLinkedListMethods{TLink}"/>
    /// <seealso cref="ILinksListMethods{TLink}"/>
    public unsafe class UnusedLinksListMethods<TLink> :
    ↪  AbsoluteCircularDoublyLinkedListMethods<TLink>, ILinksListMethods<TLink>
    {
        private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
        ↪  UncheckedConverter<TLink, long>.Default;
        private readonly byte* _links;
        private readonly byte* _header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UnusedLinksListMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UnusedLinksListMethods(byte* links, byte* header)
        {
            _links = links;
            _header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref LinksHeader<TLink> GetHeaderReference() => ref
        ↪  AsRef<LinksHeader<TLink>>(_header);
```

```
57
58          /// <summary>
59          /// <para>
60          /// Gets the link data part reference using the specified link.
61          /// </para>
62          /// <para></para>
63          /// </summary>
64          /// <param name="link">
65          /// <para>The link.</para>
66          /// <para></para>
67          /// </param>
68          /// <returns>
69          /// <para>A ref raw link data part of t link</para>
70          /// <para></para>
71          /// </returns>
72          [MethodImpl(MethodImplOptions.AggressiveInlining)]
73          protected virtual ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) => ref
            ↪  AsRef<RawLinkDataPart<TLink>>(_links + (RawLinkDataPart<TLink>.SizeInBytes *
            ↪  _addressToInt64Converter.Convert(link)));
74
75          /// <summary>
76          /// <para>
77          /// Gets the first.
78          /// </para>
79          /// <para></para>
80          /// </summary>
81          /// <returns>
82          /// <para>The link</para>
83          /// <para></para>
84          /// </returns>
85          [MethodImpl(MethodImplOptions.AggressiveInlining)]
86          protected override TLink GetFirst() => GetHeaderReference().FirstFreeLink;
87
88          /// <summary>
89          /// <para>
90          /// Gets the last.
91          /// </para>
92          /// <para></para>
93          /// </summary>
94          /// <returns>
95          /// <para>The link</para>
96          /// <para></para>
97          /// </returns>
98          [MethodImpl(MethodImplOptions.AggressiveInlining)]
99          protected override TLink GetLast() => GetHeaderReference().LastFreeLink;
100
101         /// <summary>
102         /// <para>
103         /// Gets the previous using the specified element.
104         /// </para>
105         /// <para></para>
106         /// </summary>
107         /// <param name="element">
108         /// <para>The element.</para>
109         /// <para></para>
110         /// </param>
111         /// <returns>
112         /// <para>The link</para>
113         /// <para></para>
114         /// </returns>
115         [MethodImpl(MethodImplOptions.AggressiveInlining)]
116         protected override TLink GetPrevious(TLink element) =>
            ↪  GetLinkDataPartReference(element).Source;
117
118         /// <summary>
119         /// <para>
120         /// Gets the next using the specified element.
121         /// </para>
122         /// <para></para>
123         /// </summary>
124         /// <param name="element">
125         /// <para>The element.</para>
126         /// <para></para>
127         /// </param>
128         /// <returns>
129         /// <para>The link</para>
130         /// <para></para>
131         /// </returns>
```

```
132         [MethodImpl(MethodImplOptions.AggressiveInlining)]
133         protected override TLink GetNext(TLink element) =>
            ↪ GetLinkDataPartReference(element).Target;
134
135         /// <summary>
136         /// <para>
137         /// Gets the size.
138         /// </para>
139         /// <para></para>
140         /// </summary>
141         /// <returns>
142         /// <para>The link</para>
143         /// <para></para>
144         /// </returns>
145         [MethodImpl(MethodImplOptions.AggressiveInlining)]
146         protected override TLink GetSize() => GetHeaderReference().FreeLinks;
147
148         /// <summary>
149         /// <para>
150         /// Sets the first using the specified element.
151         /// </para>
152         /// <para></para>
153         /// </summary>
154         /// <param name="element">
155         /// <para>The element.</para>
156         /// <para></para>
157         /// </param>
158         [MethodImpl(MethodImplOptions.AggressiveInlining)]
159         protected override void SetFirst(TLink element) => GetHeaderReference().FirstFreeLink =
            ↪ element;
160
161         /// <summary>
162         /// <para>
163         /// Sets the last using the specified element.
164         /// </para>
165         /// <para></para>
166         /// </summary>
167         /// <param name="element">
168         /// <para>The element.</para>
169         /// <para></para>
170         /// </param>
171         [MethodImpl(MethodImplOptions.AggressiveInlining)]
172         protected override void SetLast(TLink element) => GetHeaderReference().LastFreeLink =
            ↪ element;
173
174         /// <summary>
175         /// <para>
176         /// Sets the previous using the specified element.
177         /// </para>
178         /// <para></para>
179         /// </summary>
180         /// <param name="element">
181         /// <para>The element.</para>
182         /// <para></para>
183         /// </param>
184         /// <param name="previous">
185         /// <para>The previous.</para>
186         /// <para></para>
187         /// </param>
188         [MethodImpl(MethodImplOptions.AggressiveInlining)]
189         protected override void SetPrevious(TLink element, TLink previous) =>
            ↪ GetLinkDataPartReference(element).Source = previous;
190
191         /// <summary>
192         /// <para>
193         /// Sets the next using the specified element.
194         /// </para>
195         /// <para></para>
196         /// </summary>
197         /// <param name="element">
198         /// <para>The element.</para>
199         /// <para></para>
200         /// </param>
201         /// <param name="next">
202         /// <para>The next.</para>
203         /// <para></para>
204         /// </param>
205         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
206         protected override void SetNext(TLink element, TLink next) =>
            ↪ GetLinkDataPartReference(element).Target = next;
207
208         /// <summary>
209         /// <para>
210         /// Sets the size using the specified size.
211         /// </para>
212         /// <para></para>
213         /// </summary>
214         /// <param name="size">
215         /// <para>The size.</para>
216         /// <para></para>
217         /// </param>
218         [MethodImpl(MethodImplOptions.AggressiveInlining)]
219         protected override void SetSize(TLink size) => GetHeaderReference().FreeLinks = size;
220     }
221 }
```

1.48 ./csharp/Platform.Data.Doublets/Memory/Split/RawLinkDataPart.cs

```
1  using Platform.Unsafe;
2  using System;
3  using System.Collections.Generic;
4  using System.Runtime.CompilerServices;
5
6  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
7
8  namespace Platform.Data.Doublets.Memory.Split
9  {
10     /// <summary>
11     /// <para>
12     /// The raw link data part.
13     /// </para>
14     /// <para></para>
15     /// </summary>
16     public struct RawLinkDataPart<TLink> : IEquatable<RawLinkDataPart<TLink>>
17     {
18         private static readonly EqualityComparer<TLink> _equalityComparer =
           ↪ EqualityComparer<TLink>.Default;
19
20         /// <summary>
21         /// <para>
22         /// The size.
23         /// </para>
24         /// <para></para>
25         /// </summary>
26         public static readonly long SizeInBytes = Structure<RawLinkDataPart<TLink>>.Size;
27
28         /// <summary>
29         /// <para>
30         /// The source.
31         /// </para>
32         /// <para></para>
33         /// </summary>
34         public TLink Source;
35         /// <summary>
36         /// <para>
37         /// The target.
38         /// </para>
39         /// <para></para>
40         /// </summary>
41         public TLink Target;
42
43         /// <summary>
44         /// <para>
45         /// Determines whether this instance equals.
46         /// </para>
47         /// <para></para>
48         /// </summary>
49         /// <param name="obj">
50         /// <para>The obj.</para>
51         /// <para></para>
52         /// </param>
53         /// <returns>
54         /// <para>The bool</para>
55         /// <para></para>
56         /// </returns>
57         [MethodImpl(MethodImplOptions.AggressiveInlining)]
58         public override bool Equals(object obj) => obj is RawLinkDataPart<TLink> link ?
           ↪ Equals(link) : false;
```

```

        /// <summary>
        /// <para>
        /// Determines whether this instance equals.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="other">
        /// <para>The other.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool Equals(RawLinkDataPart<TLink> other)
            => _equalityComparer.Equals(Source, other.Source)
            && _equalityComparer.Equals(Target, other.Target);

        /// <summary>
        /// <para>
        /// Gets the hash code.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The int</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override int GetHashCode() => (Source, Target).GetHashCode();

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool operator ==(RawLinkDataPart<TLink> left, RawLinkDataPart<TLink>
        ↪  right) => left.Equals(right);

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool operator !=(RawLinkDataPart<TLink> left, RawLinkDataPart<TLink>
        ↪  right) => !(left == right);
    }
}
```

1.49 ./csharp/Platform.Data.Doublets/Memory/Split/RawLinkIndexPart.cs

```
using Platform.Unsafe;
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split
{
    /// <summary>
    /// <para>
    /// The raw link index part.
    /// </para>
    /// <para></para>
    /// </summary>
    public struct RawLinkIndexPart<TLink> : IEquatable<RawLinkIndexPart<TLink>>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;

        /// <summary>
        /// <para>
        /// The size.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly long SizeInBytes = Structure<RawLinkIndexPart<TLink>>.Size;

        /// <summary>
        /// <para>
        /// The root as source.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink RootAsSource;
```

```
35          /// <summary>
36          /// <para>
37          /// The left as source.
38          /// </para>
39          /// <para></para>
40          /// </summary>
41          public TLink LeftAsSource;
42          /// <summary>
43          /// <para>
44          /// The right as source.
45          /// </para>
46          /// <para></para>
47          /// </summary>
48          public TLink RightAsSource;
49          /// <summary>
50          /// <para>
51          /// The size as source.
52          /// </para>
53          /// <para></para>
54          /// </summary>
55          public TLink SizeAsSource;
56          /// <summary>
57          /// <para>
58          /// The root as target.
59          /// </para>
60          /// <para></para>
61          /// </summary>
62          public TLink RootAsTarget;
63          /// <summary>
64          /// <para>
65          /// The left as target.
66          /// </para>
67          /// <para></para>
68          /// </summary>
69          public TLink LeftAsTarget;
70          /// <summary>
71          /// <para>
72          /// The right as target.
73          /// </para>
74          /// <para></para>
75          /// </summary>
76          public TLink RightAsTarget;
77          /// <summary>
78          /// <para>
79          /// The size as target.
80          /// </para>
81          /// <para></para>
82          /// </summary>
83          public TLink SizeAsTarget;
84
85          /// <summary>
86          /// <para>
87          /// Determines whether this instance equals.
88          /// </para>
89          /// <para></para>
90          /// </summary>
91          /// <param name="obj">
92          /// <para>The obj.</para>
93          /// <para></para>
94          /// </param>
95          /// <returns>
96          /// <para>The bool</para>
97          /// <para></para>
98          /// </returns>
99          [MethodImpl(MethodImplOptions.AggressiveInlining)]
100         public override bool Equals(object obj) => obj is RawLinkIndexPart<TLink> link ?
            ↪  Equals(link) : false;
101
102         /// <summary>
103         /// <para>
104         /// Determines whether this instance equals.
105         /// </para>
106         /// <para></para>
107         /// </summary>
108         /// <param name="other">
109         /// <para>The other.</para>
110         /// <para></para>
111         /// </param>
```

```
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool Equals(RawLinkIndexPart<TLink> other)
            => _equalityComparer.Equals(RootAsSource, other.RootAsSource)
            && _equalityComparer.Equals(LeftAsSource, other.LeftAsSource)
            && _equalityComparer.Equals(RightAsSource, other.RightAsSource)
            && _equalityComparer.Equals(SizeAsSource, other.SizeAsSource)
            && _equalityComparer.Equals(RootAsTarget, other.RootAsTarget)
            && _equalityComparer.Equals(LeftAsTarget, other.LeftAsTarget)
            && _equalityComparer.Equals(RightAsTarget, other.RightAsTarget)
            && _equalityComparer.Equals(SizeAsTarget, other.SizeAsTarget);

        /// <summary>
        /// <para>
        /// Gets the hash code.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The int</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override int GetHashCode() => (RootAsSource, LeftAsSource, RightAsSource,
        ↪  SizeAsSource, RootAsTarget, LeftAsTarget, RightAsTarget, SizeAsTarget).GetHashCode();

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool operator ==(RawLinkIndexPart<TLink> left, RawLinkIndexPart<TLink>
        ↪  right) => left.Equals(right);

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool operator !=(RawLinkIndexPart<TLink> left, RawLinkIndexPart<TLink>
        ↪  right) => !(left == right);
    }
}
```

1.50 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32ExternalLinksRecursionlessSizeBalancedTree

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.Split.Generic;
using TLink = System.UInt32;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 external links recursionless size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="ExternalLinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
    /// <seealso cref="ILinksTreeMethods{TLink}"/>
    public unsafe abstract class UInt32ExternalLinksRecursionlessSizeBalancedTreeMethodsBase :
    ↪  ExternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink>, ILinksTreeMethods<TLink>
    {
        /// <summary>
        /// <para>
        /// The links data parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkDataPart<TLink>* LinksDataParts;
        /// <summary>
        /// <para>
        /// The links index parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkIndexPart<TLink>* LinksIndexParts;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
```

```
        /// </summary>
        protected new readonly LinksHeader<TLink>* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪  cref="UInt32ExternalLinksRecursionlessSizeBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected
        ↪  UInt32ExternalLinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header)
            : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts, (byte*)header)
        {
            LinksDataParts = linksDataParts;
            LinksIndexParts = linksIndexParts;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetZero() => 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(TLink value) => value == 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
```

```
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(TLink first, TLink second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(TLink value) => value > OU;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(TLink first, TLink second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(TLink first, TLink second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(TLink value) => true; // value >= 0 is
        ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThanZero(TLink value) => value == 0UL; // value is
        ↪  always >= 0 for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(TLink first, TLink second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThanZero(TLink value) => false; // value < 0 is always false
        ↪  for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
```

```
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(TLink first, TLink second) => first < second;

        /// <summary>
        /// <para>
        /// Increments the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Increment(TLink value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Decrement(TLink value) => --value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Add(TLink first, TLink second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
```

```
343             /// </param>
344             /// <returns>
345             /// <para>The link</para>
346             /// <para></para>
347             /// </returns>
348             [MethodImpl(MethodImplOptions.AggressiveInlining)]
349             protected override TLink Subtract(TLink first, TLink second) => first - second;
350
351             /// <summary>
352             /// <para>
353             /// Gets the header reference.
354             /// </para>
355             /// <para></para>
356             /// </summary>
357             /// <returns>
358             /// <para>A ref links header of t link</para>
359             /// <para></para>
360             /// </returns>
361             [MethodImpl(MethodImplOptions.AggressiveInlining)]
362             protected override ref LinksHeader<TLink> GetHeaderReference() => ref *Header;
363
364             /// <summary>
365             /// <para>
366             /// Gets the link data part reference using the specified link.
367             /// </para>
368             /// <para></para>
369             /// </summary>
370             /// <param name="link">
371             /// <para>The link.</para>
372             /// <para></para>
373             /// </param>
374             /// <returns>
375             /// <para>A ref raw link data part of t link</para>
376             /// <para></para>
377             /// </returns>
378             [MethodImpl(MethodImplOptions.AggressiveInlining)]
379             protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
                 ↪  ref LinksDataParts[link];
380
381             /// <summary>
382             /// <para>
383             /// Gets the link index part reference using the specified link.
384             /// </para>
385             /// <para></para>
386             /// </summary>
387             /// <param name="link">
388             /// <para>The link.</para>
389             /// <para></para>
390             /// </param>
391             /// <returns>
392             /// <para>A ref raw link index part of t link</para>
393             /// <para></para>
394             /// </returns>
395             [MethodImpl(MethodImplOptions.AggressiveInlining)]
396             protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
                 ↪  ref LinksIndexParts[link];
397
398             /// <summary>
399             /// <para>
400             /// Determines whether this instance first is to the left of second.
401             /// </para>
402             /// <para></para>
403             /// </summary>
404             /// <param name="first">
405             /// <para>The first.</para>
406             /// <para></para>
407             /// </param>
408             /// <param name="second">
409             /// <para>The second.</para>
410             /// <para></para>
411             /// </param>
412             /// <returns>
413             /// <para>The bool</para>
414             /// <para></para>
415             /// </returns>
416             [MethodImpl(MethodImplOptions.AggressiveInlining)]
417             protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
418             {
```

```
            ref var firstLink = ref LinksDataParts[first];
            ref var secondLink = ref LinksDataParts[second];
            return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
        {
            ref var firstLink = ref LinksDataParts[first];
            ref var secondLink = ref LinksDataParts[second];
            return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }
    }
}
```

1.51 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32ExternalLinksSizeBalancedTreeMethodsBase

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.Split.Generic;
using TLink = System.UInt32;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 external links size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="ExternalLinksSizeBalancedTreeMethodsBase{TLink}"/>
    /// <seealso cref="ILinksTreeMethods{TLink}"/>
    public unsafe abstract class UInt32ExternalLinksSizeBalancedTreeMethodsBase :
    ↪  ExternalLinksSizeBalancedTreeMethodsBase<TLink>, ILinksTreeMethods<TLink>
    {
        /// <summary>
        /// <para>
        /// The links data parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkDataPart<TLink>* LinksDataParts;
        /// <summary>
        /// <para>
        /// The links index parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkIndexPart<TLink>* LinksIndexParts;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly LinksHeader<TLink>* Header;

        /// <summary>
```

```
        /// <para>
        /// Initializes a new <see cref="UInt32ExternalLinksSizeBalancedTreeMethodsBase"/>
        ↪  instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected UInt32ExternalLinksSizeBalancedTreeMethodsBase(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header)
            : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts, (byte*)header)
        {
            LinksDataParts = linksDataParts;
            LinksIndexParts = linksIndexParts;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetZero() => 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(TLink value) => value == 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
```

```
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(TLink first, TLink second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(TLink value) => value > OU;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(TLink first, TLink second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(TLink first, TLink second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
```

```
195         /// </returns>
196         [MethodImpl(MethodImplOptions.AggressiveInlining)]
197         protected override bool GreaterOrEqualThanZero(TLink value) => true; // value >= 0 is
            ↪ always true for ulong
198
199         /// <summary>
200         /// <para>
201         /// Determines whether this instance less or equal than zero.
202         /// </para>
203         /// <para></para>
204         /// </summary>
205         /// <param name="value">
206         /// <para>The value.</para>
207         /// <para></para>
208         /// </param>
209         /// <returns>
210         /// <para>The bool</para>
211         /// <para></para>
212         /// </returns>
213         [MethodImpl(MethodImplOptions.AggressiveInlining)]
214         protected override bool LessOrEqualThanZero(TLink value) => value == 0UL; // value is
            ↪ always >= 0 for ulong
215
216         /// <summary>
217         /// <para>
218         /// Determines whether this instance less or equal than.
219         /// </para>
220         /// <para></para>
221         /// </summary>
222         /// <param name="first">
223         /// <para>The first.</para>
224         /// <para></para>
225         /// </param>
226         /// <param name="second">
227         /// <para>The second.</para>
228         /// <para></para>
229         /// </param>
230         /// <returns>
231         /// <para>The bool</para>
232         /// <para></para>
233         /// </returns>
234         [MethodImpl(MethodImplOptions.AggressiveInlining)]
235         protected override bool LessOrEqualThan(TLink first, TLink second) => first <= second;
236
237         /// <summary>
238         /// <para>
239         /// Determines whether this instance less than zero.
240         /// </para>
241         /// <para></para>
242         /// </summary>
243         /// <param name="value">
244         /// <para>The value.</para>
245         /// <para></para>
246         /// </param>
247         /// <returns>
248         /// <para>The bool</para>
249         /// <para></para>
250         /// </returns>
251         [MethodImpl(MethodImplOptions.AggressiveInlining)]
252         protected override bool LessThanZero(TLink value) => false; // value < 0 is always false
            ↪ for ulong
253
254         /// <summary>
255         /// <para>
256         /// Determines whether this instance less than.
257         /// </para>
258         /// <para></para>
259         /// </summary>
260         /// <param name="first">
261         /// <para>The first.</para>
262         /// <para></para>
263         /// </param>
264         /// <param name="second">
265         /// <para>The second.</para>
266         /// <para></para>
267         /// </param>
268         /// <returns>
269         /// <para>The bool</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(TLink first, TLink second) => first < second;

        /// <summary>
        /// <para>
        /// Increments the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Increment(TLink value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Decrement(TLink value) => --value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Add(TLink first, TLink second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
```

```
348         [MethodImpl(MethodImplOptions.AggressiveInlining)]
349         protected override TLink Subtract(TLink first, TLink second) => first - second;
350
351         /// <summary>
352         /// <para>
353         /// Gets the header reference.
354         /// </para>
355         /// <para></para>
356         /// </summary>
357         /// <returns>
358         /// <para>A ref links header of t link</para>
359         /// <para></para>
360         /// </returns>
361         [MethodImpl(MethodImplOptions.AggressiveInlining)]
362         protected override ref LinksHeader<TLink> GetHeaderReference() => ref *Header;
363
364         /// <summary>
365         /// <para>
366         /// Gets the link data part reference using the specified link.
367         /// </para>
368         /// <para></para>
369         /// </summary>
370         /// <param name="link">
371         /// <para>The link.</para>
372         /// <para></para>
373         /// </param>
374         /// <returns>
375         /// <para>A ref raw link data part of t link</para>
376         /// <para></para>
377         /// </returns>
378         [MethodImpl(MethodImplOptions.AggressiveInlining)]
379         protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
            ↪  ref LinksDataParts[link];
380
381         /// <summary>
382         /// <para>
383         /// Gets the link index part reference using the specified link.
384         /// </para>
385         /// <para></para>
386         /// </summary>
387         /// <param name="link">
388         /// <para>The link.</para>
389         /// <para></para>
390         /// </param>
391         /// <returns>
392         /// <para>A ref raw link index part of t link</para>
393         /// <para></para>
394         /// </returns>
395         [MethodImpl(MethodImplOptions.AggressiveInlining)]
396         protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
            ↪  ref LinksIndexParts[link];
397
398         /// <summary>
399         /// <para>
400         /// Determines whether this instance first is to the left of second.
401         /// </para>
402         /// <para></para>
403         /// </summary>
404         /// <param name="first">
405         /// <para>The first.</para>
406         /// <para></para>
407         /// </param>
408         /// <param name="second">
409         /// <para>The second.</para>
410         /// <para></para>
411         /// </param>
412         /// <returns>
413         /// <para>The bool</para>
414         /// <para></para>
415         /// </returns>
416         [MethodImpl(MethodImplOptions.AggressiveInlining)]
417         protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
418         {
419             ref var firstLink = ref LinksDataParts[first];
420             ref var secondLink = ref LinksDataParts[second];
421             return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                ↪  secondLink.Source, secondLink.Target);
422         }
```

```

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
        {
            ref var firstLink = ref LinksDataParts[first];
            ref var secondLink = ref LinksDataParts[second];
            return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }
    }
}
```

1.52 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32ExternalLinksSourcesRecursionlessSizeBalanc

```
using System.Runtime.CompilerServices;
using TLink = System.UInt32;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 external links sources recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt32ExternalLinksRecursionlessSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt32ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods :
    ↪  UInt32ExternalLinksRecursionlessSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪  cref="UInt32ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public
        ↪  UInt32ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪  linksIndexParts, header) { }

```

```
42          /// <summary>
43          /// <para>
44          /// Gets the left reference using the specified node.
45          /// </para>
46          /// <para></para>
47          /// </summary>
48          /// <param name="node">
49          /// <para>The node.</para>
50          /// <para></para>
51          /// </param>
52          /// <returns>
53          /// <para>The ref link</para>
54          /// <para></para>
55          /// </returns>
56          [MethodImpl(MethodImplOptions.AggressiveInlining)]
57          protected override ref TLink GetLeftReference(TLink node) => ref
            ↪ LinksIndexParts[node].LeftAsSource;
58
59          /// <summary>
60          /// <para>
61          /// Gets the right reference using the specified node.
62          /// </para>
63          /// <para></para>
64          /// </summary>
65          /// <param name="node">
66          /// <para>The node.</para>
67          /// <para></para>
68          /// </param>
69          /// <returns>
70          /// <para>The ref link</para>
71          /// <para></para>
72          /// </returns>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ LinksIndexParts[node].RightAsSource;
75
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsSource;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsSource;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
```

```
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  LinksIndexParts[node].LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsSource = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => Header->RootAsSource;

        /// <summary>
        /// <para>
```

```
193             /// Gets the base part value using the specified node.
194             /// </para>
195             /// <para></para>
196             /// </summary>
197             /// <param name="node">
198             /// <para>The node.</para>
199             /// <para></para>
200             /// </param>
201             /// <returns>
202             /// <para>The link</para>
203             /// <para></para>
204             /// </returns>
205             [MethodImpl(MethodImplOptions.AggressiveInlining)]
206             protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Source;
207
208             /// <summary>
209             /// <para>
210             /// Determines whether this instance first is to the left of second.
211             /// </para>
212             /// <para></para>
213             /// </summary>
214             /// <param name="firstSource">
215             /// <para>The first source.</para>
216             /// <para></para>
217             /// </param>
218             /// <param name="firstTarget">
219             /// <para>The first target.</para>
220             /// <para></para>
221             /// </param>
222             /// <param name="secondSource">
223             /// <para>The second source.</para>
224             /// <para></para>
225             /// </param>
226             /// <param name="secondTarget">
227             /// <para>The second target.</para>
228             /// <para></para>
229             /// </param>
230             /// <returns>
231             /// <para>The bool</para>
232             /// <para></para>
233             /// </returns>
234             [MethodImpl(MethodImplOptions.AggressiveInlining)]
235             protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
                ↪  TLink secondSource, TLink secondTarget)
236                 => firstSource < secondSource || firstSource == secondSource && firstTarget <
                    ↪  secondTarget;
237
238             /// <summary>
239             /// <para>
240             /// Determines whether this instance first is to the right of second.
241             /// </para>
242             /// <para></para>
243             /// </summary>
244             /// <param name="firstSource">
245             /// <para>The first source.</para>
246             /// <para></para>
247             /// </param>
248             /// <param name="firstTarget">
249             /// <para>The first target.</para>
250             /// <para></para>
251             /// </param>
252             /// <param name="secondSource">
253             /// <para>The second source.</para>
254             /// <para></para>
255             /// </param>
256             /// <param name="secondTarget">
257             /// <para>The second target.</para>
258             /// <para></para>
259             /// </param>
260             /// <returns>
261             /// <para>The bool</para>
262             /// <para></para>
263             /// </returns>
264             [MethodImpl(MethodImplOptions.AggressiveInlining)]
265             protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
                ↪  TLink secondSource, TLink secondTarget)
266                 => firstSource > secondSource || firstSource == secondSource && firstTarget >
                    ↪  secondTarget;
```

```
267
268         /// <summary>
269         /// <para>
270         /// Clears the node using the specified node.
271         /// </para>
272         /// <para></para>
273         /// </summary>
274         /// <param name="node">
275         /// <para>The node.</para>
276         /// <para></para>
277         /// </param>
278         [MethodImpl(MethodImplOptions.AggressiveInlining)]
279         protected override void ClearNode(TLink node)
280         {
281             ref var link = ref LinksIndexParts[node];
282             link.LeftAsSource = Zero;
283             link.RightAsSource = Zero;
284             link.SizeAsSource = Zero;
285         }
286     }
287 }
```

1.53 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32ExternalLinksSourcesSizeBalancedTreeMeth

```
1  using System.Runtime.CompilerServices;
2  using TLink = System.UInt32;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Data.Doublets.Memory.Split.Specific
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 32 external links sources size balanced tree methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
14     /// <seealso cref="UInt32ExternalLinksSizeBalancedTreeMethodsBase"/>
15     public unsafe class UInt32ExternalLinksSourcesSizeBalancedTreeMethods :
       ↪  UInt32ExternalLinksSizeBalancedTreeMethodsBase
16     {
17         /// <summary>
18         /// <para>
19         /// Initializes a new <see cref="UInt32ExternalLinksSourcesSizeBalancedTreeMethods"/>
           ↪  instance.
20         /// </para>
21         /// <para></para>
22         /// </summary>
23         /// <param name="constants">
24         /// <para>A constants.</para>
25         /// <para></para>
26         /// </param>
27         /// <param name="linksDataParts">
28         /// <para>A links data parts.</para>
29         /// <para></para>
30         /// </param>
31         /// <param name="linksIndexParts">
32         /// <para>A links index parts.</para>
33         /// <para></para>
34         /// </param>
35         /// <param name="header">
36         /// <para>A header.</para>
37         /// <para></para>
38         /// </param>
39         [MethodImpl(MethodImplOptions.AggressiveInlining)]
40         public UInt32ExternalLinksSourcesSizeBalancedTreeMethods(LinksConstants<TLink>
           ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
           ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
           ↪  linksIndexParts, header) { }
41
42         /// <summary>
43         /// <para>
44         /// Gets the left reference using the specified node.
45         /// </para>
46         /// <para></para>
47         /// </summary>
48         /// <param name="node">
49         /// <para>The node.</para>
50         /// <para></para>
51         /// </param>
```

```
52          /// <returns>
53          /// <para>The ref link</para>
54          /// <para></para>
55          /// </returns>
56          [MethodImpl(MethodImplOptions.AggressiveInlining)]
57          protected override ref TLink GetLeftReference(TLink node) => ref
            ↪ LinksIndexParts[node].LeftAsSource;
58
59          /// <summary>
60          /// <para>
61          /// Gets the right reference using the specified node.
62          /// </para>
63          /// <para></para>
64          /// </summary>
65          /// <param name="node">
66          /// <para>The node.</para>
67          /// <para></para>
68          /// </param>
69          /// <returns>
70          /// <para>The ref link</para>
71          /// <para></para>
72          /// </returns>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ LinksIndexParts[node].RightAsSource;
75
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsSource;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsSource;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
125         protected override void SetLeft(TLink node, TLink left) =>
            ↪ LinksIndexParts[node].LeftAsSource = left;
126
```

```
127             /// <summary>
128             /// <para>
129             /// Sets the right using the specified node.
130             /// </para>
131             /// <para></para>
132             /// </summary>
133             /// <param name="node">
134             /// <para>The node.</para>
135             /// <para></para>
136             /// </param>
137             /// <param name="right">
138             /// <para>The right.</para>
139             /// <para></para>
140             /// </param>
141             [MethodImpl(MethodImplOptions.AggressiveInlining)]
142             protected override void SetRight(TLink node, TLink right) =>
                ↪  LinksIndexParts[node].RightAsSource = right;
143
144             /// <summary>
145             /// <para>
146             /// Gets the size using the specified node.
147             /// </para>
148             /// <para></para>
149             /// </summary>
150             /// <param name="node">
151             /// <para>The node.</para>
152             /// <para></para>
153             /// </param>
154             /// <returns>
155             /// <para>The link</para>
156             /// <para></para>
157             /// </returns>
158             [MethodImpl(MethodImplOptions.AggressiveInlining)]
159             protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsSource;
160
161             /// <summary>
162             /// <para>
163             /// Sets the size using the specified node.
164             /// </para>
165             /// <para></para>
166             /// </summary>
167             /// <param name="node">
168             /// <para>The node.</para>
169             /// <para></para>
170             /// </param>
171             /// <param name="size">
172             /// <para>The size.</para>
173             /// <para></para>
174             /// </param>
175             [MethodImpl(MethodImplOptions.AggressiveInlining)]
176             protected override void SetSize(TLink node, TLink size) =>
                ↪  LinksIndexParts[node].SizeAsSource = size;
177
178             /// <summary>
179             /// <para>
180             /// Gets the tree root.
181             /// </para>
182             /// <para></para>
183             /// </summary>
184             /// <returns>
185             /// <para>The link</para>
186             /// <para></para>
187             /// </returns>
188             [MethodImpl(MethodImplOptions.AggressiveInlining)]
189             protected override TLink GetTreeRoot() => Header->RootAsSource;
190
191             /// <summary>
192             /// <para>
193             /// Gets the base part value using the specified node.
194             /// </para>
195             /// <para></para>
196             /// </summary>
197             /// <param name="node">
198             /// <para>The node.</para>
199             /// <para></para>
200             /// </param>
201             /// <returns>
202             /// <para>The link</para>
```

```
203         /// <para></para>
204         /// </returns>
205         [MethodImpl(MethodImplOptions.AggressiveInlining)]
206         protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Source;
207 
208         /// <summary>
209         /// <para>
210         /// Determines whether this instance first is to the left of second.
211         /// </para>
212         /// <para></para>
213         /// </summary>
214         /// <param name="firstSource">
215         /// <para>The first source.</para>
216         /// <para></para>
217         /// </param>
218         /// <param name="firstTarget">
219         /// <para>The first target.</para>
220         /// <para></para>
221         /// </param>
222         /// <param name="secondSource">
223         /// <para>The second source.</para>
224         /// <para></para>
225         /// </param>
226         /// <param name="secondTarget">
227         /// <para>The second target.</para>
228         /// <para></para>
229         /// </param>
230         /// <returns>
231         /// <para>The bool</para>
232         /// <para></para>
233         /// </returns>
234         [MethodImpl(MethodImplOptions.AggressiveInlining)]
235         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
              ↪  TLink secondSource, TLink secondTarget)
236             => firstSource < secondSource || firstSource == secondSource && firstTarget <
                  ↪  secondTarget;
237 
238         /// <summary>
239         /// <para>
240         /// Determines whether this instance first is to the right of second.
241         /// </para>
242         /// <para></para>
243         /// </summary>
244         /// <param name="firstSource">
245         /// <para>The first source.</para>
246         /// <para></para>
247         /// </param>
248         /// <param name="firstTarget">
249         /// <para>The first target.</para>
250         /// <para></para>
251         /// </param>
252         /// <param name="secondSource">
253         /// <para>The second source.</para>
254         /// <para></para>
255         /// </param>
256         /// <param name="secondTarget">
257         /// <para>The second target.</para>
258         /// <para></para>
259         /// </param>
260         /// <returns>
261         /// <para>The bool</para>
262         /// <para></para>
263         /// </returns>
264         [MethodImpl(MethodImplOptions.AggressiveInlining)]
265         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
              ↪  TLink secondSource, TLink secondTarget)
266             => firstSource > secondSource || firstSource == secondSource && firstTarget >
                  ↪  secondTarget;
267 
268         /// <summary>
269         /// <para>
270         /// Clears the node using the specified node.
271         /// </para>
272         /// <para></para>
273         /// </summary>
274         /// <param name="node">
275         /// <para>The node.</para>
276         /// <para></para>
```

```
277         /// </param>
278         [MethodImpl(MethodImplOptions.AggressiveInlining)]
279         protected override void ClearNode(TLink node)
280         {
281             ref var link = ref LinksIndexParts[node];
282             link.LeftAsSource = Zero;
283             link.RightAsSource = Zero;
284             link.SizeAsSource = Zero;
285         }
286     }
287 }
```

1.54 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32ExternalLinksTargetsRecursionlessSizeBalanc

```
1  using System.Runtime.CompilerServices;
2  using TLink = System.UInt32;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Data.Doublets.Memory.Split.Specific
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 32 external links targets recursionless size balanced tree methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
14     /// <seealso cref="UInt32ExternalLinksRecursionlessSizeBalancedTreeMethodsBase"/>
15     public unsafe class UInt32ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods :
       ↪  UInt32ExternalLinksRecursionlessSizeBalancedTreeMethodsBase
16     {
17         /// <summary>
18         /// <para>
19         /// Initializes a new <see
           ↪  cref="UInt32ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods"/> instance.
20         /// </para>
21         /// <para></para>
22         /// </summary>
23         /// <param name="constants">
24         /// <para>A constants.</para>
25         /// <para></para>
26         /// </param>
27         /// <param name="linksDataParts">
28         /// <para>A links data parts.</para>
29         /// <para></para>
30         /// </param>
31         /// <param name="linksIndexParts">
32         /// <para>A links index parts.</para>
33         /// <para></para>
34         /// </param>
35         /// <param name="header">
36         /// <para>A header.</para>
37         /// <para></para>
38         /// </param>
39         [MethodImpl(MethodImplOptions.AggressiveInlining)]
40         public
           ↪  UInt32ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
           ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
           ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
           ↪  linksIndexParts, header) { }
41
42         /// <summary>
43         /// <para>
44         /// Gets the left reference using the specified node.
45         /// </para>
46         /// <para></para>
47         /// </summary>
48         /// <param name="node">
49         /// <para>The node.</para>
50         /// <para></para>
51         /// </param>
52         /// <returns>
53         /// <para>The ref link</para>
54         /// <para></para>
55         /// </returns>
56         [MethodImpl(MethodImplOptions.AggressiveInlining)]
57         protected override ref TLink GetLeftReference(TLink node) => ref
           ↪  LinksIndexParts[node].LeftAsTarget;
58
59         /// <summary>
```

```
60          /// <para>
61          /// Gets the right reference using the specified node.
62          /// </para>
63          /// <para></para>
64          /// </summary>
65          /// <param name="node">
66          /// <para>The node.</para>
67          /// <para></para>
68          /// </param>
69          /// <returns>
70          /// <para>The ref link</para>
71          /// <para></para>
72          /// </returns>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ LinksIndexParts[node].RightAsTarget;
75
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsTarget;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsTarget;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
125         protected override void SetLeft(TLink node, TLink left) =>
            ↪ LinksIndexParts[node].LeftAsTarget = left;
126
127         /// <summary>
128         /// <para>
129         /// Sets the right using the specified node.
130         /// </para>
131         /// <para></para>
132         /// </summary>
133         /// <param name="node">
134         /// <para>The node.</para>
135         /// <para></para>
```

```
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsTarget = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsTarget;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsTarget = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => Header->RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
```

```
212         /// <para></para>
213         /// </summary>
214         /// <param name="firstSource">
215         /// <para>The first source.</para>
216         /// <para></para>
217         /// </param>
218         /// <param name="firstTarget">
219         /// <para>The first target.</para>
220         /// <para></para>
221         /// </param>
222         /// <param name="secondSource">
223         /// <para>The second source.</para>
224         /// <para></para>
225         /// </param>
226         /// <param name="secondTarget">
227         /// <para>The second target.</para>
228         /// <para></para>
229         /// </param>
230         /// <returns>
231         /// <para>The bool</para>
232         /// <para></para>
233         /// </returns>
234         [MethodImpl(MethodImplOptions.AggressiveInlining)]
235         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
              ↪ TLink secondSource, TLink secondTarget)
236             => firstTarget < secondTarget || firstTarget == secondTarget && firstSource <
                  ↪ secondSource;
237 
238         /// <summary>
239         /// <para>
240         /// Determines whether this instance first is to the right of second.
241         /// </para>
242         /// <para></para>
243         /// </summary>
244         /// <param name="firstSource">
245         /// <para>The first source.</para>
246         /// <para></para>
247         /// </param>
248         /// <param name="firstTarget">
249         /// <para>The first target.</para>
250         /// <para></para>
251         /// </param>
252         /// <param name="secondSource">
253         /// <para>The second source.</para>
254         /// <para></para>
255         /// </param>
256         /// <param name="secondTarget">
257         /// <para>The second target.</para>
258         /// <para></para>
259         /// </param>
260         /// <returns>
261         /// <para>The bool</para>
262         /// <para></para>
263         /// </returns>
264         [MethodImpl(MethodImplOptions.AggressiveInlining)]
265         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
              ↪ TLink secondSource, TLink secondTarget)
266             => firstTarget > secondTarget || firstTarget == secondTarget && firstSource >
                  ↪ secondSource;
267 
268         /// <summary>
269         /// <para>
270         /// Clears the node using the specified node.
271         /// </para>
272         /// <para></para>
273         /// </summary>
274         /// <param name="node">
275         /// <para>The node.</para>
276         /// <para></para>
277         /// </param>
278         [MethodImpl(MethodImplOptions.AggressiveInlining)]
279         protected override void ClearNode(TLink node)
280         {
281             ref var link = ref LinksIndexParts[node];
282             link.LeftAsTarget = Zero;
283             link.RightAsTarget = Zero;
284             link.SizeAsTarget = Zero;
285         }
```

```
286     }
287 }
```

1.55 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32ExternalLinksTargetsSizeBalancedTreeMetho

```
1  using System.Runtime.CompilerServices;
2  using TLink = System.UInt32;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Data.Doublets.Memory.Split.Specific
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 32 external links targets size balanced tree methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
14     /// <seealso cref="UInt32ExternalLinksSizeBalancedTreeMethodsBase"/>
15     public unsafe class UInt32ExternalLinksTargetsSizeBalancedTreeMethods :
       ↪  UInt32ExternalLinksSizeBalancedTreeMethodsBase
16     {
17         /// <summary>
18         /// <para>
19         /// Initializes a new <see cref="UInt32ExternalLinksTargetsSizeBalancedTreeMethods"/>
           ↪  instance.
20         /// </para>
21         /// <para></para>
22         /// </summary>
23         /// <param name="constants">
24         /// <para>A constants.</para>
25         /// <para></para>
26         /// </param>
27         /// <param name="linksDataParts">
28         /// <para>A links data parts.</para>
29         /// <para></para>
30         /// </param>
31         /// <param name="linksIndexParts">
32         /// <para>A links index parts.</para>
33         /// <para></para>
34         /// </param>
35         /// <param name="header">
36         /// <para>A header.</para>
37         /// <para></para>
38         /// </param>
39         [MethodImpl(MethodImplOptions.AggressiveInlining)]
40         public UInt32ExternalLinksTargetsSizeBalancedTreeMethods(LinksConstants<TLink>
           ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
           ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
           ↪  linksIndexParts, header) { }
41
42         /// <summary>
43         /// <para>
44         /// Gets the left reference using the specified node.
45         /// </para>
46         /// <para></para>
47         /// </summary>
48         /// <param name="node">
49         /// <para>The node.</para>
50         /// <para></para>
51         /// </param>
52         /// <returns>
53         /// <para>The ref link</para>
54         /// <para></para>
55         /// </returns>
56         [MethodImpl(MethodImplOptions.AggressiveInlining)]
57         protected override ref TLink GetLeftReference(TLink node) => ref
           ↪  LinksIndexParts[node].LeftAsTarget;
58
59         /// <summary>
60         /// <para>
61         /// Gets the right reference using the specified node.
62         /// </para>
63         /// <para></para>
64         /// </summary>
65         /// <param name="node">
66         /// <para>The node.</para>
67         /// <para></para>
68         /// </param>
```

```
69          /// <returns>
70          /// <para>The ref link</para>
71          /// <para></para>
72          /// </returns>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ LinksIndexParts[node].RightAsTarget;
75
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsTarget;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsTarget;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
125         protected override void SetLeft(TLink node, TLink left) =>
            ↪ LinksIndexParts[node].LeftAsTarget = left;
126
127         /// <summary>
128         /// <para>
129         /// Sets the right using the specified node.
130         /// </para>
131         /// <para></para>
132         /// </summary>
133         /// <param name="node">
134         /// <para>The node.</para>
135         /// <para></para>
136         /// </param>
137         /// <param name="right">
138         /// <para>The right.</para>
139         /// <para></para>
140         /// </param>
141         [MethodImpl(MethodImplOptions.AggressiveInlining)]
142         protected override void SetRight(TLink node, TLink right) =>
            ↪ LinksIndexParts[node].RightAsTarget = right;
143
```

```
        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsTarget;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsTarget = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => Header->RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
```

```
221         /// </param>
222         /// <param name="secondSource">
223         /// <para>The second source.</para>
224         /// <para></para>
225         /// </param>
226         /// <param name="secondTarget">
227         /// <para>The second target.</para>
228         /// <para></para>
229         /// </param>
230         /// <returns>
231         /// <para>The bool</para>
232         /// <para></para>
233         /// </returns>
234         [MethodImpl(MethodImplOptions.AggressiveInlining)]
235         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget)
236             => firstTarget < secondTarget || firstTarget == secondTarget && firstSource <
                ↪ secondSource;
237 
238         /// <summary>
239         /// <para>
240         /// Determines whether this instance first is to the right of second.
241         /// </para>
242         /// <para></para>
243         /// </summary>
244         /// <param name="firstSource">
245         /// <para>The first source.</para>
246         /// <para></para>
247         /// </param>
248         /// <param name="firstTarget">
249         /// <para>The first target.</para>
250         /// <para></para>
251         /// </param>
252         /// <param name="secondSource">
253         /// <para>The second source.</para>
254         /// <para></para>
255         /// </param>
256         /// <param name="secondTarget">
257         /// <para>The second target.</para>
258         /// <para></para>
259         /// </param>
260         /// <returns>
261         /// <para>The bool</para>
262         /// <para></para>
263         /// </returns>
264         [MethodImpl(MethodImplOptions.AggressiveInlining)]
265         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget)
266             => firstTarget > secondTarget || firstTarget == secondTarget && firstSource >
                ↪ secondSource;
267 
268         /// <summary>
269         /// <para>
270         /// Clears the node using the specified node.
271         /// </para>
272         /// <para></para>
273         /// </summary>
274         /// <param name="node">
275         /// <para>The node.</para>
276         /// <para></para>
277         /// </param>
278         [MethodImpl(MethodImplOptions.AggressiveInlining)]
279         protected override void ClearNode(TLink node)
280         {
281             ref var link = ref LinksIndexParts[node];
282             link.LeftAsTarget = Zero;
283             link.RightAsTarget = Zero;
284             link.SizeAsTarget = Zero;
285         }
286     }
287 }
```

1.56 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32InternalLinksRecursionlessSizeBalancedTreeM

```
1  using System.Runtime.CompilerServices;
2  using Platform.Data.Doublets.Memory.Split.Generic;
3  using TLink = System.UInt32;
4 
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
```

```
6
7   namespace Platform.Data.Doublets.Memory.Split.Specific
8   {
9       /// <summary>
10      /// <para>
11      /// Represents the int 32 internal links recursionless size balanced tree methods base.
12      /// </para>
13      /// <para></para>
14      /// </summary>
15      /// <seealso cref="InternalLinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
16      public unsafe abstract class UInt32InternalLinksRecursionlessSizeBalancedTreeMethodsBase :
        ↪ InternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink>
17      {
18          /// <summary>
19          /// <para>
20          /// The links data parts.
21          /// </para>
22          /// <para></para>
23          /// </summary>
24          protected new readonly RawLinkDataPart<TLink>* LinksDataParts;
25          /// <summary>
26          /// <para>
27          /// The links index parts.
28          /// </para>
29          /// <para></para>
30          /// </summary>
31          protected new readonly RawLinkIndexPart<TLink>* LinksIndexParts;
32          /// <summary>
33          /// <para>
34          /// The header.
35          /// </para>
36          /// <para></para>
37          /// </summary>
38          protected new readonly LinksHeader<TLink>* Header;
39
40          /// <summary>
41          /// <para>
42          /// Initializes a new <see
            ↪ cref="UInt32InternalLinksRecursionlessSizeBalancedTreeMethodsBase"/> instance.
43          /// </para>
44          /// <para></para>
45          /// </summary>
46          /// <param name="constants">
47          /// <para>A constants.</para>
48          /// <para></para>
49          /// </param>
50          /// <param name="linksDataParts">
51          /// <para>A links data parts.</para>
52          /// <para></para>
53          /// </param>
54          /// <param name="linksIndexParts">
55          /// <para>A links index parts.</para>
56          /// <para></para>
57          /// </param>
58          /// <param name="header">
59          /// <para>A header.</para>
60          /// <para></para>
61          /// </param>
62          [MethodImpl(MethodImplOptions.AggressiveInlining)]
63          protected
            ↪ UInt32InternalLinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<TLink>
            ↪ constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
            ↪ linksIndexParts, LinksHeader<TLink>* header)
64              : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts, (byte*)header)
65          {
66              LinksDataParts = linksDataParts;
67              LinksIndexParts = linksIndexParts;
68              Header = header;
69          }
70
71          /// <summary>
72          /// <para>
73          /// Gets the zero.
74          /// </para>
75          /// <para></para>
76          /// </summary>
77          /// <returns>
78          /// <para>The link</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetZero() => 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(TLink value) => value == 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(TLink first, TLink second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(TLink value) => value > 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
```

```
157         [MethodImpl(MethodImplOptions.AggressiveInlining)]
158         protected override bool GreaterThan(TLink first, TLink second) => first > second;
159
160         /// <summary>
161         /// <para>
162         /// Determines whether this instance greater or equal than.
163         /// </para>
164         /// <para></para>
165         /// </summary>
166         /// <param name="first">
167         /// <para>The first.</para>
168         /// <para></para>
169         /// </param>
170         /// <param name="second">
171         /// <para>The second.</para>
172         /// <para></para>
173         /// </param>
174         /// <returns>
175         /// <para>The bool</para>
176         /// <para></para>
177         /// </returns>
178         [MethodImpl(MethodImplOptions.AggressiveInlining)]
179         protected override bool GreaterOrEqualThan(TLink first, TLink second) => first >= second;
180
181         /// <summary>
182         /// <para>
183         /// Determines whether this instance greater or equal than zero.
184         /// </para>
185         /// <para></para>
186         /// </summary>
187         /// <param name="value">
188         /// <para>The value.</para>
189         /// <para></para>
190         /// </param>
191         /// <returns>
192         /// <para>The bool</para>
193         /// <para></para>
194         /// </returns>
195         [MethodImpl(MethodImplOptions.AggressiveInlining)]
196         protected override bool GreaterOrEqualThanZero(TLink value) => true; // value >= 0 is
            ↪  always true for ulong
197
198         /// <summary>
199         /// <para>
200         /// Determines whether this instance less or equal than zero.
201         /// </para>
202         /// <para></para>
203         /// </summary>
204         /// <param name="value">
205         /// <para>The value.</para>
206         /// <para></para>
207         /// </param>
208         /// <returns>
209         /// <para>The bool</para>
210         /// <para></para>
211         /// </returns>
212         [MethodImpl(MethodImplOptions.AggressiveInlining)]
213         protected override bool LessOrEqualThanZero(TLink value) => value == 0UL; // value is
            ↪  always >= 0 for ulong
214
215         /// <summary>
216         /// <para>
217         /// Determines whether this instance less or equal than.
218         /// </para>
219         /// <para></para>
220         /// </summary>
221         /// <param name="first">
222         /// <para>The first.</para>
223         /// <para></para>
224         /// </param>
225         /// <param name="second">
226         /// <para>The second.</para>
227         /// <para></para>
228         /// </param>
229         /// <returns>
230         /// <para>The bool</para>
231         /// <para></para>
232         /// </returns>
```

```
233         [MethodImpl(MethodImplOptions.AggressiveInlining)]
234         protected override bool LessOrEqualThan(TLink first, TLink second) => first <= second;
235 
236         /// <summary>
237         /// <para>
238         /// Determines whether this instance less than zero.
239         /// </para>
240         /// <para></para>
241         /// </summary>
242         /// <param name="value">
243         /// <para>The value.</para>
244         /// <para></para>
245         /// </param>
246         /// <returns>
247         /// <para>The bool</para>
248         /// <para></para>
249         /// </returns>
250         [MethodImpl(MethodImplOptions.AggressiveInlining)]
251         protected override bool LessThanZero(TLink value) => false; // value < 0 is always false
            ↪  for ulong
252 
253         /// <summary>
254         /// <para>
255         /// Determines whether this instance less than.
256         /// </para>
257         /// <para></para>
258         /// </summary>
259         /// <param name="first">
260         /// <para>The first.</para>
261         /// <para></para>
262         /// </param>
263         /// <param name="second">
264         /// <para>The second.</para>
265         /// <para></para>
266         /// </param>
267         /// <returns>
268         /// <para>The bool</para>
269         /// <para></para>
270         /// </returns>
271         [MethodImpl(MethodImplOptions.AggressiveInlining)]
272         protected override bool LessThan(TLink first, TLink second) => first < second;
273 
274         /// <summary>
275         /// <para>
276         /// Increments the value.
277         /// </para>
278         /// <para></para>
279         /// </summary>
280         /// <param name="value">
281         /// <para>The value.</para>
282         /// <para></para>
283         /// </param>
284         /// <returns>
285         /// <para>The link</para>
286         /// <para></para>
287         /// </returns>
288         [MethodImpl(MethodImplOptions.AggressiveInlining)]
289         protected override TLink Increment(TLink value) => ++value;
290 
291         /// <summary>
292         /// <para>
293         /// Decrements the value.
294         /// </para>
295         /// <para></para>
296         /// </summary>
297         /// <param name="value">
298         /// <para>The value.</para>
299         /// <para></para>
300         /// </param>
301         /// <returns>
302         /// <para>The link</para>
303         /// <para></para>
304         /// </returns>
305         [MethodImpl(MethodImplOptions.AggressiveInlining)]
306         protected override TLink Decrement(TLink value) => --value;
307 
308         /// <summary>
309         /// <para>
```

```
310         /// Adds the first.
311         /// </para>
312         /// <para></para>
313         /// </summary>
314         /// <param name="first">
315         /// <para>The first.</para>
316         /// <para></para>
317         /// </param>
318         /// <param name="second">
319         /// <para>The second.</para>
320         /// <para></para>
321         /// </param>
322         /// <returns>
323         /// <para>The link</para>
324         /// <para></para>
325         /// </returns>
326         [MethodImpl(MethodImplOptions.AggressiveInlining)]
327         protected override TLink Add(TLink first, TLink second) => first + second;
328
329         /// <summary>
330         /// <para>
331         /// Subtracts the first.
332         /// </para>
333         /// <para></para>
334         /// </summary>
335         /// <param name="first">
336         /// <para>The first.</para>
337         /// <para></para>
338         /// </param>
339         /// <param name="second">
340         /// <para>The second.</para>
341         /// <para></para>
342         /// </param>
343         /// <returns>
344         /// <para>The link</para>
345         /// <para></para>
346         /// </returns>
347         [MethodImpl(MethodImplOptions.AggressiveInlining)]
348         protected override TLink Subtract(TLink first, TLink second) => first - second;
349
350         /// <summary>
351         /// <para>
352         /// Gets the link data part reference using the specified link.
353         /// </para>
354         /// <para></para>
355         /// </summary>
356         /// <param name="link">
357         /// <para>The link.</para>
358         /// <para></para>
359         /// </param>
360         /// <returns>
361         /// <para>A ref raw link data part of t link</para>
362         /// <para></para>
363         /// </returns>
364         [MethodImpl(MethodImplOptions.AggressiveInlining)]
365         protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
          ↪  ref LinksDataParts[link];
366
367         /// <summary>
368         /// <para>
369         /// Gets the link index part reference using the specified link.
370         /// </para>
371         /// <para></para>
372         /// </summary>
373         /// <param name="link">
374         /// <para>The link.</para>
375         /// <para></para>
376         /// </param>
377         /// <returns>
378         /// <para>A ref raw link index part of t link</para>
379         /// <para></para>
380         /// </returns>
381         [MethodImpl(MethodImplOptions.AggressiveInlining)]
382         protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
          ↪  ref LinksIndexParts[link];
383
384         /// <summary>
385         /// <para>
```

```
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second) =>
        ↪ GetKeyPartValue(first) < GetKeyPartValue(second);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second) =>
        ↪ GetKeyPartValue(first) > GetKeyPartValue(second);
    }
}
```

1.57 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32InternalLinksSizeBalancedTreeMethodsBase.

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.Split.Generic;
using TLink = System.UInt32;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 internal links size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="InternalLinksSizeBalancedTreeMethodsBase{TLink}"/>
    public unsafe abstract class UInt32InternalLinksSizeBalancedTreeMethodsBase :
    ↪ InternalLinksSizeBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// The links data parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkDataPart<TLink>* LinksDataParts;
        /// <summary>
        /// <para>
        /// The links index parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkIndexPart<TLink>* LinksIndexParts;
        /// <summary>
```

```
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly LinksHeader<TLink>* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32InternalLinksSizeBalancedTreeMethodsBase"/>
        ↪  instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected UInt32InternalLinksSizeBalancedTreeMethodsBase(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header)
            : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts, (byte*)header)
        {
            LinksDataParts = linksDataParts;
            LinksIndexParts = linksIndexParts;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetZero() => 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(TLink value) => value == 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
```

```
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(TLink first, TLink second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(TLink value) => value > OU;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(TLink first, TLink second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(TLink first, TLink second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
```

```
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(TLink value) => true; // value >= 0 is
        ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThanZero(TLink value) => value == 0UL; // value is
        ↪  always >= 0 for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(TLink first, TLink second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThanZero(TLink value) => false; // value < 0 is always false
        ↪  for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
```

```
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(TLink first, TLink second) => first < second;

        /// <summary>
        /// <para>
        /// Increments the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Increment(TLink value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Decrement(TLink value) => --value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Add(TLink first, TLink second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
```

```
339             /// <param name="second">
340             /// <para>The second.</para>
341             /// <para></para>
342             /// </param>
343             /// <returns>
344             /// <para>The link</para>
345             /// <para></para>
346             /// </returns>
347             [MethodImpl(MethodImplOptions.AggressiveInlining)]
348             protected override TLink Subtract(TLink first, TLink second) => first - second;
349
350             /// <summary>
351             /// <para>
352             /// Gets the link data part reference using the specified link.
353             /// </para>
354             /// <para></para>
355             /// </summary>
356             /// <param name="link">
357             /// <para>The link.</para>
358             /// <para></para>
359             /// </param>
360             /// <returns>
361             /// <para>A ref raw link data part of t link</para>
362             /// <para></para>
363             /// </returns>
364             [MethodImpl(MethodImplOptions.AggressiveInlining)]
365             protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
                ↪  ref LinksDataParts[link];
366
367             /// <summary>
368             /// <para>
369             /// Gets the link index part reference using the specified link.
370             /// </para>
371             /// <para></para>
372             /// </summary>
373             /// <param name="link">
374             /// <para>The link.</para>
375             /// <para></para>
376             /// </param>
377             /// <returns>
378             /// <para>A ref raw link index part of t link</para>
379             /// <para></para>
380             /// </returns>
381             [MethodImpl(MethodImplOptions.AggressiveInlining)]
382             protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
                ↪  ref LinksIndexParts[link];
383
384             /// <summary>
385             /// <para>
386             /// Determines whether this instance first is to the left of second.
387             /// </para>
388             /// <para></para>
389             /// </summary>
390             /// <param name="first">
391             /// <para>The first.</para>
392             /// <para></para>
393             /// </param>
394             /// <param name="second">
395             /// <para>The second.</para>
396             /// <para></para>
397             /// </param>
398             /// <returns>
399             /// <para>The bool</para>
400             /// <para></para>
401             /// </returns>
402             [MethodImpl(MethodImplOptions.AggressiveInlining)]
403             protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second) =>
                ↪  GetKeyPartValue(first) < GetKeyPartValue(second);
404
405             /// <summary>
406             /// <para>
407             /// Determines whether this instance first is to the right of second.
408             /// </para>
409             /// <para></para>
410             /// </summary>
411             /// <param name="first">
412             /// <para>The first.</para>
413             /// <para></para>
```

```
414         /// </param>
415         /// <param name="second">
416         /// <para>The second.</para>
417         /// <para></para>
418         /// </param>
419         /// <returns>
420         /// <para>The bool</para>
421         /// <para></para>
422         /// </returns>
423         [MethodImpl(MethodImplOptions.AggressiveInlining)]
424         protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second) =>
            ↪ GetKeyPartValue(first) > GetKeyPartValue(second);
425     }
426 }
```

1.58 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32InternalLinksSourcesLinkedListMethods.cs

```
1  using System.Runtime.CompilerServices;
2  using TLink = System.UInt32;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Data.Doublets.Memory.Split.Generic
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 32 internal links sources linked list methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
14     /// <seealso cref="InternalLinksSourcesLinkedListMethods{TLink}"/>
15     public unsafe class UInt32InternalLinksSourcesLinkedListMethods :
        ↪ InternalLinksSourcesLinkedListMethods<TLink>
16     {
17         private readonly RawLinkDataPart<TLink>* _linksDataParts;
18         private readonly RawLinkIndexPart<TLink>* _linksIndexParts;
19
20         /// <summary>
21         /// <para>
22         /// Initializes a new <see cref="UInt32InternalLinksSourcesLinkedListMethods"/> instance.
23         /// </para>
24         /// <para></para>
25         /// </summary>
26         /// <param name="constants">
27         /// <para>A constants.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="linksDataParts">
31         /// <para>A links data parts.</para>
32         /// <para></para>
33         /// </param>
34         /// <param name="linksIndexParts">
35         /// <para>A links index parts.</para>
36         /// <para></para>
37         /// </param>
38         [MethodImpl(MethodImplOptions.AggressiveInlining)]
39         public UInt32InternalLinksSourcesLinkedListMethods(LinksConstants<TLink> constants,
            ↪ RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>* linksIndexParts)
40             : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts)
41         {
42             _linksDataParts = linksDataParts;
43             _linksIndexParts = linksIndexParts;
44         }
45
46         /// <summary>
47         /// <para>
48         /// Gets the link data part reference using the specified link.
49         /// </para>
50         /// <para></para>
51         /// </summary>
52         /// <param name="link">
53         /// <para>The link.</para>
54         /// <para></para>
55         /// </param>
56         /// <returns>
57         /// <para>A ref raw link data part of t link</para>
58         /// <para></para>
59         /// </returns>
60         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
        protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
        ↪ ref _linksDataParts[link];

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
        ↪ ref _linksIndexParts[link];
    }
}
```

1.59 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32InternalLinksSourcesRecursionlessSizeBalanc

```
using System.Runtime.CompilerServices;
using TLink = System.UInt32;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 internal links sources recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt32InternalLinksRecursionlessSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt32InternalLinksSourcesRecursionlessSizeBalancedTreeMethods :
    ↪ UInt32InternalLinksRecursionlessSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪ cref="UInt32InternalLinksSourcesRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public
        ↪ UInt32InternalLinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪ constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪ linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪ linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
```

```
49          /// <para>The node.</para>
50          /// <para></para>
51          /// </param>
52          /// <returns>
53          /// <para>The ref link</para>
54          /// <para></para>
55          /// </returns>
56          [MethodImpl(MethodImplOptions.AggressiveInlining)]
57          protected override ref TLink GetLeftReference(TLink node) => ref
            ↪ LinksIndexParts[node].LeftAsSource;
58
59          /// <summary>
60          /// <para>
61          /// Gets the right reference using the specified node.
62          /// </para>
63          /// <para></para>
64          /// </summary>
65          /// <param name="node">
66          /// <para>The node.</para>
67          /// <para></para>
68          /// </param>
69          /// <returns>
70          /// <para>The ref link</para>
71          /// <para></para>
72          /// </returns>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ LinksIndexParts[node].RightAsSource;
75
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsSource;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsSource;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
125         protected override void SetLeft(TLink node, TLink left) =>
            ↪ LinksIndexParts[node].LeftAsSource = left;
126
127         /// <summary>
128         /// <para>
129         /// Sets the right using the specified node.
130         /// </para>
131         /// <para></para>
132         /// </summary>
133         /// <param name="node">
134         /// <para>The node.</para>
135         /// <para></para>
136         /// </param>
137         /// <param name="right">
138         /// <para>The right.</para>
139         /// <para></para>
140         /// </param>
141         [MethodImpl(MethodImplOptions.AggressiveInlining)]
142         protected override void SetRight(TLink node, TLink right) =>
            ↪ LinksIndexParts[node].RightAsSource = right;
143
144         /// <summary>
145         /// <para>
146         /// Gets the size using the specified node.
147         /// </para>
148         /// <para></para>
149         /// </summary>
150         /// <param name="node">
151         /// <para>The node.</para>
152         /// <para></para>
153         /// </param>
154         /// <returns>
155         /// <para>The link</para>
156         /// <para></para>
157         /// </returns>
158         [MethodImpl(MethodImplOptions.AggressiveInlining)]
159         protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsSource;
160
161         /// <summary>
162         /// <para>
163         /// Sets the size using the specified node.
164         /// </para>
165         /// <para></para>
166         /// </summary>
167         /// <param name="node">
168         /// <para>The node.</para>
169         /// <para></para>
170         /// </param>
171         /// <param name="size">
172         /// <para>The size.</para>
173         /// <para></para>
174         /// </param>
175         [MethodImpl(MethodImplOptions.AggressiveInlining)]
176         protected override void SetSize(TLink node, TLink size) =>
            ↪ LinksIndexParts[node].SizeAsSource = size;
177
178         /// <summary>
179         /// <para>
180         /// Gets the tree root using the specified node.
181         /// </para>
182         /// <para></para>
183         /// </summary>
184         /// <param name="node">
185         /// <para>The node.</para>
186         /// <para></para>
187         /// </param>
188         /// <returns>
189         /// <para>The link</para>
190         /// <para></para>
191         /// </returns>
192         [MethodImpl(MethodImplOptions.AggressiveInlining)]
193         protected override TLink GetTreeRoot(TLink node) => LinksIndexParts[node].RootAsSource;
194
195         /// <summary>
196         /// <para>
197         /// Gets the base part value using the specified node.
198         /// </para>
199         /// <para></para>
```

```
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Source;

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetKeyPartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref LinksIndexParts[node];
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        public override TLink Search(TLink source, TLink target) =>
        ↪  SearchCore(GetTreeRoot(source), target);
    }
}
```

1.60 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32InternalLinksSourcesSizeBalancedTreeMetho

```
using System.Runtime.CompilerServices;
using TLink = System.UInt32;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
```

```
    /// <summary>
    /// <para>
    /// Represents the int 32 internal links sources size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt32InternalLinksSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt32InternalLinksSourcesSizeBalancedTreeMethods :
    ↪ UInt32InternalLinksSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32InternalLinksSourcesSizeBalancedTreeMethods"/>
        ↪ instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt32InternalLinksSourcesSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪ constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪ linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪ linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪ LinksIndexParts[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪ LinksIndexParts[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  LinksIndexParts[node].LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsSource = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
```

```
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot(TLink node) => LinksIndexParts[node].RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Source;

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetKeyPartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref LinksIndexParts[node];
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        public override TLink Search(TLink source, TLink target) =>
        ↪ SearchCore(GetTreeRoot(source), target);
    }
}
```

1.61 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32InternalLinksTargetsRecursionlessSizeBalanc

```
using System.Runtime.CompilerServices;
using TLink = System.UInt32;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 internal links targets recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt32InternalLinksRecursionlessSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt32InternalLinksTargetsRecursionlessSizeBalancedTreeMethods :
    ↪ UInt32InternalLinksRecursionlessSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪ cref="UInt32InternalLinksTargetsRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
```

```
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public
        ↪  UInt32InternalLinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪  linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪  LinksIndexParts[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  LinksIndexParts[node].RightAsTarget;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsTarget;
```

```
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
125         protected override void SetLeft(TLink node, TLink left) =>
            ↪ LinksIndexParts[node].LeftAsTarget = left;
126
127         /// <summary>
128         /// <para>
129         /// Sets the right using the specified node.
130         /// </para>
131         /// <para></para>
132         /// </summary>
133         /// <param name="node">
134         /// <para>The node.</para>
135         /// <para></para>
136         /// </param>
137         /// <param name="right">
138         /// <para>The right.</para>
139         /// <para></para>
140         /// </param>
141         [MethodImpl(MethodImplOptions.AggressiveInlining)]
142         protected override void SetRight(TLink node, TLink right) =>
            ↪ LinksIndexParts[node].RightAsTarget = right;
143
144         /// <summary>
145         /// <para>
146         /// Gets the size using the specified node.
147         /// </para>
148         /// <para></para>
149         /// </summary>
150         /// <param name="node">
151         /// <para>The node.</para>
152         /// <para></para>
153         /// </param>
154         /// <returns>
155         /// <para>The link</para>
156         /// <para></para>
157         /// </returns>
158         [MethodImpl(MethodImplOptions.AggressiveInlining)]
159         protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsTarget;
160
161         /// <summary>
162         /// <para>
163         /// Sets the size using the specified node.
164         /// </para>
165         /// <para></para>
166         /// </summary>
167         /// <param name="node">
168         /// <para>The node.</para>
169         /// <para></para>
170         /// </param>
171         /// <param name="size">
172         /// <para>The size.</para>
173         /// <para></para>
174         /// </param>
175         [MethodImpl(MethodImplOptions.AggressiveInlining)]
176         protected override void SetSize(TLink node, TLink size) =>
            ↪ LinksIndexParts[node].SizeAsTarget = size;
177
178         /// <summary>
179         /// <para>
180         /// Gets the tree root using the specified node.
181         /// </para>
182         /// <para></para>
183         /// </summary>
```

```
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot(TLink node) => LinksIndexParts[node].RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetKeyPartValue(TLink node) => LinksDataParts[node].Source;

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref LinksIndexParts[node];
            link.LeftAsTarget = Zero;
            link.RightAsTarget = Zero;
            link.SizeAsTarget = Zero;
        }

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
```

```
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        public override TLink Search(TLink source, TLink target) =>
        ↪ SearchCore(GetTreeRoot(target), source);
    }
}
```

1.62 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32InternalLinksTargetsSizeBalancedTreeMetho

```
using System.Runtime.CompilerServices;
using TLink = System.UInt32;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 internal links targets size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt32InternalLinksSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt32InternalLinksTargetsSizeBalancedTreeMethods :
    ↪ UInt32InternalLinksSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32InternalLinksTargetsSizeBalancedTreeMethods"/>
        ↪ instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt32InternalLinksTargetsSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪ constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪ linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪ linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪ LinksIndexParts[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  LinksIndexParts[node].RightAsTarget;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsTarget;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  LinksIndexParts[node].LeftAsTarget = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
```

```
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsTarget = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsTarget;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsTarget = size;

        /// <summary>
        /// <para>
        /// Gets the tree root using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot(TLink node) => LinksIndexParts[node].RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified node.
```

```
215             /// </para>
216             /// <para></para>
217             /// </summary>
218             /// <param name="node">
219             /// <para>The node.</para>
220             /// <para></para>
221             /// </param>
222             /// <returns>
223             /// <para>The link</para>
224             /// <para></para>
225             /// </returns>
226             [MethodImpl(MethodImplOptions.AggressiveInlining)]
227             protected override TLink GetKeyPartValue(TLink node) => LinksDataParts[node].Source;
228
229             /// <summary>
230             /// <para>
231             /// Clears the node using the specified node.
232             /// </para>
233             /// <para></para>
234             /// </summary>
235             /// <param name="node">
236             /// <para>The node.</para>
237             /// <para></para>
238             /// </param>
239             [MethodImpl(MethodImplOptions.AggressiveInlining)]
240             protected override void ClearNode(TLink node)
241             {
242                 ref var link = ref LinksIndexParts[node];
243                 link.LeftAsTarget = Zero;
244                 link.RightAsTarget = Zero;
245                 link.SizeAsTarget = Zero;
246             }
247
248             /// <summary>
249             /// <para>
250             /// Searches the source.
251             /// </para>
252             /// <para></para>
253             /// </summary>
254             /// <param name="source">
255             /// <para>The source.</para>
256             /// <para></para>
257             /// </param>
258             /// <param name="target">
259             /// <para>The target.</para>
260             /// <para></para>
261             /// </param>
262             /// <returns>
263             /// <para>The link</para>
264             /// <para></para>
265             /// </returns>
266             public override TLink Search(TLink source, TLink target) =>
                ↪ SearchCore(GetTreeRoot(target), source);
267         }
268     }
```

1.63 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32SplitMemoryLinks.cs

```
1   using System;
2   using System.Runtime.CompilerServices;
3   using Platform.Singletons;
4   using Platform.Memory;
5   using Platform.Data.Doublets.Memory.Split.Generic;
6   using TLink = System.UInt32;
7
8   #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
9
10  namespace Platform.Data.Doublets.Memory.Split.Specific
11  {
12      /// <summary>
13      /// <para>
14      /// Represents the int 32 split memory links.
15      /// </para>
16      /// <para></para>
17      /// </summary>
18      /// <seealso cref="SplitMemoryLinksBase{TLink}"/>
19      public unsafe class UInt32SplitMemoryLinks : SplitMemoryLinksBase<TLink>
20      {
21          private readonly Func<ILinksTreeMethods<TLink>> _createInternalSourceTreeMethods;
22          private readonly Func<ILinksTreeMethods<TLink>> _createExternalSourceTreeMethods;
```

```
23          private readonly Func<ILinksTreeMethods<TLink>> _createInternalTargetTreeMethods;
24          private readonly Func<ILinksTreeMethods<TLink>> _createExternalTargetTreeMethods;
25          private LinksHeader<TLink>* _header;
26          private RawLinkDataPart<TLink>* _linksDataParts;
27          private RawLinkIndexPart<TLink>* _linksIndexParts;
28
29          /// <summary>
30          /// <para>
31          /// Initializes a new <see cref="UInt32SplitMemoryLinks"/> instance.
32          /// </para>
33          /// <para></para>
34          /// </summary>
35          /// <param name="dataMemory">
36          /// <para>A data memory.</para>
37          /// <para></para>
38          /// </param>
39          /// <param name="indexMemory">
40          /// <para>A index memory.</para>
41          /// <para></para>
42          /// </param>
43          [MethodImpl(MethodImplOptions.AggressiveInlining)]
44          public UInt32SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪  indexMemory) : this(dataMemory, indexMemory, DefaultLinksSizeStep) { }
45
46          /// <summary>
47          /// <para>
48          /// Initializes a new <see cref="UInt32SplitMemoryLinks"/> instance.
49          /// </para>
50          /// <para></para>
51          /// </summary>
52          /// <param name="dataMemory">
53          /// <para>A data memory.</para>
54          /// <para></para>
55          /// </param>
56          /// <param name="indexMemory">
57          /// <para>A index memory.</para>
58          /// <para></para>
59          /// </param>
60          /// <param name="memoryReservationStep">
61          /// <para>A memory reservation step.</para>
62          /// <para></para>
63          /// </param>
64          [MethodImpl(MethodImplOptions.AggressiveInlining)]
65          public UInt32SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪  indexMemory, long memoryReservationStep) : this(dataMemory, indexMemory,
            ↪  memoryReservationStep, Default<LinksConstants<TLink>>.Instance,
            ↪  IndexTreeType.Default, useLinkedList: true) { }
66
67          /// <summary>
68          /// <para>
69          /// Initializes a new <see cref="UInt32SplitMemoryLinks"/> instance.
70          /// </para>
71          /// <para></para>
72          /// </summary>
73          /// <param name="dataMemory">
74          /// <para>A data memory.</para>
75          /// <para></para>
76          /// </param>
77          /// <param name="indexMemory">
78          /// <para>A index memory.</para>
79          /// <para></para>
80          /// </param>
81          /// <param name="memoryReservationStep">
82          /// <para>A memory reservation step.</para>
83          /// <para></para>
84          /// </param>
85          /// <param name="constants">
86          /// <para>A constants.</para>
87          /// <para></para>
88          /// </param>
89          [MethodImpl(MethodImplOptions.AggressiveInlining)]
90          public UInt32SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪  indexMemory, long memoryReservationStep, LinksConstants<TLink> constants) :
            ↪  this(dataMemory, indexMemory, memoryReservationStep, constants,
            ↪  IndexTreeType.Default, useLinkedList: true) { }
91
92          /// <summary>
93          /// <para>
```

```
94          /// Initializes a new <see cref="UInt32SplitMemoryLinks"/> instance.
95          /// </para>
96          /// <para></para>
97          /// </summary>
98          /// <param name="dataMemory">
99          /// <para>A data memory.</para>
100         /// <para></para>
101         /// </param>
102         /// <param name="indexMemory">
103         /// <para>A index memory.</para>
104         /// <para></para>
105         /// </param>
106         /// <param name="memoryReservationStep">
107         /// <para>A memory reservation step.</para>
108         /// <para></para>
109         /// </param>
110         /// <param name="constants">
111         /// <para>A constants.</para>
112         /// <para></para>
113         /// </param>
114         /// <param name="indexTreeType">
115         /// <para>A index tree type.</para>
116         /// <para></para>
117         /// </param>
118         /// <param name="useLinkedList">
119         /// <para>A use linked list.</para>
120         /// <para></para>
121         /// </param>
122         [MethodImpl(MethodImplOptions.AggressiveInlining)]
123         public UInt32SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪ indexMemory, long memoryReservationStep, LinksConstants<TLink> constants,
            ↪ IndexTreeType indexTreeType, bool useLinkedList) : base(dataMemory, indexMemory,
            ↪ memoryReservationStep, constants, useLinkedList)
124         {
125             if (indexTreeType == IndexTreeType.SizeBalancedTree)
126             {
127                 _createInternalSourceTreeMethods = () => new
                    ↪ UInt32InternalLinksSourcesSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
128                 _createExternalSourceTreeMethods = () => new
                    ↪ UInt32ExternalLinksSourcesSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
129                 _createInternalTargetTreeMethods = () => new
                    ↪ UInt32InternalLinksTargetsSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
130                 _createExternalTargetTreeMethods = () => new
                    ↪ UInt32ExternalLinksTargetsSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
131             }
132             else
133             {
134                 _createInternalSourceTreeMethods = () => new
                    ↪ UInt32InternalLinksSourcesRecursionlessSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
135                 _createExternalSourceTreeMethods = () => new
                    ↪ UInt32ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
136                 _createInternalTargetTreeMethods = () => new
                    ↪ UInt32InternalLinksTargetsRecursionlessSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
137                 _createExternalTargetTreeMethods = () => new
                    ↪ UInt32ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
138             }
139             Init(dataMemory, indexMemory);
140         }
141
142         /// <summary>
143         /// <para>
144         /// Sets the pointers using the specified data memory.
145         /// </para>
146         /// <para></para>
147         /// </summary>
148         /// <param name="dataMemory">
149         /// <para>The data memory.</para>
150         /// <para></para>
151         /// </param>
```

```
152         /// <param name="indexMemory">
153         /// <para>The index memory.</para>
154         /// <para></para>
155         /// </param>
156         [MethodImpl(MethodImplOptions.AggressiveInlining)]
157         protected override void SetPointers(IResizableDirectMemory dataMemory,
            ↪ IResizableDirectMemory indexMemory)
158         {
159             _linksDataParts = (RawLinkDataPart<TLink>*)dataMemory.Pointer;
160             _linksIndexParts = (RawLinkIndexPart<TLink>*)indexMemory.Pointer;
161             _header = (LinksHeader<TLink>*)indexMemory.Pointer;
162             if (_useLinkedList)
163             {
164                 InternalSourcesListMethods = new
                    ↪ UInt32InternalLinksSourcesLinkedListMethods(Constants, _linksDataParts,
                    ↪ _linksIndexParts);
165             }
166             else
167             {
168                 InternalSourcesTreeMethods = _createInternalSourceTreeMethods();
169             }
170             ExternalSourcesTreeMethods = _createExternalSourceTreeMethods();
171             InternalTargetsTreeMethods = _createInternalTargetTreeMethods();
172             ExternalTargetsTreeMethods = _createExternalTargetTreeMethods();
173             UnusedLinksListMethods = new UInt32UnusedLinksListMethods(_linksDataParts, _header);
174         }
175 
176         /// <summary>
177         /// <para>
178         /// Resets the pointers.
179         /// </para>
180         /// <para></para>
181         /// </summary>
182         [MethodImpl(MethodImplOptions.AggressiveInlining)]
183         protected override void ResetPointers()
184         {
185             base.ResetPointers();
186             _linksDataParts = null;
187             _linksIndexParts = null;
188             _header = null;
189         }
190 
191         /// <summary>
192         /// <para>
193         /// Gets the header reference.
194         /// </para>
195         /// <para></para>
196         /// </summary>
197         /// <returns>
198         /// <para>A ref links header of t link</para>
199         /// <para></para>
200         /// </returns>
201         [MethodImpl(MethodImplOptions.AggressiveInlining)]
202         protected override ref LinksHeader<TLink> GetHeaderReference() => ref *_header;
203 
204         /// <summary>
205         /// <para>
206         /// Gets the link data part reference using the specified link index.
207         /// </para>
208         /// <para></para>
209         /// </summary>
210         /// <param name="linkIndex">
211         /// <para>The link index.</para>
212         /// <para></para>
213         /// </param>
214         /// <returns>
215         /// <para>A ref raw link data part of t link</para>
216         /// <para></para>
217         /// </returns>
218         [MethodImpl(MethodImplOptions.AggressiveInlining)]
219         protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink linkIndex)
            ↪ => ref _linksDataParts[linkIndex];
220 
221         /// <summary>
222         /// <para>
223         /// Gets the link index part reference using the specified link index.
224         /// </para>
225         /// <para></para>
```

```
226             /// </summary>
227             /// <param name="linkIndex">
228             /// <para>The link index.</para>
229             /// <para></para>
230             /// </param>
231             /// <returns>
232             /// <para>A ref raw link index part of t link</para>
233             /// <para></para>
234             /// </returns>
235             [MethodImpl(MethodImplOptions.AggressiveInlining)]
236             protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink
                ↪  linkIndex) => ref _linksIndexParts[linkIndex];
237
238             /// <summary>
239             /// <para>
240             /// Determines whether this instance are equal.
241             /// </para>
242             /// <para></para>
243             /// </summary>
244             /// <param name="first">
245             /// <para>The first.</para>
246             /// <para></para>
247             /// </param>
248             /// <param name="second">
249             /// <para>The second.</para>
250             /// <para></para>
251             /// </param>
252             /// <returns>
253             /// <para>The bool</para>
254             /// <para></para>
255             /// </returns>
256             [MethodImpl(MethodImplOptions.AggressiveInlining)]
257             protected override bool AreEqual(TLink first, TLink second) => first == second;
258
259             /// <summary>
260             /// <para>
261             /// Determines whether this instance less than.
262             /// </para>
263             /// <para></para>
264             /// </summary>
265             /// <param name="first">
266             /// <para>The first.</para>
267             /// <para></para>
268             /// </param>
269             /// <param name="second">
270             /// <para>The second.</para>
271             /// <para></para>
272             /// </param>
273             /// <returns>
274             /// <para>The bool</para>
275             /// <para></para>
276             /// </returns>
277             [MethodImpl(MethodImplOptions.AggressiveInlining)]
278             protected override bool LessThan(TLink first, TLink second) => first < second;
279
280             /// <summary>
281             /// <para>
282             /// Determines whether this instance less or equal than.
283             /// </para>
284             /// <para></para>
285             /// </summary>
286             /// <param name="first">
287             /// <para>The first.</para>
288             /// <para></para>
289             /// </param>
290             /// <param name="second">
291             /// <para>The second.</para>
292             /// <para></para>
293             /// </param>
294             /// <returns>
295             /// <para>The bool</para>
296             /// <para></para>
297             /// </returns>
298             [MethodImpl(MethodImplOptions.AggressiveInlining)]
299             protected override bool LessOrEqualThan(TLink first, TLink second) => first <= second;
300
301             /// <summary>
302             /// <para>
```

```
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(TLink first, TLink second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(TLink first, TLink second) => first >= second;

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetZero() => 0U;

        /// <summary>
        /// <para>
        /// Gets the one.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetOne() => 1U;

        /// <summary>
        /// <para>
        /// Converts the to int 64 using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The long</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override long ConvertToInt64(TLink value) => value;

        /// <summary>
        /// <para>
        /// Converts the to address using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink ConvertToAddress(long value) => (TLink)value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Add(TLink first, TLink second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink Subtract(TLink first, TLink second) => first - second;

        /// <summary>
        /// <para>
        /// Increments the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
```

```
459         [MethodImpl(MethodImplOptions.AggressiveInlining)]
460         protected override TLink Increment(TLink link) => ++link;
461 
462         /// <summary>
463         /// <para>
464         /// Decrements the link.
465         /// </para>
466         /// <para></para>
467         /// </summary>
468         /// <param name="link">
469         /// <para>The link.</para>
470         /// <para></para>
471         /// </param>
472         /// <returns>
473         /// <para>The link</para>
474         /// <para></para>
475         /// </returns>
476         [MethodImpl(MethodImplOptions.AggressiveInlining)]
477         protected override TLink Decrement(TLink link) => --link;
478     }
479 }
```

1.64 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt32UnusedLinksListMethods.cs

```
1  using System.Runtime.CompilerServices;
2  using Platform.Data.Doublets.Memory.Split.Generic;
3  using TLink = System.UInt32;
4 
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6 
7  namespace Platform.Data.Doublets.Memory.Split.Specific
8  {
9      /// <summary>
10     /// <para>
11     /// Represents the int 32 unused links list methods.
12     /// </para>
13     /// <para></para>
14     /// </summary>
15     /// <seealso cref="UnusedLinksListMethods{TLink}"/>
16     public unsafe class UInt32UnusedLinksListMethods : UnusedLinksListMethods<TLink>
17     {
18         private readonly RawLinkDataPart<TLink>* _links;
19         private readonly LinksHeader<TLink>* _header;
20 
21         /// <summary>
22         /// <para>
23         /// Initializes a new <see cref="UInt32UnusedLinksListMethods"/> instance.
24         /// </para>
25         /// <para></para>
26         /// </summary>
27         /// <param name="links">
28         /// <para>A links.</para>
29         /// <para></para>
30         /// </param>
31         /// <param name="header">
32         /// <para>A header.</para>
33         /// <para></para>
34         /// </param>
35         [MethodImpl(MethodImplOptions.AggressiveInlining)]
36         public UInt32UnusedLinksListMethods(RawLinkDataPart<TLink>* links, LinksHeader<TLink>*
           ↪ header)
37             : base((byte*)links, (byte*)header)
38         {
39             _links = links;
40             _header = header;
41         }
42 
43         /// <summary>
44         /// <para>
45         /// Gets the link data part reference using the specified link.
46         /// </para>
47         /// <para></para>
48         /// </summary>
49         /// <param name="link">
50         /// <para>The link.</para>
51         /// <para></para>
52         /// </param>
53         /// <returns>
54         /// <para>A ref raw link data part of t link</para>
55         /// <para></para>
```

```
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
        ↪ ref _links[link];

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<TLink> GetHeaderReference() => ref *_header;
    }
}
```

1.65 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64ExternalLinksRecursionlessSizeBalancedTree

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.Split.Generic;
using TLink = System.UInt64;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 external links recursionless size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="ExternalLinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
    /// <seealso cref="ILinksTreeMethods{TLink}"/>
    public unsafe abstract class UInt64ExternalLinksRecursionlessSizeBalancedTreeMethodsBase :
    ↪ ExternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink>, ILinksTreeMethods<TLink>
    {
        /// <summary>
        /// <para>
        /// The links data parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkDataPart<TLink>* LinksDataParts;
        /// <summary>
        /// <para>
        /// The links index parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkIndexPart<TLink>* LinksIndexParts;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly LinksHeader<TLink>* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪ cref="UInt64ExternalLinksRecursionlessSizeBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
```

```
56          /// <para>A links index parts.</para>
57          /// <para></para>
58          /// </param>
59          /// <param name="header">
60          /// <para>A header.</para>
61          /// <para></para>
62          /// </param>
63          [MethodImpl(MethodImplOptions.AggressiveInlining)]
64          protected
            ↪  UInt64ExternalLinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<TLink>
            ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
            ↪  linksIndexParts, LinksHeader<TLink>* header)
65              : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts, (byte*)header)
66          {
67              LinksDataParts = linksDataParts;
68              LinksIndexParts = linksIndexParts;
69              Header = header;
70          }
71
72          /// <summary>
73          /// <para>
74          /// Gets the zero.
75          /// </para>
76          /// <para></para>
77          /// </summary>
78          /// <returns>
79          /// <para>The ulong</para>
80          /// <para></para>
81          /// </returns>
82          [MethodImpl(MethodImplOptions.AggressiveInlining)]
83          protected override ulong GetZero() => 0UL;
84
85          /// <summary>
86          /// <para>
87          /// Determines whether this instance equal to zero.
88          /// </para>
89          /// <para></para>
90          /// </summary>
91          /// <param name="value">
92          /// <para>The value.</para>
93          /// <para></para>
94          /// </param>
95          /// <returns>
96          /// <para>The bool</para>
97          /// <para></para>
98          /// </returns>
99          [MethodImpl(MethodImplOptions.AggressiveInlining)]
100         protected override bool EqualToZero(ulong value) => value == 0UL;
101
102         /// <summary>
103         /// <para>
104         /// Determines whether this instance are equal.
105         /// </para>
106         /// <para></para>
107         /// </summary>
108         /// <param name="first">
109         /// <para>The first.</para>
110         /// <para></para>
111         /// </param>
112         /// <param name="second">
113         /// <para>The second.</para>
114         /// <para></para>
115         /// </param>
116         /// <returns>
117         /// <para>The bool</para>
118         /// <para></para>
119         /// </returns>
120         [MethodImpl(MethodImplOptions.AggressiveInlining)]
121         protected override bool AreEqual(ulong first, ulong second) => first == second;
122
123         /// <summary>
124         /// <para>
125         /// Determines whether this instance greater than zero.
126         /// </para>
127         /// <para></para>
128         /// </summary>
129         /// <param name="value">
130         /// <para>The value.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(ulong value) => value > 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(ulong first, ulong second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(ulong value) => true; // value >= 0 is
        ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
```

```
208         /// </param>
209         /// <returns>
210         /// <para>The bool</para>
211         /// <para></para>
212         /// </returns>
213         [MethodImpl(MethodImplOptions.AggressiveInlining)]
214         protected override bool LessOrEqualThanZero(ulong value) => value == 0UL; // value is
            ↪  always >= 0 for ulong
215
216         /// <summary>
217         /// <para>
218         /// Determines whether this instance less or equal than.
219         /// </para>
220         /// <para></para>
221         /// </summary>
222         /// <param name="first">
223         /// <para>The first.</para>
224         /// <para></para>
225         /// </param>
226         /// <param name="second">
227         /// <para>The second.</para>
228         /// <para></para>
229         /// </param>
230         /// <returns>
231         /// <para>The bool</para>
232         /// <para></para>
233         /// </returns>
234         [MethodImpl(MethodImplOptions.AggressiveInlining)]
235         protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;
236
237         /// <summary>
238         /// <para>
239         /// Determines whether this instance less than zero.
240         /// </para>
241         /// <para></para>
242         /// </summary>
243         /// <param name="value">
244         /// <para>The value.</para>
245         /// <para></para>
246         /// </param>
247         /// <returns>
248         /// <para>The bool</para>
249         /// <para></para>
250         /// </returns>
251         [MethodImpl(MethodImplOptions.AggressiveInlining)]
252         protected override bool LessThanZero(ulong value) => false; // value < 0 is always false
            ↪  for ulong
253
254         /// <summary>
255         /// <para>
256         /// Determines whether this instance less than.
257         /// </para>
258         /// <para></para>
259         /// </summary>
260         /// <param name="first">
261         /// <para>The first.</para>
262         /// <para></para>
263         /// </param>
264         /// <param name="second">
265         /// <para>The second.</para>
266         /// <para></para>
267         /// </param>
268         /// <returns>
269         /// <para>The bool</para>
270         /// <para></para>
271         /// </returns>
272         [MethodImpl(MethodImplOptions.AggressiveInlining)]
273         protected override bool LessThan(ulong first, ulong second) => first < second;
274
275         /// <summary>
276         /// <para>
277         /// Increments the value.
278         /// </para>
279         /// <para></para>
280         /// </summary>
281         /// <param name="value">
282         /// <para>The value.</para>
283         /// <para></para>
```

```
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Increment(ulong value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Decrement(ulong value) => --value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Add(ulong first, ulong second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Subtract(ulong first, ulong second) => first - second;

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
362         protected override ref LinksHeader<TLink> GetHeaderReference() => ref *Header;
363
364         /// <summary>
365         /// <para>
366         /// Gets the link data part reference using the specified link.
367         /// </para>
368         /// <para></para>
369         /// </summary>
370         /// <param name="link">
371         /// <para>The link.</para>
372         /// <para></para>
373         /// </param>
374         /// <returns>
375         /// <para>A ref raw link data part of t link</para>
376         /// <para></para>
377         /// </returns>
378         [MethodImpl(MethodImplOptions.AggressiveInlining)]
379         protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
            ↪ ref LinksDataParts[link];
380
381         /// <summary>
382         /// <para>
383         /// Gets the link index part reference using the specified link.
384         /// </para>
385         /// <para></para>
386         /// </summary>
387         /// <param name="link">
388         /// <para>The link.</para>
389         /// <para></para>
390         /// </param>
391         /// <returns>
392         /// <para>A ref raw link index part of t link</para>
393         /// <para></para>
394         /// </returns>
395         [MethodImpl(MethodImplOptions.AggressiveInlining)]
396         protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
            ↪ ref LinksIndexParts[link];
397
398         /// <summary>
399         /// <para>
400         /// Determines whether this instance first is to the left of second.
401         /// </para>
402         /// <para></para>
403         /// </summary>
404         /// <param name="first">
405         /// <para>The first.</para>
406         /// <para></para>
407         /// </param>
408         /// <param name="second">
409         /// <para>The second.</para>
410         /// <para></para>
411         /// </param>
412         /// <returns>
413         /// <para>The bool</para>
414         /// <para></para>
415         /// </returns>
416         [MethodImpl(MethodImplOptions.AggressiveInlining)]
417         protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
418         {
419             ref var firstLink = ref LinksDataParts[first];
420             ref var secondLink = ref LinksDataParts[second];
421             return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                ↪ secondLink.Source, secondLink.Target);
422         }
423
424         /// <summary>
425         /// <para>
426         /// Determines whether this instance first is to the right of second.
427         /// </para>
428         /// <para></para>
429         /// </summary>
430         /// <param name="first">
431         /// <para>The first.</para>
432         /// <para></para>
433         /// </param>
434         /// <param name="second">
435         /// <para>The second.</para>
436         /// <para></para>
```

```
437             /// </param>
438             /// <returns>
439             /// <para>The bool</para>
440             /// <para></para>
441             /// </returns>
442             [MethodImpl(MethodImplOptions.AggressiveInlining)]
443             protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
444             {
445                 ref var firstLink = ref LinksDataParts[first];
446                 ref var secondLink = ref LinksDataParts[second];
447                 return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
                    ↪  secondLink.Source, secondLink.Target);
448             }
449         }
450     }
```

1.66 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64ExternalLinksSizeBalancedTreeMethodsBase

```
1   using System.Runtime.CompilerServices;
2   using Platform.Data.Doublets.Memory.Split.Generic;
3   using TLink = System.UInt64;
4
5   #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7   namespace Platform.Data.Doublets.Memory.Split.Specific
8   {
9       /// <summary>
10      /// <para>
11      /// Represents the int 64 external links size balanced tree methods base.
12      /// </para>
13      /// <para></para>
14      /// </summary>
15      /// <seealso cref="ExternalLinksSizeBalancedTreeMethodsBase{TLink}"/>
16      /// <seealso cref="ILinksTreeMethods{TLink}"/>
17      public unsafe abstract class UInt64ExternalLinksSizeBalancedTreeMethodsBase :
        ↪  ExternalLinksSizeBalancedTreeMethodsBase<TLink>, ILinksTreeMethods<TLink>
18      {
19          /// <summary>
20          /// <para>
21          /// The links data parts.
22          /// </para>
23          /// <para></para>
24          /// </summary>
25          protected new readonly RawLinkDataPart<TLink>* LinksDataParts;
26          /// <summary>
27          /// <para>
28          /// The links index parts.
29          /// </para>
30          /// <para></para>
31          /// </summary>
32          protected new readonly RawLinkIndexPart<TLink>* LinksIndexParts;
33          /// <summary>
34          /// <para>
35          /// The header.
36          /// </para>
37          /// <para></para>
38          /// </summary>
39          protected new readonly LinksHeader<TLink>* Header;
40
41          /// <summary>
42          /// <para>
43          /// Initializes a new <see cref="UInt64ExternalLinksSizeBalancedTreeMethodsBase"/>
            ↪  instance.
44          /// </para>
45          /// <para></para>
46          /// </summary>
47          /// <param name="constants">
48          /// <para>A constants.</para>
49          /// <para></para>
50          /// </param>
51          /// <param name="linksDataParts">
52          /// <para>A links data parts.</para>
53          /// <para></para>
54          /// </param>
55          /// <param name="linksIndexParts">
56          /// <para>A links index parts.</para>
57          /// <para></para>
58          /// </param>
59          /// <param name="header">
```

```
60          /// <para>A header.</para>
61          /// <para></para>
62          /// </param>
63          [MethodImpl(MethodImplOptions.AggressiveInlining)]
64          protected UInt64ExternalLinksSizeBalancedTreeMethodsBase(LinksConstants<TLink>
            ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
            ↪  linksIndexParts, LinksHeader<TLink>* header)
65              : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts, (byte*)header)
66          {
67              LinksDataParts = linksDataParts;
68              LinksIndexParts = linksIndexParts;
69              Header = header;
70          }
71
72          /// <summary>
73          /// <para>
74          /// Gets the zero.
75          /// </para>
76          /// <para></para>
77          /// </summary>
78          /// <returns>
79          /// <para>The ulong</para>
80          /// <para></para>
81          /// </returns>
82          [MethodImpl(MethodImplOptions.AggressiveInlining)]
83          protected override ulong GetZero() => OUL;
84
85          /// <summary>
86          /// <para>
87          /// Determines whether this instance equal to zero.
88          /// </para>
89          /// <para></para>
90          /// </summary>
91          /// <param name="value">
92          /// <para>The value.</para>
93          /// <para></para>
94          /// </param>
95          /// <returns>
96          /// <para>The bool</para>
97          /// <para></para>
98          /// </returns>
99          [MethodImpl(MethodImplOptions.AggressiveInlining)]
100         protected override bool EqualToZero(ulong value) => value == OUL;
101
102         /// <summary>
103         /// <para>
104         /// Determines whether this instance are equal.
105         /// </para>
106         /// <para></para>
107         /// </summary>
108         /// <param name="first">
109         /// <para>The first.</para>
110         /// <para></para>
111         /// </param>
112         /// <param name="second">
113         /// <para>The second.</para>
114         /// <para></para>
115         /// </param>
116         /// <returns>
117         /// <para>The bool</para>
118         /// <para></para>
119         /// </returns>
120         [MethodImpl(MethodImplOptions.AggressiveInlining)]
121         protected override bool AreEqual(ulong first, ulong second) => first == second;
122
123         /// <summary>
124         /// <para>
125         /// Determines whether this instance greater than zero.
126         /// </para>
127         /// <para></para>
128         /// </summary>
129         /// <param name="value">
130         /// <para>The value.</para>
131         /// <para></para>
132         /// </param>
133         /// <returns>
134         /// <para>The bool</para>
135         /// <para></para>
```

```
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(ulong value) => value > 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(ulong first, ulong second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(ulong value) => true; // value >= 0 is
         ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
```

```
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThanZero(ulong value) => value == 0UL; // value is
        ↪  always >= 0 for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThanZero(ulong value) => false; // value < 0 is always false
        ↪  for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(ulong first, ulong second) => first < second;

        /// <summary>
        /// <para>
        /// Increments the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
```

```
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Increment(ulong value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Decrement(ulong value) => --value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Add(ulong first, ulong second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Subtract(ulong first, ulong second) => first - second;

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<TLink> GetHeaderReference() => ref *Header;

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link.
```

```
367         /// </para>
368         /// <para></para>
369         /// </summary>
370         /// <param name="link">
371         /// <para>The link.</para>
372         /// <para></para>
373         /// </param>
374         /// <returns>
375         /// <para>A ref raw link data part of t link</para>
376         /// <para></para>
377         /// </returns>
378         [MethodImpl(MethodImplOptions.AggressiveInlining)]
379         protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
            ↪ ref LinksDataParts[link];
380
381         /// <summary>
382         /// <para>
383         /// Gets the link index part reference using the specified link.
384         /// </para>
385         /// <para></para>
386         /// </summary>
387         /// <param name="link">
388         /// <para>The link.</para>
389         /// <para></para>
390         /// </param>
391         /// <returns>
392         /// <para>A ref raw link index part of t link</para>
393         /// <para></para>
394         /// </returns>
395         [MethodImpl(MethodImplOptions.AggressiveInlining)]
396         protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
            ↪ ref LinksIndexParts[link];
397
398         /// <summary>
399         /// <para>
400         /// Determines whether this instance first is to the left of second.
401         /// </para>
402         /// <para></para>
403         /// </summary>
404         /// <param name="first">
405         /// <para>The first.</para>
406         /// <para></para>
407         /// </param>
408         /// <param name="second">
409         /// <para>The second.</para>
410         /// <para></para>
411         /// </param>
412         /// <returns>
413         /// <para>The bool</para>
414         /// <para></para>
415         /// </returns>
416         [MethodImpl(MethodImplOptions.AggressiveInlining)]
417         protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
418         {
419             ref var firstLink = ref LinksDataParts[first];
420             ref var secondLink = ref LinksDataParts[second];
421             return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                ↪ secondLink.Source, secondLink.Target);
422         }
423
424         /// <summary>
425         /// <para>
426         /// Determines whether this instance first is to the right of second.
427         /// </para>
428         /// <para></para>
429         /// </summary>
430         /// <param name="first">
431         /// <para>The first.</para>
432         /// <para></para>
433         /// </param>
434         /// <param name="second">
435         /// <para>The second.</para>
436         /// <para></para>
437         /// </param>
438         /// <returns>
439         /// <para>The bool</para>
440         /// <para></para>
441         /// </returns>
```

```
442         [MethodImpl(MethodImplOptions.AggressiveInlining)]
443         protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
444         {
445             ref var firstLink = ref LinksDataParts[first];
446             ref var secondLink = ref LinksDataParts[second];
447             return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
                ↪  secondLink.Source, secondLink.Target);
448         }
449     }
450 }
```

1.67 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64ExternalLinksSourcesRecursionlessSizeBalanc

```
1  using System.Runtime.CompilerServices;
2  using TLink = System.UInt64;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Data.Doublets.Memory.Split.Specific
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 64 external links sources recursionless size balanced tree methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
14     /// <seealso cref="UInt64ExternalLinksRecursionlessSizeBalancedTreeMethodsBase"/>
15     public unsafe class UInt64ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods :
       ↪  UInt64ExternalLinksRecursionlessSizeBalancedTreeMethodsBase
16     {
17         /// <summary>
18         /// <para>
19         /// Initializes a new <see
           ↪  cref="UInt64ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods"/> instance.
20         /// </para>
21         /// <para></para>
22         /// </summary>
23         /// <param name="constants">
24         /// <para>A constants.</para>
25         /// <para></para>
26         /// </param>
27         /// <param name="linksDataParts">
28         /// <para>A links data parts.</para>
29         /// <para></para>
30         /// </param>
31         /// <param name="linksIndexParts">
32         /// <para>A links index parts.</para>
33         /// <para></para>
34         /// </param>
35         /// <param name="header">
36         /// <para>A header.</para>
37         /// <para></para>
38         /// </param>
39         [MethodImpl(MethodImplOptions.AggressiveInlining)]
40         public
           ↪  UInt64ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
           ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
           ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
           ↪  linksIndexParts, header) { }
41
42         /// <summary>
43         /// <para>
44         /// Gets the left reference using the specified node.
45         /// </para>
46         /// <para></para>
47         /// </summary>
48         /// <param name="node">
49         /// <para>The node.</para>
50         /// <para></para>
51         /// </param>
52         /// <returns>
53         /// <para>The ref link</para>
54         /// <para></para>
55         /// </returns>
56         [MethodImpl(MethodImplOptions.AggressiveInlining)]
57         protected override ref TLink GetLeftReference(TLink node) => ref
           ↪  LinksIndexParts[node].LeftAsSource;
58
59         /// <summary>
```

```
60          /// <para>
61          /// Gets the right reference using the specified node.
62          /// </para>
63          /// <para></para>
64          /// </summary>
65          /// <param name="node">
66          /// <para>The node.</para>
67          /// <para></para>
68          /// </param>
69          /// <returns>
70          /// <para>The ref link</para>
71          /// <para></para>
72          /// </returns>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ LinksIndexParts[node].RightAsSource;
75
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsSource;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsSource;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
125         protected override void SetLeft(TLink node, TLink left) =>
            ↪ LinksIndexParts[node].LeftAsSource = left;
126
127         /// <summary>
128         /// <para>
129         /// Sets the right using the specified node.
130         /// </para>
131         /// <para></para>
132         /// </summary>
133         /// <param name="node">
134         /// <para>The node.</para>
135         /// <para></para>
```

```
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsSource = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => Header->RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
```

```
212         /// <para></para>
213         /// </summary>
214         /// <param name="firstSource">
215         /// <para>The first source.</para>
216         /// <para></para>
217         /// </param>
218         /// <param name="firstTarget">
219         /// <para>The first target.</para>
220         /// <para></para>
221         /// </param>
222         /// <param name="secondSource">
223         /// <para>The second source.</para>
224         /// <para></para>
225         /// </param>
226         /// <param name="secondTarget">
227         /// <para>The second target.</para>
228         /// <para></para>
229         /// </param>
230         /// <returns>
231         /// <para>The bool</para>
232         /// <para></para>
233         /// </returns>
234         [MethodImpl(MethodImplOptions.AggressiveInlining)]
235         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
          ↪  TLink secondSource, TLink secondTarget)
236             => firstSource < secondSource || firstSource == secondSource && firstTarget <
              ↪  secondTarget;
237 
238         /// <summary>
239         /// <para>
240         /// Determines whether this instance first is to the right of second.
241         /// </para>
242         /// <para></para>
243         /// </summary>
244         /// <param name="firstSource">
245         /// <para>The first source.</para>
246         /// <para></para>
247         /// </param>
248         /// <param name="firstTarget">
249         /// <para>The first target.</para>
250         /// <para></para>
251         /// </param>
252         /// <param name="secondSource">
253         /// <para>The second source.</para>
254         /// <para></para>
255         /// </param>
256         /// <param name="secondTarget">
257         /// <para>The second target.</para>
258         /// <para></para>
259         /// </param>
260         /// <returns>
261         /// <para>The bool</para>
262         /// <para></para>
263         /// </returns>
264         [MethodImpl(MethodImplOptions.AggressiveInlining)]
265         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
          ↪  TLink secondSource, TLink secondTarget)
266             => firstSource > secondSource || firstSource == secondSource && firstTarget >
              ↪  secondTarget;
267 
268         /// <summary>
269         /// <para>
270         /// Clears the node using the specified node.
271         /// </para>
272         /// <para></para>
273         /// </summary>
274         /// <param name="node">
275         /// <para>The node.</para>
276         /// <para></para>
277         /// </param>
278         [MethodImpl(MethodImplOptions.AggressiveInlining)]
279         protected override void ClearNode(TLink node)
280         {
281             ref var link = ref LinksIndexParts[node];
282             link.LeftAsSource = Zero;
283             link.RightAsSource = Zero;
284             link.SizeAsSource = Zero;
285         }
```

```
286     }
287 }
```

1.68 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64ExternalLinksSourcesSizeBalancedTreeMeth

```
1  using System.Runtime.CompilerServices;
2  using TLink = System.UInt64;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Data.Doublets.Memory.Split.Specific
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 64 external links sources size balanced tree methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
14     /// <seealso cref="UInt64ExternalLinksSizeBalancedTreeMethodsBase"/>
15     public unsafe class UInt64ExternalLinksSourcesSizeBalancedTreeMethods :
       ↪  UInt64ExternalLinksSizeBalancedTreeMethodsBase
16     {
17         /// <summary>
18         /// <para>
19         /// Initializes a new <see cref="UInt64ExternalLinksSourcesSizeBalancedTreeMethods"/>
           ↪  instance.
20         /// </para>
21         /// <para></para>
22         /// </summary>
23         /// <param name="constants">
24         /// <para>A constants.</para>
25         /// <para></para>
26         /// </param>
27         /// <param name="linksDataParts">
28         /// <para>A links data parts.</para>
29         /// <para></para>
30         /// </param>
31         /// <param name="linksIndexParts">
32         /// <para>A links index parts.</para>
33         /// <para></para>
34         /// </param>
35         /// <param name="header">
36         /// <para>A header.</para>
37         /// <para></para>
38         /// </param>
39         [MethodImpl(MethodImplOptions.AggressiveInlining)]
40         public UInt64ExternalLinksSourcesSizeBalancedTreeMethods(LinksConstants<TLink>
           ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
           ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
           ↪  linksIndexParts, header) { }
41
42         /// <summary>
43         /// <para>
44         /// Gets the left reference using the specified node.
45         /// </para>
46         /// <para></para>
47         /// </summary>
48         /// <param name="node">
49         /// <para>The node.</para>
50         /// <para></para>
51         /// </param>
52         /// <returns>
53         /// <para>The ref link</para>
54         /// <para></para>
55         /// </returns>
56         [MethodImpl(MethodImplOptions.AggressiveInlining)]
57         protected override ref TLink GetLeftReference(TLink node) => ref
           ↪  LinksIndexParts[node].LeftAsSource;
58
59         /// <summary>
60         /// <para>
61         /// Gets the right reference using the specified node.
62         /// </para>
63         /// <para></para>
64         /// </summary>
65         /// <param name="node">
66         /// <para>The node.</para>
67         /// <para></para>
68         /// </param>
```

```
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪ LinksIndexParts[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪ LinksIndexParts[node].LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪ LinksIndexParts[node].RightAsSource = right;

```

```
        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => Header->RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
```

```
221         /// </param>
222         /// <param name="secondSource">
223         /// <para>The second source.</para>
224         /// <para></para>
225         /// </param>
226         /// <param name="secondTarget">
227         /// <para>The second target.</para>
228         /// <para></para>
229         /// </param>
230         /// <returns>
231         /// <para>The bool</para>
232         /// <para></para>
233         /// </returns>
234         [MethodImpl(MethodImplOptions.AggressiveInlining)]
235         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget)
236             => firstSource < secondSource || firstSource == secondSource && firstTarget <
                ↪ secondTarget;
237 
238         /// <summary>
239         /// <para>
240         /// Determines whether this instance first is to the right of second.
241         /// </para>
242         /// <para></para>
243         /// </summary>
244         /// <param name="firstSource">
245         /// <para>The first source.</para>
246         /// <para></para>
247         /// </param>
248         /// <param name="firstTarget">
249         /// <para>The first target.</para>
250         /// <para></para>
251         /// </param>
252         /// <param name="secondSource">
253         /// <para>The second source.</para>
254         /// <para></para>
255         /// </param>
256         /// <param name="secondTarget">
257         /// <para>The second target.</para>
258         /// <para></para>
259         /// </param>
260         /// <returns>
261         /// <para>The bool</para>
262         /// <para></para>
263         /// </returns>
264         [MethodImpl(MethodImplOptions.AggressiveInlining)]
265         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget)
266             => firstSource > secondSource || firstSource == secondSource && firstTarget >
                ↪ secondTarget;
267 
268         /// <summary>
269         /// <para>
270         /// Clears the node using the specified node.
271         /// </para>
272         /// <para></para>
273         /// </summary>
274         /// <param name="node">
275         /// <para>The node.</para>
276         /// <para></para>
277         /// </param>
278         [MethodImpl(MethodImplOptions.AggressiveInlining)]
279         protected override void ClearNode(TLink node)
280         {
281             ref var link = ref LinksIndexParts[node];
282             link.LeftAsSource = Zero;
283             link.RightAsSource = Zero;
284             link.SizeAsSource = Zero;
285         }
286     }
287 }
```

1.69 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64ExternalLinksTargetsRecursionlessSizeBalanc

```
1  using System.Runtime.CompilerServices;
2  using TLink = System.UInt64;
3 
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5 
```

```
namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 external links targets recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt64ExternalLinksRecursionlessSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt64ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods :
    ↪ UInt64ExternalLinksRecursionlessSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪ cref="UInt64ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public
        ↪ UInt64ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪ constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪ linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪ linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪ LinksIndexParts[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪ LinksIndexParts[node].RightAsTarget;

```

```
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsTarget;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsTarget;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
125         protected override void SetLeft(TLink node, TLink left) =>
            ↪ LinksIndexParts[node].LeftAsTarget = left;
126
127         /// <summary>
128         /// <para>
129         /// Sets the right using the specified node.
130         /// </para>
131         /// <para></para>
132         /// </summary>
133         /// <param name="node">
134         /// <para>The node.</para>
135         /// <para></para>
136         /// </param>
137         /// <param name="right">
138         /// <para>The right.</para>
139         /// <para></para>
140         /// </param>
141         [MethodImpl(MethodImplOptions.AggressiveInlining)]
142         protected override void SetRight(TLink node, TLink right) =>
            ↪ LinksIndexParts[node].RightAsTarget = right;
143
144         /// <summary>
145         /// <para>
146         /// Gets the size using the specified node.
147         /// </para>
148         /// <para></para>
149         /// </summary>
150         /// <param name="node">
151         /// <para>The node.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsTarget;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsTarget = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => Header->RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
```

```
229         /// </param>
230         /// <returns>
231         /// <para>The bool</para>
232         /// <para></para>
233         /// </returns>
234         [MethodImpl(MethodImplOptions.AggressiveInlining)]
235         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget)
236             => firstTarget < secondTarget || firstTarget == secondTarget && firstSource <
                ↪ secondSource;
237 
238         /// <summary>
239         /// <para>
240         /// Determines whether this instance first is to the right of second.
241         /// </para>
242         /// <para></para>
243         /// </summary>
244         /// <param name="firstSource">
245         /// <para>The first source.</para>
246         /// <para></para>
247         /// </param>
248         /// <param name="firstTarget">
249         /// <para>The first target.</para>
250         /// <para></para>
251         /// </param>
252         /// <param name="secondSource">
253         /// <para>The second source.</para>
254         /// <para></para>
255         /// </param>
256         /// <param name="secondTarget">
257         /// <para>The second target.</para>
258         /// <para></para>
259         /// </param>
260         /// <returns>
261         /// <para>The bool</para>
262         /// <para></para>
263         /// </returns>
264         [MethodImpl(MethodImplOptions.AggressiveInlining)]
265         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget)
266             => firstTarget > secondTarget || firstTarget == secondTarget && firstSource >
                ↪ secondSource;
267 
268         /// <summary>
269         /// <para>
270         /// Clears the node using the specified node.
271         /// </para>
272         /// <para></para>
273         /// </summary>
274         /// <param name="node">
275         /// <para>The node.</para>
276         /// <para></para>
277         /// </param>
278         [MethodImpl(MethodImplOptions.AggressiveInlining)]
279         protected override void ClearNode(TLink node)
280         {
281             ref var link = ref LinksIndexParts[node];
282             link.LeftAsTarget = Zero;
283             link.RightAsTarget = Zero;
284             link.SizeAsTarget = Zero;
285         }
286     }
287 }
```

1.70 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64ExternalLinksTargetsSizeBalancedTreeMetho

```
1  using System.Runtime.CompilerServices;
2  using TLink = System.UInt64;
3 
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5 
6  namespace Platform.Data.Doublets.Memory.Split.Specific
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 64 external links targets size balanced tree methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
```

```
14      /// <seealso cref="UInt64ExternalLinksSizeBalancedTreeMethodsBase"/>
15      public unsafe class UInt64ExternalLinksTargetsSizeBalancedTreeMethods :
        ↪  UInt64ExternalLinksSizeBalancedTreeMethodsBase
16      {
17          /// <summary>
18          /// <para>
19          /// Initializes a new <see cref="UInt64ExternalLinksTargetsSizeBalancedTreeMethods"/>
            ↪  instance.
20          /// </para>
21          /// <para></para>
22          /// </summary>
23          /// <param name="constants">
24          /// <para>A constants.</para>
25          /// <para></para>
26          /// </param>
27          /// <param name="linksDataParts">
28          /// <para>A links data parts.</para>
29          /// <para></para>
30          /// </param>
31          /// <param name="linksIndexParts">
32          /// <para>A links index parts.</para>
33          /// <para></para>
34          /// </param>
35          /// <param name="header">
36          /// <para>A header.</para>
37          /// <para></para>
38          /// </param>
39          [MethodImpl(MethodImplOptions.AggressiveInlining)]
40          public UInt64ExternalLinksTargetsSizeBalancedTreeMethods(LinksConstants<TLink>
            ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
            ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
            ↪  linksIndexParts, header) { }
41
42          /// <summary>
43          /// <para>
44          /// Gets the left reference using the specified node.
45          /// </para>
46          /// <para></para>
47          /// </summary>
48          /// <param name="node">
49          /// <para>The node.</para>
50          /// <para></para>
51          /// </param>
52          /// <returns>
53          /// <para>The ref link</para>
54          /// <para></para>
55          /// </returns>
56          [MethodImpl(MethodImplOptions.AggressiveInlining)]
57          protected override ref TLink GetLeftReference(TLink node) => ref
            ↪  LinksIndexParts[node].LeftAsTarget;
58
59          /// <summary>
60          /// <para>
61          /// Gets the right reference using the specified node.
62          /// </para>
63          /// <para></para>
64          /// </summary>
65          /// <param name="node">
66          /// <para>The node.</para>
67          /// <para></para>
68          /// </param>
69          /// <returns>
70          /// <para>The ref link</para>
71          /// <para></para>
72          /// </returns>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected override ref TLink GetRightReference(TLink node) => ref
            ↪  LinksIndexParts[node].RightAsTarget;
75
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
```

```
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsTarget;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsTarget;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
125         protected override void SetLeft(TLink node, TLink left) =>
        ↪  LinksIndexParts[node].LeftAsTarget = left;
126
127         /// <summary>
128         /// <para>
129         /// Sets the right using the specified node.
130         /// </para>
131         /// <para></para>
132         /// </summary>
133         /// <param name="node">
134         /// <para>The node.</para>
135         /// <para></para>
136         /// </param>
137         /// <param name="right">
138         /// <para>The right.</para>
139         /// <para></para>
140         /// </param>
141         [MethodImpl(MethodImplOptions.AggressiveInlining)]
142         protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsTarget = right;
143
144         /// <summary>
145         /// <para>
146         /// Gets the size using the specified node.
147         /// </para>
148         /// <para></para>
149         /// </summary>
150         /// <param name="node">
151         /// <para>The node.</para>
152         /// <para></para>
153         /// </param>
154         /// <returns>
155         /// <para>The link</para>
156         /// <para></para>
157         /// </returns>
158         [MethodImpl(MethodImplOptions.AggressiveInlining)]
159         protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsTarget;
160
```

```
        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsTarget = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => Header->RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget)
```

```
            => firstTarget < secondTarget || firstTarget == secondTarget && firstSource <
            ↪  secondSource;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget)
            => firstTarget > secondTarget || firstTarget == secondTarget && firstSource >
            ↪  secondSource;

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref LinksIndexParts[node];
            link.LeftAsTarget = Zero;
            link.RightAsTarget = Zero;
            link.SizeAsTarget = Zero;
        }
    }
}
```

1.71 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64InternalLinksRecursionlessSizeBalancedTreeM

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.Split.Generic;
using TLink = System.UInt64;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 internal links recursionless size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="InternalLinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
    public unsafe abstract class UInt64InternalLinksRecursionlessSizeBalancedTreeMethodsBase :
    ↪  InternalLinksRecursionlessSizeBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// The links data parts.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkDataPart<TLink>* LinksDataParts;
        /// <summary>
        /// <para>
        /// The links index parts.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLinkIndexPart<TLink>* LinksIndexParts;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly LinksHeader<TLink>* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪  cref="UInt64InternalLinksRecursionlessSizeBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected
        ↪  UInt64InternalLinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header)
            : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts, (byte*)header)
        {
            LinksDataParts = linksDataParts;
            LinksIndexParts = linksIndexParts;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetZero() => 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(ulong value) => value == 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(ulong first, ulong second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(ulong value) => value > 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(ulong first, ulong second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
```

```
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(ulong value) => true; // value >= 0 is
        ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThanZero(ulong value) => value == 0UL; // value is
        ↪  always >= 0 for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
```

```
250         [MethodImpl(MethodImplOptions.AggressiveInlining)]
251         protected override bool LessThanZero(ulong value) => false; // value < 0 is always false
            ↪  for ulong
252
253         /// <summary>
254         /// <para>
255         /// Determines whether this instance less than.
256         /// </para>
257         /// <para></para>
258         /// </summary>
259         /// <param name="first">
260         /// <para>The first.</para>
261         /// <para></para>
262         /// </param>
263         /// <param name="second">
264         /// <para>The second.</para>
265         /// <para></para>
266         /// </param>
267         /// <returns>
268         /// <para>The bool</para>
269         /// <para></para>
270         /// </returns>
271         [MethodImpl(MethodImplOptions.AggressiveInlining)]
272         protected override bool LessThan(ulong first, ulong second) => first < second;
273
274         /// <summary>
275         /// <para>
276         /// Increments the value.
277         /// </para>
278         /// <para></para>
279         /// </summary>
280         /// <param name="value">
281         /// <para>The value.</para>
282         /// <para></para>
283         /// </param>
284         /// <returns>
285         /// <para>The ulong</para>
286         /// <para></para>
287         /// </returns>
288         [MethodImpl(MethodImplOptions.AggressiveInlining)]
289         protected override ulong Increment(ulong value) => ++value;
290
291         /// <summary>
292         /// <para>
293         /// Decrements the value.
294         /// </para>
295         /// <para></para>
296         /// </summary>
297         /// <param name="value">
298         /// <para>The value.</para>
299         /// <para></para>
300         /// </param>
301         /// <returns>
302         /// <para>The ulong</para>
303         /// <para></para>
304         /// </returns>
305         [MethodImpl(MethodImplOptions.AggressiveInlining)]
306         protected override ulong Decrement(ulong value) => --value;
307
308         /// <summary>
309         /// <para>
310         /// Adds the first.
311         /// </para>
312         /// <para></para>
313         /// </summary>
314         /// <param name="first">
315         /// <para>The first.</para>
316         /// <para></para>
317         /// </param>
318         /// <param name="second">
319         /// <para>The second.</para>
320         /// <para></para>
321         /// </param>
322         /// <returns>
323         /// <para>The ulong</para>
324         /// <para></para>
325         /// </returns>
326         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
        protected override ulong Add(ulong first, ulong second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Subtract(ulong first, ulong second) => first - second;

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link data part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
        ↪  ref LinksDataParts[link];

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
        ↪  ref LinksIndexParts[link];

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
403         protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second) =>
            ↪ GetKeyPartValue(first) < GetKeyPartValue(second);
404
405         /// <summary>
406         /// <para>
407         /// Determines whether this instance first is to the right of second.
408         /// </para>
409         /// <para></para>
410         /// </summary>
411         /// <param name="first">
412         /// <para>The first.</para>
413         /// <para></para>
414         /// </param>
415         /// <param name="second">
416         /// <para>The second.</para>
417         /// <para></para>
418         /// </param>
419         /// <returns>
420         /// <para>The bool</para>
421         /// <para></para>
422         /// </returns>
423         [MethodImpl(MethodImplOptions.AggressiveInlining)]
424         protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second) =>
            ↪ GetKeyPartValue(first) > GetKeyPartValue(second);
425     }
426 }
```

1.72 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64InternalLinksSizeBalancedTreeMethodsBase.

```
1  using System.Runtime.CompilerServices;
2  using Platform.Data.Doublets.Memory.Split.Generic;
3  using TLink = System.UInt64;
4
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7  namespace Platform.Data.Doublets.Memory.Split.Specific
8  {
9      /// <summary>
10     /// <para>
11     /// Represents the int 64 internal links size balanced tree methods base.
12     /// </para>
13     /// <para></para>
14     /// </summary>
15     /// <seealso cref="InternalLinksSizeBalancedTreeMethodsBase{TLink}"/>
16     public unsafe abstract class UInt64InternalLinksSizeBalancedTreeMethodsBase :
       ↪ InternalLinksSizeBalancedTreeMethodsBase<TLink>
17     {
18         /// <summary>
19         /// <para>
20         /// The links data parts.
21         /// </para>
22         /// <para></para>
23         /// </summary>
24         protected new readonly RawLinkDataPart<TLink>* LinksDataParts;
25         /// <summary>
26         /// <para>
27         /// The links index parts.
28         /// </para>
29         /// <para></para>
30         /// </summary>
31         protected new readonly RawLinkIndexPart<TLink>* LinksIndexParts;
32         /// <summary>
33         /// <para>
34         /// The header.
35         /// </para>
36         /// <para></para>
37         /// </summary>
38         protected new readonly LinksHeader<TLink>* Header;
39
40         /// <summary>
41         /// <para>
42         /// Initializes a new <see cref="UInt64InternalLinksSizeBalancedTreeMethodsBase"/>
           ↪ instance.
43         /// </para>
44         /// <para></para>
45         /// </summary>
46         /// <param name="constants">
47         /// <para>A constants.</para>
48         /// <para></para>
```

```
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected UInt64InternalLinksSizeBalancedTreeMethodsBase(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header)
            : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts, (byte*)header)
        {
            LinksDataParts = linksDataParts;
            LinksIndexParts = linksIndexParts;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetZero() => 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(ulong value) => value == 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(ulong first, ulong second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(ulong value) => value > 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(ulong first, ulong second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(ulong value) => true; // value >= 0 is
        ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
```

```
202         /// <para></para>
203         /// </summary>
204         /// <param name="value">
205         /// <para>The value.</para>
206         /// <para></para>
207         /// </param>
208         /// <returns>
209         /// <para>The bool</para>
210         /// <para></para>
211         /// </returns>
212         [MethodImpl(MethodImplOptions.AggressiveInlining)]
213         protected override bool LessOrEqualThanZero(ulong value) => value == 0UL; // value is
            ↪  always >= 0 for ulong
214
215         /// <summary>
216         /// <para>
217         /// Determines whether this instance less or equal than.
218         /// </para>
219         /// <para></para>
220         /// </summary>
221         /// <param name="first">
222         /// <para>The first.</para>
223         /// <para></para>
224         /// </param>
225         /// <param name="second">
226         /// <para>The second.</para>
227         /// <para></para>
228         /// </param>
229         /// <returns>
230         /// <para>The bool</para>
231         /// <para></para>
232         /// </returns>
233         [MethodImpl(MethodImplOptions.AggressiveInlining)]
234         protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;
235
236         /// <summary>
237         /// <para>
238         /// Determines whether this instance less than zero.
239         /// </para>
240         /// <para></para>
241         /// </summary>
242         /// <param name="value">
243         /// <para>The value.</para>
244         /// <para></para>
245         /// </param>
246         /// <returns>
247         /// <para>The bool</para>
248         /// <para></para>
249         /// </returns>
250         [MethodImpl(MethodImplOptions.AggressiveInlining)]
251         protected override bool LessThanZero(ulong value) => false; // value < 0 is always false
            ↪  for ulong
252
253         /// <summary>
254         /// <para>
255         /// Determines whether this instance less than.
256         /// </para>
257         /// <para></para>
258         /// </summary>
259         /// <param name="first">
260         /// <para>The first.</para>
261         /// <para></para>
262         /// </param>
263         /// <param name="second">
264         /// <para>The second.</para>
265         /// <para></para>
266         /// </param>
267         /// <returns>
268         /// <para>The bool</para>
269         /// <para></para>
270         /// </returns>
271         [MethodImpl(MethodImplOptions.AggressiveInlining)]
272         protected override bool LessThan(ulong first, ulong second) => first < second;
273
274         /// <summary>
275         /// <para>
276         /// Increments the value.
277         /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Increment(ulong value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Decrement(ulong value) => --value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Add(ulong first, ulong second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Subtract(ulong first, ulong second) => first - second;

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link data part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
        ↪  ref LinksDataParts[link];

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
        ↪  ref LinksIndexParts[link];

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second) =>
        ↪  GetKeyPartValue(first) < GetKeyPartValue(second);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second) =>
        ↪  GetKeyPartValue(first) > GetKeyPartValue(second);
    }
}
```

1.73 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64InternalLinksSourcesLinkedListMethods.cs

```
using System.Runtime.CompilerServices;
using TLink = System.UInt64;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Generic
{
    /// <summary>
    /// <para>
    /// Represents the int 64 internal links sources linked list methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="InternalLinksSourcesLinkedListMethods{TLink}"/>
    public unsafe class UInt64InternalLinksSourcesLinkedListMethods :
    ↪ InternalLinksSourcesLinkedListMethods<TLink>
    {
        private readonly RawLinkDataPart<TLink>* _linksDataParts;
        private readonly RawLinkIndexPart<TLink>* _linksIndexParts;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64InternalLinksSourcesLinkedListMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt64InternalLinksSourcesLinkedListMethods(LinksConstants<TLink> constants,
        ↪ RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>* linksIndexParts)
            : base(constants, (byte*)linksDataParts, (byte*)linksIndexParts)
        {
            _linksDataParts = linksDataParts;
            _linksIndexParts = linksIndexParts;
        }

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link data part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
        ↪ ref _linksDataParts[link];

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink link) =>
        ↪ ref _linksIndexParts[link];
    }
}
```

1.74 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64InternalLinksSourcesRecursionlessSizeBalanc

```
using System.Runtime.CompilerServices;
using TLink = System.UInt64;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 internal links sources recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt64InternalLinksRecursionlessSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt64InternalLinksSourcesRecursionlessSizeBalancedTreeMethods :
    ↪ UInt64InternalLinksRecursionlessSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪ cref="UInt64InternalLinksSourcesRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public
        ↪ UInt64InternalLinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪ constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪ linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪ linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪ LinksIndexParts[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  LinksIndexParts[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  LinksIndexParts[node].LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
```

```
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsSource = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot(TLink node) => LinksIndexParts[node].RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Source;

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified node.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetKeyPartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref LinksIndexParts[node];
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        public override TLink Search(TLink source, TLink target) =>
        ↪ SearchCore(GetTreeRoot(source), target);
    }
}
```

1.75 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64InternalLinksSourcesSizeBalancedTreeMetho

```
using System.Runtime.CompilerServices;
using TLink = System.UInt64;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 internal links sources size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt64InternalLinksSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt64InternalLinksSourcesSizeBalancedTreeMethods :
    ↪ UInt64InternalLinksSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64InternalLinksSourcesSizeBalancedTreeMethods"/>
        ↪ instance.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt64InternalLinksSourcesSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪  linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪  LinksIndexParts[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  LinksIndexParts[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsSource;

        /// <summary>
```

```
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  LinksIndexParts[node].LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsSource = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
```

```
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  LinksIndexParts[node].SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot(TLink node) => LinksIndexParts[node].RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Source;

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetKeyPartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref LinksIndexParts[node];
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }
```

```

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        public override TLink Search(TLink source, TLink target) =>
        ↪  SearchCore(GetTreeRoot(source), target);
    }
}
```

1.76 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64InternalLinksTargetsRecursionlessSizeBalanc

```
using System.Runtime.CompilerServices;
using TLink = System.UInt64;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 internal links targets recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt64InternalLinksRecursionlessSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt64InternalLinksTargetsRecursionlessSizeBalancedTreeMethods :
    ↪  UInt64InternalLinksRecursionlessSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪  cref="UInt64InternalLinksTargetsRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public
        ↪  UInt64InternalLinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪  constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪  linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪  linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
48          /// <param name="node">
49          /// <para>The node.</para>
50          /// <para></para>
51          /// </param>
52          /// <returns>
53          /// <para>The ref ulong</para>
54          /// <para></para>
55          /// </returns>
56          [MethodImpl(MethodImplOptions.AggressiveInlining)]
57          protected override ref ulong GetLeftReference(ulong node) => ref
            ↪ LinksIndexParts[node].LeftAsTarget;
58
59          /// <summary>
60          /// <para>
61          /// Gets the right reference using the specified node.
62          /// </para>
63          /// <para></para>
64          /// </summary>
65          /// <param name="node">
66          /// <para>The node.</para>
67          /// <para></para>
68          /// </param>
69          /// <returns>
70          /// <para>The ref ulong</para>
71          /// <para></para>
72          /// </returns>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected override ref ulong GetRightReference(ulong node) => ref
            ↪ LinksIndexParts[node].RightAsTarget;
75
76          /// <summary>
77          /// <para>
78          /// Gets the left using the specified node.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="node">
83          /// <para>The node.</para>
84          /// <para></para>
85          /// </param>
86          /// <returns>
87          /// <para>The link</para>
88          /// <para></para>
89          /// </returns>
90          [MethodImpl(MethodImplOptions.AggressiveInlining)]
91          protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsTarget;
92
93          /// <summary>
94          /// <para>
95          /// Gets the right using the specified node.
96          /// </para>
97          /// <para></para>
98          /// </summary>
99          /// <param name="node">
100         /// <para>The node.</para>
101         /// <para></para>
102         /// </param>
103         /// <returns>
104         /// <para>The link</para>
105         /// <para></para>
106         /// </returns>
107         [MethodImpl(MethodImplOptions.AggressiveInlining)]
108         protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsTarget;
109
110         /// <summary>
111         /// <para>
112         /// Sets the left using the specified node.
113         /// </para>
114         /// <para></para>
115         /// </summary>
116         /// <param name="node">
117         /// <para>The node.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="left">
121         /// <para>The left.</para>
122         /// <para></para>
123         /// </param>
```

```
124             [MethodImpl(MethodImplOptions.AggressiveInlining)]
125             protected override void SetLeft(TLink node, TLink left) =>
                ↪  LinksIndexParts[node].LeftAsTarget = left;
126
127             /// <summary>
128             /// <para>
129             /// Sets the right using the specified node.
130             /// </para>
131             /// <para></para>
132             /// </summary>
133             /// <param name="node">
134             /// <para>The node.</para>
135             /// <para></para>
136             /// </param>
137             /// <param name="right">
138             /// <para>The right.</para>
139             /// <para></para>
140             /// </param>
141             [MethodImpl(MethodImplOptions.AggressiveInlining)]
142             protected override void SetRight(TLink node, TLink right) =>
                ↪  LinksIndexParts[node].RightAsTarget = right;
143
144             /// <summary>
145             /// <para>
146             /// Gets the size using the specified node.
147             /// </para>
148             /// <para></para>
149             /// </summary>
150             /// <param name="node">
151             /// <para>The node.</para>
152             /// <para></para>
153             /// </param>
154             /// <returns>
155             /// <para>The link</para>
156             /// <para></para>
157             /// </returns>
158             [MethodImpl(MethodImplOptions.AggressiveInlining)]
159             protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsTarget;
160
161             /// <summary>
162             /// <para>
163             /// Sets the size using the specified node.
164             /// </para>
165             /// <para></para>
166             /// </summary>
167             /// <param name="node">
168             /// <para>The node.</para>
169             /// <para></para>
170             /// </param>
171             /// <param name="size">
172             /// <para>The size.</para>
173             /// <para></para>
174             /// </param>
175             [MethodImpl(MethodImplOptions.AggressiveInlining)]
176             protected override void SetSize(TLink node, TLink size) =>
                ↪  LinksIndexParts[node].SizeAsTarget = size;
177
178             /// <summary>
179             /// <para>
180             /// Gets the tree root using the specified node.
181             /// </para>
182             /// <para></para>
183             /// </summary>
184             /// <param name="node">
185             /// <para>The node.</para>
186             /// <para></para>
187             /// </param>
188             /// <returns>
189             /// <para>The link</para>
190             /// <para></para>
191             /// </returns>
192             [MethodImpl(MethodImplOptions.AggressiveInlining)]
193             protected override TLink GetTreeRoot(TLink node) => LinksIndexParts[node].RootAsTarget;
194
195             /// <summary>
196             /// <para>
197             /// Gets the base part value using the specified node.
198             /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Target;

        /// <summary>
        /// <para>
        /// Gets the key part value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetKeyPartValue(TLink node) => LinksDataParts[node].Source;

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref LinksIndexParts[node];
            link.LeftAsTarget = Zero;
            link.RightAsTarget = Zero;
            link.SizeAsTarget = Zero;
        }

        /// <summary>
        /// <para>
        /// Searches the source.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        public override TLink Search(TLink source, TLink target) =>
        ↪  SearchCore(GetTreeRoot(target), source);
    }
}
```

1.77 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64InternalLinksTargetsSizeBalancedTreeMetho

```
using System.Runtime.CompilerServices;
using TLink = System.UInt64;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

```

```
namespace Platform.Data.Doublets.Memory.Split.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 internal links targets size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt64InternalLinksSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt64InternalLinksTargetsSizeBalancedTreeMethods :
    ↪ UInt64InternalLinksSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64InternalLinksTargetsSizeBalancedTreeMethods"/>
        ↪ instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksDataParts">
        /// <para>A links data parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="linksIndexParts">
        /// <para>A links index parts.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt64InternalLinksTargetsSizeBalancedTreeMethods(LinksConstants<TLink>
        ↪ constants, RawLinkDataPart<TLink>* linksDataParts, RawLinkIndexPart<TLink>*
        ↪ linksIndexParts, LinksHeader<TLink>* header) : base(constants, linksDataParts,
        ↪ linksIndexParts, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetLeftReference(ulong node) => ref
        ↪ LinksIndexParts[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetRightReference(ulong node) => ref
        ↪ LinksIndexParts[node].RightAsTarget;

        /// <summary>
```

```
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => LinksIndexParts[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => LinksIndexParts[node].RightAsTarget;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  LinksIndexParts[node].LeftAsTarget = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  LinksIndexParts[node].RightAsTarget = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
```

```
153         /// </param>
154         /// <returns>
155         /// <para>The link</para>
156         /// <para></para>
157         /// </returns>
158         [MethodImpl(MethodImplOptions.AggressiveInlining)]
159         protected override TLink GetSize(TLink node) => LinksIndexParts[node].SizeAsTarget;
160 
161         /// <summary>
162         /// <para>
163         /// Sets the size using the specified node.
164         /// </para>
165         /// <para></para>
166         /// </summary>
167         /// <param name="node">
168         /// <para>The node.</para>
169         /// <para></para>
170         /// </param>
171         /// <param name="size">
172         /// <para>The size.</para>
173         /// <para></para>
174         /// </param>
175         [MethodImpl(MethodImplOptions.AggressiveInlining)]
176         protected override void SetSize(TLink node, TLink size) =>
            ↪ LinksIndexParts[node].SizeAsTarget = size;
177 
178         /// <summary>
179         /// <para>
180         /// Gets the tree root using the specified node.
181         /// </para>
182         /// <para></para>
183         /// </summary>
184         /// <param name="node">
185         /// <para>The node.</para>
186         /// <para></para>
187         /// </param>
188         /// <returns>
189         /// <para>The link</para>
190         /// <para></para>
191         /// </returns>
192         [MethodImpl(MethodImplOptions.AggressiveInlining)]
193         protected override TLink GetTreeRoot(TLink node) => LinksIndexParts[node].RootAsTarget;
194 
195         /// <summary>
196         /// <para>
197         /// Gets the base part value using the specified node.
198         /// </para>
199         /// <para></para>
200         /// </summary>
201         /// <param name="node">
202         /// <para>The node.</para>
203         /// <para></para>
204         /// </param>
205         /// <returns>
206         /// <para>The link</para>
207         /// <para></para>
208         /// </returns>
209         [MethodImpl(MethodImplOptions.AggressiveInlining)]
210         protected override TLink GetBasePartValue(TLink node) => LinksDataParts[node].Target;
211 
212         /// <summary>
213         /// <para>
214         /// Gets the key part value using the specified node.
215         /// </para>
216         /// <para></para>
217         /// </summary>
218         /// <param name="node">
219         /// <para>The node.</para>
220         /// <para></para>
221         /// </param>
222         /// <returns>
223         /// <para>The link</para>
224         /// <para></para>
225         /// </returns>
226         [MethodImpl(MethodImplOptions.AggressiveInlining)]
227         protected override TLink GetKeyPartValue(TLink node) => LinksDataParts[node].Source;
228 
229         /// <summary>
```

```
230         /// <para>
231         /// Clears the node using the specified node.
232         /// </para>
233         /// <para></para>
234         /// </summary>
235         /// <param name="node">
236         /// <para>The node.</para>
237         /// <para></para>
238         /// </param>
239         [MethodImpl(MethodImplOptions.AggressiveInlining)]
240         protected override void ClearNode(TLink node)
241         {
242             ref var link = ref LinksIndexParts[node];
243             link.LeftAsTarget = Zero;
244             link.RightAsTarget = Zero;
245             link.SizeAsTarget = Zero;
246         }
247 
248         /// <summary>
249         /// <para>
250         /// Searches the source.
251         /// </para>
252         /// <para></para>
253         /// </summary>
254         /// <param name="source">
255         /// <para>The source.</para>
256         /// <para></para>
257         /// </param>
258         /// <param name="target">
259         /// <para>The target.</para>
260         /// <para></para>
261         /// </param>
262         /// <returns>
263         /// <para>The link</para>
264         /// <para></para>
265         /// </returns>
266         public override TLink Search(TLink source, TLink target) =>
            ↪ SearchCore(GetTreeRoot(target), source);
267     }
268 }
```

1.78 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64SplitMemoryLinks.cs

```
1  using System;
2  using System.Runtime.CompilerServices;
3  using Platform.Singletons;
4  using Platform.Memory;
5  using Platform.Data.Doublets.Memory.Split.Generic;
6  using TLink = System.UInt64;
7 
8  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
9 
10 namespace Platform.Data.Doublets.Memory.Split.Specific
11 {
12     /// <summary>
13     /// <para>
14     /// Represents the int 64 split memory links.
15     /// </para>
16     /// <para></para>
17     /// </summary>
18     /// <seealso cref="SplitMemoryLinksBase{TLink}"/>
19     public unsafe class UInt64SplitMemoryLinks : SplitMemoryLinksBase<TLink>
20     {
21         private readonly Func<ILinksTreeMethods<TLink>> _createInternalSourceTreeMethods;
22         private readonly Func<ILinksTreeMethods<TLink>> _createExternalSourceTreeMethods;
23         private readonly Func<ILinksTreeMethods<TLink>> _createInternalTargetTreeMethods;
24         private readonly Func<ILinksTreeMethods<TLink>> _createExternalTargetTreeMethods;
25         private LinksHeader<ulong>* _header;
26         private RawLinkDataPart<ulong>* _linksDataParts;
27         private RawLinkIndexPart<ulong>* _linksIndexParts;
28 
29         /// <summary>
30         /// <para>
31         /// Initializes a new <see cref="UInt64SplitMemoryLinks"/> instance.
32         /// </para>
33         /// <para></para>
34         /// </summary>
35         /// <param name="dataMemory">
36         /// <para>A data memory.</para>
37         /// <para></para>
```

```
        /// </param>
        /// <param name="indexMemory">
        /// <para>A index memory.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt64SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
        ↪  indexMemory) : this(dataMemory, indexMemory, DefaultLinksSizeStep) { }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64SplitMemoryLinks"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="dataMemory">
        /// <para>A data memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="indexMemory">
        /// <para>A index memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="memoryReservationStep">
        /// <para>A memory reservation step.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt64SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
        ↪  indexMemory, long memoryReservationStep) : this(dataMemory, indexMemory,
        ↪  memoryReservationStep, Default<LinksConstants<TLink>>.Instance,
        ↪  IndexTreeType.Default, useLinkedList: true) { }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64SplitMemoryLinks"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="dataMemory">
        /// <para>A data memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="indexMemory">
        /// <para>A index memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="memoryReservationStep">
        /// <para>A memory reservation step.</para>
        /// <para></para>
        /// </param>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt64SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
        ↪  indexMemory, long memoryReservationStep, LinksConstants<TLink> constants) :
        ↪  this(dataMemory, indexMemory, memoryReservationStep, constants,
        ↪  IndexTreeType.Default, useLinkedList: true) { }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64SplitMemoryLinks"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="dataMemory">
        /// <para>A data memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="indexMemory">
        /// <para>A index memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="memoryReservationStep">
        /// <para>A memory reservation step.</para>
```

```
108         /// <para></para>
109         /// </param>
110         /// <param name="constants">
111         /// <para>A constants.</para>
112         /// <para></para>
113         /// </param>
114         /// <param name="indexTreeType">
115         /// <para>A index tree type.</para>
116         /// <para></para>
117         /// </param>
118         /// <param name="useLinkedList">
119         /// <para>A use linked list.</para>
120         /// <para></para>
121         /// </param>
122         [MethodImpl(MethodImplOptions.AggressiveInlining)]
123         public UInt64SplitMemoryLinks(IResizableDirectMemory dataMemory, IResizableDirectMemory
            ↪ indexMemory, long memoryReservationStep, LinksConstants<TLink> constants,
            ↪ IndexTreeType indexTreeType, bool useLinkedList) : base(dataMemory, indexMemory,
            ↪ memoryReservationStep, constants, useLinkedList)
124         {
125             if (indexTreeType == IndexTreeType.SizeBalancedTree)
126             {
127                 _createInternalSourceTreeMethods = () => new
                    ↪ UInt64InternalLinksSourcesSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
128                 _createExternalSourceTreeMethods = () => new
                    ↪ UInt64ExternalLinksSourcesSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
129                 _createInternalTargetTreeMethods = () => new
                    ↪ UInt64InternalLinksTargetsSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
130                 _createExternalTargetTreeMethods = () => new
                    ↪ UInt64ExternalLinksTargetsSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
131             }
132             else
133             {
134                 _createInternalSourceTreeMethods = () => new
                    ↪ UInt64InternalLinksSourcesRecursionlessSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
135                 _createExternalSourceTreeMethods = () => new
                    ↪ UInt64ExternalLinksSourcesRecursionlessSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
136                 _createInternalTargetTreeMethods = () => new
                    ↪ UInt64InternalLinksTargetsRecursionlessSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
137                 _createExternalTargetTreeMethods = () => new
                    ↪ UInt64ExternalLinksTargetsRecursionlessSizeBalancedTreeMethods(Constants,
                    ↪ _linksDataParts, _linksIndexParts, _header);
138             }
139             Init(dataMemory, indexMemory);
140         }
141 
142         /// <summary>
143         /// <para>
144         /// Sets the pointers using the specified data memory.
145         /// </para>
146         /// <para></para>
147         /// </summary>
148         /// <param name="dataMemory">
149         /// <para>The data memory.</para>
150         /// <para></para>
151         /// </param>
152         /// <param name="indexMemory">
153         /// <para>The index memory.</para>
154         /// <para></para>
155         /// </param>
156         [MethodImpl(MethodImplOptions.AggressiveInlining)]
157         protected override void SetPointers(IResizableDirectMemory dataMemory,
            ↪ IResizableDirectMemory indexMemory)
158         {
159             _linksDataParts = (RawLinkDataPart<TLink>*)dataMemory.Pointer;
160             _linksIndexParts = (RawLinkIndexPart<TLink>*)indexMemory.Pointer;
161             _header = (LinksHeader<TLink>*)indexMemory.Pointer;
162             if (_useLinkedList)
163             {
```

```
                InternalSourcesListMethods = new
                ↪  UInt64InternalLinksSourcesLinkedListMethods(Constants, _linksDataParts,
                ↪  _linksIndexParts);
            }
            else
            {
                InternalSourcesTreeMethods = _createInternalSourceTreeMethods();
            }
            ExternalSourcesTreeMethods = _createExternalSourceTreeMethods();
            InternalTargetsTreeMethods = _createInternalTargetTreeMethods();
            ExternalTargetsTreeMethods = _createExternalTargetTreeMethods();
            UnusedLinksListMethods = new UInt64UnusedLinksListMethods(_linksDataParts, _header);
        }

        /// <summary>
        /// <para>
        /// Resets the pointers.
        /// </para>
        /// <para></para>
        /// </summary>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ResetPointers()
        {
            base.ResetPointers();
            _linksDataParts = null;
            _linksIndexParts = null;
            _header = null;
        }

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<TLink> GetHeaderReference() => ref *_header;

        /// <summary>
        /// <para>
        /// Gets the link data part reference using the specified link index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link data part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink linkIndex)
        ↪  => ref _linksDataParts[linkIndex];

        /// <summary>
        /// <para>
        /// Gets the link index part reference using the specified link index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link index part of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLinkIndexPart<TLink> GetLinkIndexPartReference(TLink
        ↪  linkIndex) => ref _linksIndexParts[linkIndex];

```

```
        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(ulong first, ulong second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(ulong first, ulong second) => first < second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
```

```
316         /// <para>The bool</para>
317         /// <para></para>
318         /// </returns>
319         [MethodImpl(MethodImplOptions.AggressiveInlining)]
320         protected override bool GreaterThan(ulong first, ulong second) => first > second;
321 
322         /// <summary>
323         /// <para>
324         /// Determines whether this instance greater or equal than.
325         /// </para>
326         /// <para></para>
327         /// </summary>
328         /// <param name="first">
329         /// <para>The first.</para>
330         /// <para></para>
331         /// </param>
332         /// <param name="second">
333         /// <para>The second.</para>
334         /// <para></para>
335         /// </param>
336         /// <returns>
337         /// <para>The bool</para>
338         /// <para></para>
339         /// </returns>
340         [MethodImpl(MethodImplOptions.AggressiveInlining)]
341         protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;
342 
343         /// <summary>
344         /// <para>
345         /// Gets the zero.
346         /// </para>
347         /// <para></para>
348         /// </summary>
349         /// <returns>
350         /// <para>The ulong</para>
351         /// <para></para>
352         /// </returns>
353         [MethodImpl(MethodImplOptions.AggressiveInlining)]
354         protected override ulong GetZero() => 0UL;
355 
356         /// <summary>
357         /// <para>
358         /// Gets the one.
359         /// </para>
360         /// <para></para>
361         /// </summary>
362         /// <returns>
363         /// <para>The ulong</para>
364         /// <para></para>
365         /// </returns>
366         [MethodImpl(MethodImplOptions.AggressiveInlining)]
367         protected override ulong GetOne() => 1UL;
368 
369         /// <summary>
370         /// <para>
371         /// Converts the to int 64 using the specified value.
372         /// </para>
373         /// <para></para>
374         /// </summary>
375         /// <param name="value">
376         /// <para>The value.</para>
377         /// <para></para>
378         /// </param>
379         /// <returns>
380         /// <para>The long</para>
381         /// <para></para>
382         /// </returns>
383         [MethodImpl(MethodImplOptions.AggressiveInlining)]
384         protected override long ConvertToInt64(ulong value) => (long)value;
385 
386         /// <summary>
387         /// <para>
388         /// Converts the to address using the specified value.
389         /// </para>
390         /// <para></para>
391         /// </summary>
392         /// <param name="value">
393         /// <para>The value.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong ConvertToAddress(long value) => (ulong)value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Add(ulong first, ulong second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Subtract(ulong first, ulong second) => first - second;

        /// <summary>
        /// <para>
        /// Increments the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Increment(ulong link) => ++link;

        /// <summary>
        /// <para>
        /// Decrements the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
```

```
472         /// <returns>
473         /// <para>The ulong</para>
474         /// <para></para>
475         /// </returns>
476         [MethodImpl(MethodImplOptions.AggressiveInlining)]
477         protected override ulong Decrement(ulong link) => --link;
478     }
479 }
```

1.79 ./csharp/Platform.Data.Doublets/Memory/Split/Specific/UInt64UnusedLinksListMethods.cs

```
1  using System.Runtime.CompilerServices;
2  using Platform.Data.Doublets.Memory.Split.Generic;
3  using TLink = System.UInt64;
4
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7  namespace Platform.Data.Doublets.Memory.Split.Specific
8  {
9      /// <summary>
10     /// <para>
11     /// Represents the int 64 unused links list methods.
12     /// </para>
13     /// <para></para>
14     /// </summary>
15     /// <seealso cref="UnusedLinksListMethods{TLink}"/>
16     public unsafe class UInt64UnusedLinksListMethods : UnusedLinksListMethods<TLink>
17     {
18         private readonly RawLinkDataPart<ulong>* _links;
19         private readonly LinksHeader<ulong>* _header;
20
21         /// <summary>
22         /// <para>
23         /// Initializes a new <see cref="UInt64UnusedLinksListMethods"/> instance.
24         /// </para>
25         /// <para></para>
26         /// </summary>
27         /// <param name="links">
28         /// <para>A links.</para>
29         /// <para></para>
30         /// </param>
31         /// <param name="header">
32         /// <para>A header.</para>
33         /// <para></para>
34         /// </param>
35         [MethodImpl(MethodImplOptions.AggressiveInlining)]
36         public UInt64UnusedLinksListMethods(RawLinkDataPart<ulong>* links, LinksHeader<ulong>*
           ↪ header)
37             : base((byte*)links, (byte*)header)
38         {
39             _links = links;
40             _header = header;
41         }
42
43         /// <summary>
44         /// <para>
45         /// Gets the link data part reference using the specified link.
46         /// </para>
47         /// <para></para>
48         /// </summary>
49         /// <param name="link">
50         /// <para>The link.</para>
51         /// <para></para>
52         /// </param>
53         /// <returns>
54         /// <para>A ref raw link data part of t link</para>
55         /// <para></para>
56         /// </returns>
57         [MethodImpl(MethodImplOptions.AggressiveInlining)]
58         protected override ref RawLinkDataPart<TLink> GetLinkDataPartReference(TLink link) =>
           ↪ ref _links[link];
59
60         /// <summary>
61         /// <para>
62         /// Gets the header reference.
63         /// </para>
64         /// <para></para>
65         /// </summary>
66         /// <returns>
67         /// <para>A ref links header of t link</para>
```

```
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<TLink> GetHeaderReference() => ref *_header;
    }
}
```

1.80 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksAvlBalancedTreeMethodsBase.cs

```
using System;
using System.Text;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Collections.Methods.Trees;
using Platform.Converters;
using Platform.Delegates;
using Platform.Numbers;
using static System.Runtime.CompilerServices.Unsafe;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Generic
{
    /// <summary>
    /// <para>
    /// Represents the links avl balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="SizedAndThreadedAVLBalancedTreeMethods{TLink}"/>
    /// <seealso cref="ILinksTreeMethods{TLink}"/>
    public unsafe abstract class LinksAvlBalancedTreeMethodsBase<TLink> :
    ↪  SizedAndThreadedAVLBalancedTreeMethods<TLink>, ILinksTreeMethods<TLink>
    {
        private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
        ↪  UncheckedConverter<TLink, long>.Default;
        private static readonly UncheckedConverter<TLink, int> _addressToInt32Converter =
        ↪  UncheckedConverter<TLink, int>.Default;
        private static readonly UncheckedConverter<bool, TLink> _boolToAddressConverter =
        ↪  UncheckedConverter<bool, TLink>.Default;
        private static readonly UncheckedConverter<TLink, bool> _addressToBoolConverter =
        ↪  UncheckedConverter<TLink, bool>.Default;
        private static readonly UncheckedConverter<int, TLink> _int32ToAddressConverter =
        ↪  UncheckedConverter<int, TLink>.Default;

        /// <summary>
        /// <para>
        /// The break.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Break;
        /// <summary>
        /// <para>
        /// The continue.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Continue;
        /// <summary>
        /// <para>
        /// The links.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* Links;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksAvlBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
```

```
67          /// <para>A constants.</para>
68          /// <para></para>
69          /// </param>
70          /// <param name="links">
71          /// <para>A links.</para>
72          /// <para></para>
73          /// </param>
74          /// <param name="header">
75          /// <para>A header.</para>
76          /// <para></para>
77          /// </param>
78          [MethodImpl(MethodImplOptions.AggressiveInlining)]
79          protected LinksAvlBalancedTreeMethodsBase(LinksConstants<TLink> constants, byte* links,
            ↪  byte* header)
80          {
81              Links = links;
82              Header = header;
83              Break = constants.Break;
84              Continue = constants.Continue;
85          }
86
87          /// <summary>
88          /// <para>
89          /// Gets the tree root.
90          /// </para>
91          /// <para></para>
92          /// </summary>
93          /// <returns>
94          /// <para>The link</para>
95          /// <para></para>
96          /// </returns>
97          [MethodImpl(MethodImplOptions.AggressiveInlining)]
98          protected abstract TLink GetTreeRoot();
99
100         /// <summary>
101         /// <para>
102         /// Gets the base part value using the specified link.
103         /// </para>
104         /// <para></para>
105         /// </summary>
106         /// <param name="link">
107         /// <para>The link.</para>
108         /// <para></para>
109         /// </param>
110         /// <returns>
111         /// <para>The link</para>
112         /// <para></para>
113         /// </returns>
114         [MethodImpl(MethodImplOptions.AggressiveInlining)]
115         protected abstract TLink GetBasePartValue(TLink link);
116
117         /// <summary>
118         /// <para>
119         /// Determines whether this instance first is to the right of second.
120         /// </para>
121         /// <para></para>
122         /// </summary>
123         /// <param name="source">
124         /// <para>The source.</para>
125         /// <para></para>
126         /// </param>
127         /// <param name="target">
128         /// <para>The target.</para>
129         /// <para></para>
130         /// </param>
131         /// <param name="rootSource">
132         /// <para>The root source.</para>
133         /// <para></para>
134         /// </param>
135         /// <param name="rootTarget">
136         /// <para>The root target.</para>
137         /// <para></para>
138         /// </param>
139         /// <returns>
140         /// <para>The bool</para>
141         /// <para></para>
142         /// </returns>
143         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
144         protected abstract bool FirstIsToTheRightOfSecond(TLink source, TLink target, TLink
            ↪ rootSource, TLink rootTarget);
145
146         /// <summary>
147         /// <para>
148         /// Determines whether this instance first is to the left of second.
149         /// </para>
150         /// <para></para>
151         /// </summary>
152         /// <param name="source">
153         /// <para>The source.</para>
154         /// <para></para>
155         /// </param>
156         /// <param name="target">
157         /// <para>The target.</para>
158         /// <para></para>
159         /// </param>
160         /// <param name="rootSource">
161         /// <para>The root source.</para>
162         /// <para></para>
163         /// </param>
164         /// <param name="rootTarget">
165         /// <para>The root target.</para>
166         /// <para></para>
167         /// </param>
168         /// <returns>
169         /// <para>The bool</para>
170         /// <para></para>
171         /// </returns>
172         [MethodImpl(MethodImplOptions.AggressiveInlining)]
173         protected abstract bool FirstIsToTheLeftOfSecond(TLink source, TLink target, TLink
            ↪ rootSource, TLink rootTarget);
174
175         /// <summary>
176         /// <para>
177         /// Gets the header reference.
178         /// </para>
179         /// <para></para>
180         /// </summary>
181         /// <returns>
182         /// <para>A ref links header of t link</para>
183         /// <para></para>
184         /// </returns>
185         [MethodImpl(MethodImplOptions.AggressiveInlining)]
186         protected virtual ref LinksHeader<TLink> GetHeaderReference() => ref
            ↪ AsRef<LinksHeader<TLink>>(Header);
187
188         /// <summary>
189         /// <para>
190         /// Gets the link reference using the specified link.
191         /// </para>
192         /// <para></para>
193         /// </summary>
194         /// <param name="link">
195         /// <para>The link.</para>
196         /// <para></para>
197         /// </param>
198         /// <returns>
199         /// <para>A ref raw link of t link</para>
200         /// <para></para>
201         /// </returns>
202         [MethodImpl(MethodImplOptions.AggressiveInlining)]
203         protected virtual ref RawLink<TLink> GetLinkReference(TLink link) => ref
            ↪ AsRef<RawLink<TLink>>(Links + (RawLink<TLink>.SizeInBytes *
            ↪ _addressToInt64Converter.Convert(link)));
204
205         /// <summary>
206         /// <para>
207         /// Gets the link values using the specified link index.
208         /// </para>
209         /// <para></para>
210         /// </summary>
211         /// <param name="linkIndex">
212         /// <para>The link index.</para>
213         /// <para></para>
214         /// </param>
215         /// <returns>
```

```
216         /// <para>A list of t link</para>
217         /// <para></para>
218         /// </returns>
219         [MethodImpl(MethodImplOptions.AggressiveInlining)]
220         protected virtual IList<TLink>? GetLinkValues(TLink linkIndex)
221         {
222             ref var link = ref GetLinkReference(linkIndex);
223             return new Link<TLink>(linkIndex, link.Source, link.Target);
224         }
225 
226         /// <summary>
227         /// <para>
228         /// Determines whether this instance first is to the left of second.
229         /// </para>
230         /// <para></para>
231         /// </summary>
232         /// <param name="first">
233         /// <para>The first.</para>
234         /// <para></para>
235         /// </param>
236         /// <param name="second">
237         /// <para>The second.</para>
238         /// <para></para>
239         /// </param>
240         /// <returns>
241         /// <para>The bool</para>
242         /// <para></para>
243         /// </returns>
244         [MethodImpl(MethodImplOptions.AggressiveInlining)]
245         protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
246         {
247             ref var firstLink = ref GetLinkReference(first);
248             ref var secondLink = ref GetLinkReference(second);
249             return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                 ↪  secondLink.Source, secondLink.Target);
250         }
251 
252         /// <summary>
253         /// <para>
254         /// Determines whether this instance first is to the right of second.
255         /// </para>
256         /// <para></para>
257         /// </summary>
258         /// <param name="first">
259         /// <para>The first.</para>
260         /// <para></para>
261         /// </param>
262         /// <param name="second">
263         /// <para>The second.</para>
264         /// <para></para>
265         /// </param>
266         /// <returns>
267         /// <para>The bool</para>
268         /// <para></para>
269         /// </returns>
270         [MethodImpl(MethodImplOptions.AggressiveInlining)]
271         protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
272         {
273             ref var firstLink = ref GetLinkReference(first);
274             ref var secondLink = ref GetLinkReference(second);
275             return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
                 ↪  secondLink.Source, secondLink.Target);
276         }
277 
278         /// <summary>
279         /// <para>
280         /// Gets the size value using the specified value.
281         /// </para>
282         /// <para></para>
283         /// </summary>
284         /// <param name="value">
285         /// <para>The value.</para>
286         /// <para></para>
287         /// </param>
288         /// <returns>
289         /// <para>The link</para>
290         /// <para></para>
291         /// </returns>
```

```
292         [MethodImpl(MethodImplOptions.AggressiveInlining)]
293         protected virtual TLink GetSizeValue(TLink value) => Bit<TLink>.PartialRead(value, 5,
            ↪  -5);
294
295         /// <summary>
296         /// <para>
297         /// Sets the size value using the specified stored value.
298         /// </para>
299         /// <para></para>
300         /// </summary>
301         /// <param name="storedValue">
302         /// <para>The stored value.</para>
303         /// <para></para>
304         /// </param>
305         /// <param name="size">
306         /// <para>The size.</para>
307         /// <para></para>
308         /// </param>
309         [MethodImpl(MethodImplOptions.AggressiveInlining)]
310         protected virtual void SetSizeValue(ref TLink storedValue, TLink size) => storedValue =
            ↪  Bit<TLink>.PartialWrite(storedValue, size, 5, -5);
311
312         /// <summary>
313         /// <para>
314         /// Determines whether this instance get left is child value.
315         /// </para>
316         /// <para></para>
317         /// </summary>
318         /// <param name="value">
319         /// <para>The value.</para>
320         /// <para></para>
321         /// </param>
322         /// <returns>
323         /// <para>The bool</para>
324         /// <para></para>
325         /// </returns>
326         [MethodImpl(MethodImplOptions.AggressiveInlining)]
327         protected virtual bool GetLeftIsChildValue(TLink value)
328         {
329             unchecked
330             {
331                 return _addressToBoolConverter.Convert(Bit<TLink>.PartialRead(value, 4, 1));
332                 //return !EqualityComparer.Equals(Bit<TLink>.PartialRead(value, 4, 1), default);
333             }
334         }
335
336         /// <summary>
337         /// <para>
338         /// Sets the left is child value using the specified stored value.
339         /// </para>
340         /// <para></para>
341         /// </summary>
342         /// <param name="storedValue">
343         /// <para>The stored value.</para>
344         /// <para></para>
345         /// </param>
346         /// <param name="value">
347         /// <para>The value.</para>
348         /// <para></para>
349         /// </param>
350         [MethodImpl(MethodImplOptions.AggressiveInlining)]
351         protected virtual void SetLeftIsChildValue(ref TLink storedValue, bool value)
352         {
353             unchecked
354             {
355                 var previousValue = storedValue;
356                 var modified = Bit<TLink>.PartialWrite(previousValue,
                    ↪  _boolToAddressConverter.Convert(value), 4, 1);
357                 storedValue = modified;
358             }
359         }
360
361         /// <summary>
362         /// <para>
363         /// Determines whether this instance get right is child value.
364         /// </para>
365         /// <para></para>
366         /// </summary>
```

```
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual bool GetRightIsChildValue(TLink value)
        {
            unchecked
            {
                return _addressToBoolConverter.Convert(Bit<TLink>.PartialRead(value, 3, 1));
                //return !EqualityComparer.Equals(Bit<TLink>.PartialRead(value, 3, 1), default);
            }
        }

        /// <summary>
        /// <para>
        /// Sets the right is child value using the specified stored value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="storedValue">
        /// <para>The stored value.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual void SetRightIsChildValue(ref TLink storedValue, bool value)
        {
            unchecked
            {
                var previousValue = storedValue;
                var modified = Bit<TLink>.PartialWrite(previousValue,
                ↪  _boolToAddressConverter.Convert(value), 3, 1);
                storedValue = modified;
            }
        }

        /// <summary>
        /// <para>
        /// Determines whether this instance is child.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="parent">
        /// <para>The parent.</para>
        /// <para></para>
        /// </param>
        /// <param name="possibleChild">
        /// <para>The possible child.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected bool IsChild(TLink parent, TLink possibleChild)
        {
            var parentSize = GetSize(parent);
            var childSize = GetSizeOrZero(possibleChild);
            return GreaterThanZero(childSize) && LessOrEqualThan(childSize, parentSize);
        }

        /// <summary>
        /// <para>
        /// Gets the balance value using the specified stored value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="storedValue">
        /// <para>The stored value.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The sbyte</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual sbyte GetBalanceValue(TLink storedValue)
        {
            unchecked
            {
                var value = _addressToInt32Converter.Convert(Bit<TLink>.PartialRead(storedValue,
                ↪  0, 3));
                value |= 0xF8 * ((value & 4) >> 2); // if negative, then continue ones to the
                ↪  end of sbyte
                return (sbyte)value;
            }
        }

        /// <summary>
        /// <para>
        /// Sets the balance value using the specified stored value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="storedValue">
        /// <para>The stored value.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual void SetBalanceValue(ref TLink storedValue, sbyte value)
        {
            unchecked
            {
                var packagedValue = _int32ToAddressConverter.Convert((byte)value >> 5 & 4 |
                ↪  value & 3);
                var modified = Bit<TLink>.PartialWrite(storedValue, packagedValue, 0, 3);
                storedValue = modified;
            }
        }

        /// <summary>
        /// <para>
        /// The zero.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink this[TLink index]
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get
            {
                var root = GetTreeRoot();
                if (GreaterOrEqualThan(index, GetSize(root)))
                {
                    return Zero;
                }
                while (!EqualToZero(root))
                {
                    var left = GetLeftOrDefault(root);
                    var leftSize = GetSizeOrZero(left);
                    if (LessThan(index, leftSize))
                    {
                        root = left;
                        continue;
                    }
                    if (AreEqual(index, leftSize))
                    {
                        return root;
                    }
                    root = GetRightOrDefault(root);
                    index = Subtract(index, Increment(leftSize));
                }
```

```
518                 return Zero; // TODO: Impossible situation exception (only if tree structure
                    ↪ broken)
519             }
520         }
521 
522         /// <summary>
523         /// Выполняет поиск и возвращает индекс связи с указанными Source (началом) и Target
                ↪ (концом).
524         /// </summary>
525         /// <param name="source">Индекс связи, которая является началом на искомой связи.</param>
526         /// <param name="target">Индекс связи, которая является концом на искомой связи.</param>
527         /// <returns>Индекс искомой связи.</returns>
528         [MethodImpl(MethodImplOptions.AggressiveInlining)]
529         public TLink Search(TLink source, TLink target)
530         {
531             var root = GetTreeRoot();
532             while (!EqualToZero(root))
533             {
534                 ref var rootLink = ref GetLinkReference(root);
535                 var rootSource = rootLink.Source;
536                 var rootTarget = rootLink.Target;
537                 if (FirstIsToTheLeftOfSecond(source, target, rootSource, rootTarget)) //
                        ↪ node.Key < root.Key
538                 {
539                     root = GetLeftOrDefault(root);
540                 }
541                 else if (FirstIsToTheRightOfSecond(source, target, rootSource, rootTarget)) //
                        ↪ node.Key > root.Key
542                 {
543                     root = GetRightOrDefault(root);
544                 }
545                 else // node.Key == root.Key
546                 {
547                     return root;
548                 }
549             }
550             return Zero;
551         }
552 
553         // TODO: Return indices range instead of references count
554         /// <summary>
555         /// <para>
556         /// Counts the usages using the specified link.
557         /// </para>
558         /// <para></para>
559         /// </summary>
560         /// <param name="link">
561         /// <para>The link.</para>
562         /// <para></para>
563         /// </param>
564         /// <returns>
565         /// <para>The link</para>
566         /// <para></para>
567         /// </returns>
568         [MethodImpl(MethodImplOptions.AggressiveInlining)]
569         public TLink CountUsages(TLink link)
570         {
571             var root = GetTreeRoot();
572             var total = GetSize(root);
573             var totalRightIgnore = Zero;
574             while (!EqualToZero(root))
575             {
576                 var @base = GetBasePartValue(root);
577                 if (LessOrEqualThan(@base, link))
578                 {
579                     root = GetRightOrDefault(root);
580                 }
581                 else
582                 {
583                     totalRightIgnore = Add(totalRightIgnore, Increment(GetRightSize(root)));
584                     root = GetLeftOrDefault(root);
585                 }
586             }
587             root = GetTreeRoot();
588             var totalLeftIgnore = Zero;
589             while (!EqualToZero(root))
590             {
591                 var @base = GetBasePartValue(root);
```

```
                if (GreaterOrEqualThan(@base, link))
                {
                    root = GetLeftOrDefault(root);
                }
                else
                {
                    totalLeftIgnore = Add(totalLeftIgnore, Increment(GetLeftSize(root)));

                    root = GetRightOrDefault(root);
                }
            }
            return Subtract(Subtract(total, totalRightIgnore), totalLeftIgnore);
        }

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The continue.</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink EachUsage(TLink link, ReadHandler<TLink>? handler)
        {
            var root = GetTreeRoot();
            if (EqualToZero(root))
            {
                return Continue;
            }
            TLink first = Zero, current = root;
            while (!EqualToZero(current))
            {
                var @base = GetBasePartValue(current);
                if (GreaterOrEqualThan(@base, link))
                {
                    if (AreEqual(@base, link))
                    {
                        first = current;
                    }
                    current = GetLeftOrDefault(current);
                }
                else
                {
                    current = GetRightOrDefault(current);
                }
            }
            if (!EqualToZero(first))
            {
                current = first;
                while (true)
                {
                    if (AreEqual(handler(GetLinkValues(current)), Break))
                    {
                        return Break;
                    }
                    current = GetNext(current);
                    if (EqualToZero(current) || !AreEqual(GetBasePartValue(current), link))
                    {
                        break;
                    }
                }
            }
            return Continue;
        }

        /// <summary>
        /// <para>
        /// Prints the node value using the specified node.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="sb">
        /// <para>The sb.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void PrintNodeValue(TLink node, StringBuilder sb)
        {
            ref var link = ref GetLinkReference(node);
            sb.Append(' ');
            sb.Append(link.Source);
            sb.Append('-');
            sb.Append('>');
            sb.Append(link.Target);
        }
    }
}
```

1.81 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksRecursionlessSizeBalancedTreeMethodsBase

```
using System;
using System.Text;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Collections.Methods.Trees;
using Platform.Converters;
using Platform.Delegates;
using static System.Runtime.CompilerServices.Unsafe;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Generic
{
    /// <summary>
    /// <para>
    /// Represents the links recursionless size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="RecursionlessSizeBalancedTreeMethods{TLink}"/>
    /// <seealso cref="ILinksTreeMethods{TLink}"/>
    public unsafe abstract class LinksRecursionlessSizeBalancedTreeMethodsBase<TLink> :
    ↪  RecursionlessSizeBalancedTreeMethods<TLink>, ILinksTreeMethods<TLink>
    {
        private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
        ↪  UncheckedConverter<TLink, long>.Default;

        /// <summary>
        /// <para>
        /// The break.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Break;
        /// <summary>
        /// <para>
        /// The continue.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Continue;
        /// <summary>
        /// <para>
        /// The links.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* Links;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
53          protected readonly byte* Header;
54
55          /// <summary>
56          /// <para>
57          /// Initializes a new <see cref="LinksRecursionlessSizeBalancedTreeMethodsBase"/>
            ↪  instance.
58          /// </para>
59          /// <para></para>
60          /// </summary>
61          /// <param name="constants">
62          /// <para>A constants.</para>
63          /// <para></para>
64          /// </param>
65          /// <param name="links">
66          /// <para>A links.</para>
67          /// <para></para>
68          /// </param>
69          /// <param name="header">
70          /// <para>A header.</para>
71          /// <para></para>
72          /// </param>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          protected LinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<TLink> constants,
            ↪  byte* links, byte* header)
75          {
76              Links = links;
77              Header = header;
78              Break = constants.Break;
79              Continue = constants.Continue;
80          }
81
82          /// <summary>
83          /// <para>
84          /// Gets the tree root.
85          /// </para>
86          /// <para></para>
87          /// </summary>
88          /// <returns>
89          /// <para>The link</para>
90          /// <para></para>
91          /// </returns>
92          [MethodImpl(MethodImplOptions.AggressiveInlining)]
93          protected abstract TLink GetTreeRoot();
94
95          /// <summary>
96          /// <para>
97          /// Gets the base part value using the specified link.
98          /// </para>
99          /// <para></para>
100         /// </summary>
101         /// <param name="link">
102         /// <para>The link.</para>
103         /// <para></para>
104         /// </param>
105         /// <returns>
106         /// <para>The link</para>
107         /// <para></para>
108         /// </returns>
109         [MethodImpl(MethodImplOptions.AggressiveInlining)]
110         protected abstract TLink GetBasePartValue(TLink link);
111
112         /// <summary>
113         /// <para>
114         /// Determines whether this instance first is to the right of second.
115         /// </para>
116         /// <para></para>
117         /// </summary>
118         /// <param name="source">
119         /// <para>The source.</para>
120         /// <para></para>
121         /// </param>
122         /// <param name="target">
123         /// <para>The target.</para>
124         /// <para></para>
125         /// </param>
126         /// <param name="rootSource">
127         /// <para>The root source.</para>
128         /// <para></para>
```

```
        /// </param>
        /// <param name="rootTarget">
        /// <para>The root target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract bool FirstIsToTheRightOfSecond(TLink source, TLink target, TLink
        ↪  rootSource, TLink rootTarget);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="source">
        /// <para>The source.</para>
        /// <para></para>
        /// </param>
        /// <param name="target">
        /// <para>The target.</para>
        /// <para></para>
        /// </param>
        /// <param name="rootSource">
        /// <para>The root source.</para>
        /// <para></para>
        /// </param>
        /// <param name="rootTarget">
        /// <para>The root target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract bool FirstIsToTheLeftOfSecond(TLink source, TLink target, TLink
        ↪  rootSource, TLink rootTarget);

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref LinksHeader<TLink> GetHeaderReference() => ref
        ↪  AsRef<LinksHeader<TLink>>(Header);

        /// <summary>
        /// <para>
        /// Gets the link reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual ref RawLink<TLink> GetLinkReference(TLink link) => ref
        ↪  AsRef<RawLink<TLink>>(Links + (RawLink<TLink>.SizeInBytes *
        ↪  _addressToInt64Converter.Convert(link)));

        /// <summary>
```

```
        /// <para>
        /// Gets the link values using the specified link index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A list of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual IList<TLink>? GetLinkValues(TLink linkIndex)
        {
            ref var link = ref GetLinkReference(linkIndex);
            return new Link<TLink>(linkIndex, link.Source, link.Target);
        }

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
        {
            ref var firstLink = ref GetLinkReference(first);
            ref var secondLink = ref GetLinkReference(second);
            return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
        {
            ref var firstLink = ref GetLinkReference(first);
            ref var secondLink = ref GetLinkReference(second);
            return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// The zero.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        public TLink this[TLink index]
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get
            {
                var root = GetTreeRoot();
                if (GreaterOrEqualThan(index, GetSize(root)))
                {
                    return Zero;
                }
                while (!EqualToZero(root))
                {
                    var left = GetLeftOrDefault(root);
                    var leftSize = GetSizeOrZero(left);
                    if (LessThan(index, leftSize))
                    {
                        root = left;
                        continue;
                    }
                    if (AreEqual(index, leftSize))
                    {
                        return root;
                    }
                    root = GetRightOrDefault(root);
                    index = Subtract(index, Increment(leftSize));
                }
                return Zero; // TODO: Impossible situation exception (only if tree structure
                ↪  broken)
            }
        }

        /// <summary>
        /// Выполняет поиск и возвращает индекс связи с указанными Source (началом) и Target
        ↪  (концом).
        /// </summary>
        /// <param name="source">Индекс связи, которая является началом на искомой связи.</param>
        /// <param name="target">Индекс связи, которая является концом на искомой связи.</param>
        /// <returns>Индекс искомой связи.</returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink Search(TLink source, TLink target)
        {
            var root = GetTreeRoot();
            while (!EqualToZero(root))
            {
                ref var rootLink = ref GetLinkReference(root);
                var rootSource = rootLink.Source;
                var rootTarget = rootLink.Target;
                if (FirstIsToTheLeftOfSecond(source, target, rootSource, rootTarget)) //
                ↪  node.Key < root.Key
                {
                    root = GetLeftOrDefault(root);
                }
                else if (FirstIsToTheRightOfSecond(source, target, rootSource, rootTarget)) //
                ↪  node.Key > root.Key
                {
                    root = GetRightOrDefault(root);
                }
                else // node.Key == root.Key
                {
                    return root;
                }
            }
            return Zero;
        }

        // TODO: Return indices range instead of references count
        /// <summary>
        /// <para>
        /// Counts the usages using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
```

```
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink CountUsages(TLink link)
        {
            var root = GetTreeRoot();
            var total = GetSize(root);
            var totalRightIgnore = Zero;
            while (!EqualToZero(root))
            {
                var @base = GetBasePartValue(root);
                if (LessOrEqualThan(@base, link))
                {
                    root = GetRightOrDefault(root);
                }
                else
                {
                    totalRightIgnore = Add(totalRightIgnore, Increment(GetRightSize(root)));
                    root = GetLeftOrDefault(root);
                }
            }
            root = GetTreeRoot();
            var totalLeftIgnore = Zero;
            while (!EqualToZero(root))
            {
                var @base = GetBasePartValue(root);
                if (GreaterOrEqualThan(@base, link))
                {
                    root = GetLeftOrDefault(root);
                }
                else
                {
                    totalLeftIgnore = Add(totalLeftIgnore, Increment(GetLeftSize(root)));
                    root = GetRightOrDefault(root);
                }
            }
            return Subtract(Subtract(total, totalRightIgnore), totalLeftIgnore);
        }

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified base.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="@base">
        /// <para>The base.</para>
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink EachUsage(TLink @base, ReadHandler<TLink>? handler) => EachUsageCore(@base,
        ↪  GetTreeRoot(), handler);

        // TODO: 1. Move target, handler to separate object. 2. Use stack or walker 3. Use
        ↪  low-level MSIL stack.
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink EachUsageCore(TLink @base, TLink link, ReadHandler<TLink>? handler)
        {
            var @continue = Continue;
            if (EqualToZero(link))
            {
                return @continue;
            }
            var linkBasePart = GetBasePartValue(link);
            var @break = Break;
            if (GreaterThan(linkBasePart, @base))
            {
                if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
```

```
                {
                    return @break;
                }
            }
            else if (LessThan(linkBasePart, @base))
            {
                if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            else //if (linkBasePart == @base)
            {
                if (AreEqual(handler(GetLinkValues(link)), @break))
                {
                    return @break;
                }
                if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
                {
                    return @break;
                }
                if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            return @continue;
        }

        /// <summary>
        /// <para>
        /// Prints the node value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="sb">
        /// <para>The sb.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void PrintNodeValue(TLink node, StringBuilder sb)
        {
            ref var link = ref GetLinkReference(node);
            sb.Append(' ');
            sb.Append(link.Source);
            sb.Append('-');
            sb.Append('>');
            sb.Append(link.Target);
        }
    }
}
```

1.82 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksSizeBalancedTreeMethodsBase.cs

```
using System;
using System.Text;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Collections.Methods.Trees;
using Platform.Converters;
using Platform.Delegates;
using static System.Runtime.CompilerServices.Unsafe;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Generic
{
    /// <summary>
    /// <para>
    /// Represents the links size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="SizeBalancedTreeMethods{TLink}"/>
    /// <seealso cref="ILinksTreeMethods{TLink}"/>
    public unsafe abstract class LinksSizeBalancedTreeMethodsBase<TLink> :
    ↪ SizeBalancedTreeMethods<TLink>, ILinksTreeMethods<TLink>
```

```
    {
        private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
        ↪  UncheckedConverter<TLink, long>.Default;

        /// <summary>
        /// <para>
        /// The break.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Break;
        /// <summary>
        /// <para>
        /// The continue.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly TLink Continue;
        /// <summary>
        /// <para>
        /// The links.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* Links;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly byte* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksSizeBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected LinksSizeBalancedTreeMethodsBase(LinksConstants<TLink> constants, byte* links,
        ↪  byte* header)
        {
            Links = links;
            Header = header;
            Break = constants.Break;
            Continue = constants.Continue;
        }

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected abstract TLink GetTreeRoot();

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
```

```
100         /// </summary>
101         /// <param name="link">
102         /// <para>The link.</para>
103         /// <para></para>
104         /// </param>
105         /// <returns>
106         /// <para>The link</para>
107         /// <para></para>
108         /// </returns>
109         [MethodImpl(MethodImplOptions.AggressiveInlining)]
110         protected abstract TLink GetBasePartValue(TLink link);
111
112         /// <summary>
113         /// <para>
114         /// Determines whether this instance first is to the right of second.
115         /// </para>
116         /// <para></para>
117         /// </summary>
118         /// <param name="source">
119         /// <para>The source.</para>
120         /// <para></para>
121         /// </param>
122         /// <param name="target">
123         /// <para>The target.</para>
124         /// <para></para>
125         /// </param>
126         /// <param name="rootSource">
127         /// <para>The root source.</para>
128         /// <para></para>
129         /// </param>
130         /// <param name="rootTarget">
131         /// <para>The root target.</para>
132         /// <para></para>
133         /// </param>
134         /// <returns>
135         /// <para>The bool</para>
136         /// <para></para>
137         /// </returns>
138         [MethodImpl(MethodImplOptions.AggressiveInlining)]
139         protected abstract bool FirstIsToTheRightOfSecond(TLink source, TLink target, TLink
          ↪  rootSource, TLink rootTarget);
140
141         /// <summary>
142         /// <para>
143         /// Determines whether this instance first is to the left of second.
144         /// </para>
145         /// <para></para>
146         /// </summary>
147         /// <param name="source">
148         /// <para>The source.</para>
149         /// <para></para>
150         /// </param>
151         /// <param name="target">
152         /// <para>The target.</para>
153         /// <para></para>
154         /// </param>
155         /// <param name="rootSource">
156         /// <para>The root source.</para>
157         /// <para></para>
158         /// </param>
159         /// <param name="rootTarget">
160         /// <para>The root target.</para>
161         /// <para></para>
162         /// </param>
163         /// <returns>
164         /// <para>The bool</para>
165         /// <para></para>
166         /// </returns>
167         [MethodImpl(MethodImplOptions.AggressiveInlining)]
168         protected abstract bool FirstIsToTheLeftOfSecond(TLink source, TLink target, TLink
          ↪  rootSource, TLink rootTarget);
169
170         /// <summary>
171         /// <para>
172         /// Gets the header reference.
173         /// </para>
174         /// <para></para>
175         /// </summary>
```

```
176             /// <returns>
177             /// <para>A ref links header of t link</para>
178             /// <para></para>
179             /// </returns>
180             [MethodImpl(MethodImplOptions.AggressiveInlining)]
181             protected virtual ref LinksHeader<TLink> GetHeaderReference() => ref
                ↪  AsRef<LinksHeader<TLink>>(Header);
182
183             /// <summary>
184             /// <para>
185             /// Gets the link reference using the specified link.
186             /// </para>
187             /// <para></para>
188             /// </summary>
189             /// <param name="link">
190             /// <para>The link.</para>
191             /// <para></para>
192             /// </param>
193             /// <returns>
194             /// <para>A ref raw link of t link</para>
195             /// <para></para>
196             /// </returns>
197             [MethodImpl(MethodImplOptions.AggressiveInlining)]
198             protected virtual ref RawLink<TLink> GetLinkReference(TLink link) => ref
                ↪  AsRef<RawLink<TLink>>(Links + (RawLink<TLink>.SizeInBytes *
                ↪  _addressToInt64Converter.Convert(link)));
199
200             /// <summary>
201             /// <para>
202             /// Gets the link values using the specified link index.
203             /// </para>
204             /// <para></para>
205             /// </summary>
206             /// <param name="linkIndex">
207             /// <para>The link index.</para>
208             /// <para></para>
209             /// </param>
210             /// <returns>
211             /// <para>A list of t link</para>
212             /// <para></para>
213             /// </returns>
214             [MethodImpl(MethodImplOptions.AggressiveInlining)]
215             protected virtual IList<TLink>? GetLinkValues(TLink linkIndex)
216             {
217                 ref var link = ref GetLinkReference(linkIndex);
218                 return new Link<TLink>(linkIndex, link.Source, link.Target);
219             }
220
221             /// <summary>
222             /// <para>
223             /// Determines whether this instance first is to the left of second.
224             /// </para>
225             /// <para></para>
226             /// </summary>
227             /// <param name="first">
228             /// <para>The first.</para>
229             /// <para></para>
230             /// </param>
231             /// <param name="second">
232             /// <para>The second.</para>
233             /// <para></para>
234             /// </param>
235             /// <returns>
236             /// <para>The bool</para>
237             /// <para></para>
238             /// </returns>
239             [MethodImpl(MethodImplOptions.AggressiveInlining)]
240             protected override bool FirstIsToTheLeftOfSecond(TLink first, TLink second)
241             {
242                 ref var firstLink = ref GetLinkReference(first);
243                 ref var secondLink = ref GetLinkReference(second);
244                 return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                    ↪  secondLink.Source, secondLink.Target);
245             }
246
247             /// <summary>
248             /// <para>
249             /// Determines whether this instance first is to the right of second.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink first, TLink second)
        {
            ref var firstLink = ref GetLinkReference(first);
            ref var secondLink = ref GetLinkReference(second);
            return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
             ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// The zero.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink this[TLink index]
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get
            {
                var root = GetTreeRoot();
                if (GreaterOrEqualThan(index, GetSize(root)))
                {
                    return Zero;
                }
                while (!EqualToZero(root))
                {
                    var left = GetLeftOrDefault(root);
                    var leftSize = GetSizeOrZero(left);
                    if (LessThan(index, leftSize))
                    {
                        root = left;
                        continue;
                    }
                    if (AreEqual(index, leftSize))
                    {
                        return root;
                    }
                    root = GetRightOrDefault(root);
                    index = Subtract(index, Increment(leftSize));
                }
                return Zero; // TODO: Impossible situation exception (only if tree structure
                 ↪  broken)
            }
        }

        /// <summary>
        /// Выполняет поиск и возвращает индекс связи с указанными Source (началом) и Target
         ↪  (концом).
        /// </summary>
        /// <param name="source">Индекс связи, которая является началом на искомой связи.</param>
        /// <param name="target">Индекс связи, которая является концом на искомой связи.</param>
        /// <returns>Индекс искомой связи.</returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink Search(TLink source, TLink target)
        {
            var root = GetTreeRoot();
            while (!EqualToZero(root))
            {
                ref var rootLink = ref GetLinkReference(root);
                var rootSource = rootLink.Source;
                var rootTarget = rootLink.Target;
```

```
                if (FirstIsToTheLeftOfSecond(source, target, rootSource, rootTarget)) //
                ↪  node.Key < root.Key
                {
                    root = GetLeftOrDefault(root);
                }
                else if (FirstIsToTheRightOfSecond(source, target, rootSource, rootTarget)) //
                ↪  node.Key > root.Key
                {
                    root = GetRightOrDefault(root);
                }
                else // node.Key == root.Key
                {
                    return root;
                }
            }
            return Zero;
        }

        // TODO: Return indices range instead of references count
        /// <summary>
        /// <para>
        /// Counts the usages using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink CountUsages(TLink link)
        {
            var root = GetTreeRoot();
            var total = GetSize(root);
            var totalRightIgnore = Zero;
            while (!EqualToZero(root))
            {
                var @base = GetBasePartValue(root);
                if (LessOrEqualThan(@base, link))
                {
                    root = GetRightOrDefault(root);
                }
                else
                {
                    totalRightIgnore = Add(totalRightIgnore, Increment(GetRightSize(root)));
                    root = GetLeftOrDefault(root);
                }
            }
            root = GetTreeRoot();
            var totalLeftIgnore = Zero;
            while (!EqualToZero(root))
            {
                var @base = GetBasePartValue(root);
                if (GreaterOrEqualThan(@base, link))
                {
                    root = GetLeftOrDefault(root);
                }
                else
                {
                    totalLeftIgnore = Add(totalLeftIgnore, Increment(GetLeftSize(root)));
                    root = GetRightOrDefault(root);
                }
            }
            return Subtract(Subtract(total, totalRightIgnore), totalLeftIgnore);
        }

        /// <summary>
        /// <para>
        /// Eaches the usage using the specified base.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="@base">
        /// <para>The base.</para>
```

```
        /// <para></para>
        /// </param>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink EachUsage(TLink @base, ReadHandler<TLink>? handler) => EachUsageCore(@base,
        ↪  GetTreeRoot(), handler);

        // TODO: 1. Move target, handler to separate object. 2. Use stack or walker 3. Use
        ↪  low-level MSIL stack.
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink EachUsageCore(TLink @base, TLink link, ReadHandler<TLink>? handler)
        {
            var @continue = Continue;
            if (EqualToZero(link))
            {
                return @continue;
            }
            var linkBasePart = GetBasePartValue(link);
            var @break = Break;
            if (GreaterThan(linkBasePart, @base))
            {
                if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            else if (LessThan(linkBasePart, @base))
            {
                if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            else //if (linkBasePart == @base)
            {
                if (AreEqual(handler(GetLinkValues(link)), @break))
                {
                    return @break;
                }
                if (AreEqual(EachUsageCore(@base, GetLeftOrDefault(link), handler), @break))
                {
                    return @break;
                }
                if (AreEqual(EachUsageCore(@base, GetRightOrDefault(link), handler), @break))
                {
                    return @break;
                }
            }
            return @continue;
        }

        /// <summary>
        /// <para>
        /// Prints the node value using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="sb">
        /// <para>The sb.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void PrintNodeValue(TLink node, StringBuilder sb)
        {
            ref var link = ref GetLinkReference(node);
            sb.Append(' ');
            sb.Append(link.Source);
```

```
            sb.Append('-');
            sb.Append('>');
            sb.Append(link.Target);
        }
    }
}
```

1.83 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksSourcesAvlBalancedTreeMethods.cs

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Generic
{
    /// <summary>
    /// <para>
    /// Represents the links sources avl balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksAvlBalancedTreeMethodsBase{TLink}"/>
    public unsafe class LinksSourcesAvlBalancedTreeMethods<TLink> :
    ↪ LinksAvlBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksSourcesAvlBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksSourcesAvlBalancedTreeMethods(LinksConstants<TLink> constants, byte* links,
        ↪ byte* header) : base(constants, links, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪ GetLinkReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
```

```
68          [MethodImpl(MethodImplOptions.AggressiveInlining)]
69          protected override ref TLink GetRightReference(TLink node) => ref
            ↪ GetLinkReference(node).RightAsSource;
70
71          /// <summary>
72          /// <para>
73          /// Gets the left using the specified node.
74          /// </para>
75          /// <para></para>
76          /// </summary>
77          /// <param name="node">
78          /// <para>The node.</para>
79          /// <para></para>
80          /// </param>
81          /// <returns>
82          /// <para>The link</para>
83          /// <para></para>
84          /// </returns>
85          [MethodImpl(MethodImplOptions.AggressiveInlining)]
86          protected override TLink GetLeft(TLink node) => GetLinkReference(node).LeftAsSource;
87
88          /// <summary>
89          /// <para>
90          /// Gets the right using the specified node.
91          /// </para>
92          /// <para></para>
93          /// </summary>
94          /// <param name="node">
95          /// <para>The node.</para>
96          /// <para></para>
97          /// </param>
98          /// <returns>
99          /// <para>The link</para>
100         /// <para></para>
101         /// </returns>
102         [MethodImpl(MethodImplOptions.AggressiveInlining)]
103         protected override TLink GetRight(TLink node) => GetLinkReference(node).RightAsSource;
104
105         /// <summary>
106         /// <para>
107         /// Sets the left using the specified node.
108         /// </para>
109         /// <para></para>
110         /// </summary>
111         /// <param name="node">
112         /// <para>The node.</para>
113         /// <para></para>
114         /// </param>
115         /// <param name="left">
116         /// <para>The left.</para>
117         /// <para></para>
118         /// </param>
119         [MethodImpl(MethodImplOptions.AggressiveInlining)]
120         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkReference(node).LeftAsSource = left;
121
122         /// <summary>
123         /// <para>
124         /// Sets the right using the specified node.
125         /// </para>
126         /// <para></para>
127         /// </summary>
128         /// <param name="node">
129         /// <para>The node.</para>
130         /// <para></para>
131         /// </param>
132         /// <param name="right">
133         /// <para>The right.</para>
134         /// <para></para>
135         /// </param>
136         [MethodImpl(MethodImplOptions.AggressiveInlining)]
137         protected override void SetRight(TLink node, TLink right) =>
            ↪ GetLinkReference(node).RightAsSource = right;
138
139         /// <summary>
140         /// <para>
141         /// Gets the size using the specified node.
142         /// </para>
```

```
143             /// <para></para>
144             /// </summary>
145             /// <param name="node">
146             /// <para>The node.</para>
147             /// <para></para>
148             /// </param>
149             /// <returns>
150             /// <para>The link</para>
151             /// <para></para>
152             /// </returns>
153             [MethodImpl(MethodImplOptions.AggressiveInlining)]
154             protected override TLink GetSize(TLink node) =>
                ↪  GetSizeValue(GetLinkReference(node).SizeAsSource);
155
156             /// <summary>
157             /// <para>
158             /// Sets the size using the specified node.
159             /// </para>
160             /// <para></para>
161             /// </summary>
162             /// <param name="node">
163             /// <para>The node.</para>
164             /// <para></para>
165             /// </param>
166             /// <param name="size">
167             /// <para>The size.</para>
168             /// <para></para>
169             /// </param>
170             [MethodImpl(MethodImplOptions.AggressiveInlining)]
171             protected override void SetSize(TLink node, TLink size) => SetSizeValue(ref
                ↪  GetLinkReference(node).SizeAsSource, size);
172
173             /// <summary>
174             /// <para>
175             /// Determines whether this instance get left is child.
176             /// </para>
177             /// <para></para>
178             /// </summary>
179             /// <param name="node">
180             /// <para>The node.</para>
181             /// <para></para>
182             /// </param>
183             /// <returns>
184             /// <para>The bool</para>
185             /// <para></para>
186             /// </returns>
187             [MethodImpl(MethodImplOptions.AggressiveInlining)]
188             protected override bool GetLeftIsChild(TLink node) =>
                ↪  GetLeftIsChildValue(GetLinkReference(node).SizeAsSource);
189
190             /// <summary>
191             /// <para>
192             /// Sets the left is child using the specified node.
193             /// </para>
194             /// <para></para>
195             /// </summary>
196             /// <param name="node">
197             /// <para>The node.</para>
198             /// <para></para>
199             /// </param>
200             /// <param name="value">
201             /// <para>The value.</para>
202             /// <para></para>
203             /// </param>
204             [MethodImpl(MethodImplOptions.AggressiveInlining)]
205             protected override void SetLeftIsChild(TLink node, bool value) =>
                ↪  SetLeftIsChildValue(ref GetLinkReference(node).SizeAsSource, value);
206
207             /// <summary>
208             /// <para>
209             /// Determines whether this instance get right is child.
210             /// </para>
211             /// <para></para>
212             /// </summary>
213             /// <param name="node">
214             /// <para>The node.</para>
215             /// <para></para>
216             /// </param>
```

```
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GetRightIsChild(TLink node) =>
        ↪ GetRightIsChildValue(GetLinkReference(node).SizeAsSource);

        /// <summary>
        /// <para>
        /// Sets the right is child using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRightIsChild(TLink node, bool value) =>
        ↪ SetRightIsChildValue(ref GetLinkReference(node).SizeAsSource, value);

        /// <summary>
        /// <para>
        /// Gets the balance using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The sbyte</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override sbyte GetBalance(TLink node) =>
        ↪ GetBalanceValue(GetLinkReference(node).SizeAsSource);

        /// <summary>
        /// <para>
        /// Sets the balance using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetBalance(TLink node, sbyte value) => SetBalanceValue(ref
        ↪ GetLinkReference(node).SizeAsSource, value);

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => GetHeaderReference().RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink link) => GetLinkReference(link).Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => LessThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && LessThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => GreaterThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && GreaterThan(firstTarget, secondTarget));

        /// <summary>
```

```
364         /// <para>
365         /// Clears the node using the specified node.
366         /// </para>
367         /// <para></para>
368         /// </summary>
369         /// <param name="node">
370         /// <para>The node.</para>
371         /// <para></para>
372         /// </param>
373         [MethodImpl(MethodImplOptions.AggressiveInlining)]
374         protected override void ClearNode(TLink node)
375         {
376             ref var link = ref GetLinkReference(node);
377             link.LeftAsSource = Zero;
378             link.RightAsSource = Zero;
379             link.SizeAsSource = Zero;
380         }
381     }
382 }
```

1.84 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksSourcesRecursionlessSizeBalancedTreeMetho

```
1  using System.Runtime.CompilerServices;
2
3  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4
5  namespace Platform.Data.Doublets.Memory.United.Generic
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the links sources recursionless size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="LinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
14     public unsafe class LinksSourcesRecursionlessSizeBalancedTreeMethods<TLink> :
       ↪  LinksRecursionlessSizeBalancedTreeMethodsBase<TLink>
15     {
16         /// <summary>
17         /// <para>
18         /// Initializes a new <see cref="LinksSourcesRecursionlessSizeBalancedTreeMethods"/>
           ↪  instance.
19         /// </para>
20         /// <para></para>
21         /// </summary>
22         /// <param name="constants">
23         /// <para>A constants.</para>
24         /// <para></para>
25         /// </param>
26         /// <param name="links">
27         /// <para>A links.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="header">
31         /// <para>A header.</para>
32         /// <para></para>
33         /// </param>
34         [MethodImpl(MethodImplOptions.AggressiveInlining)]
35         public LinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink> constants,
           ↪  byte* links, byte* header) : base(constants, links, header) { }
36
37         /// <summary>
38         /// <para>
39         /// Gets the left reference using the specified node.
40         /// </para>
41         /// <para></para>
42         /// </summary>
43         /// <param name="node">
44         /// <para>The node.</para>
45         /// <para></para>
46         /// </param>
47         /// <returns>
48         /// <para>The ref link</para>
49         /// <para></para>
50         /// </returns>
51         [MethodImpl(MethodImplOptions.AggressiveInlining)]
52         protected override ref TLink GetLeftReference(TLink node) => ref
           ↪  GetLinkReference(node).LeftAsSource;
53
```

```
        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  GetLinkReference(node).RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => GetLinkReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => GetLinkReference(node).RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  GetLinkReference(node).LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
```

```
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  GetLinkReference(node).RightAsSource = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => GetLinkReference(node).SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  GetLinkReference(node).SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => GetHeaderReference().RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink link) => GetLinkReference(link).Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => LessThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && LessThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => GreaterThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && GreaterThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref GetLinkReference(node);
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }
    }
```

```
}
```

1.85 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksSourcesSizeBalancedTreeMethods.cs

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Generic
{
    /// <summary>
    /// <para>
    /// Represents the links sources size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksSizeBalancedTreeMethodsBase{TLink}"/>
    public unsafe class LinksSourcesSizeBalancedTreeMethods<TLink> :
    ↪ LinksSizeBalancedTreeMethodsBase<TLink>
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksSourcesSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksSourcesSizeBalancedTreeMethods(LinksConstants<TLink> constants, byte* links,
        ↪ byte* header) : base(constants, links, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪ GetLinkReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪ GetLinkReference(node).RightAsSource;

        /// <summary>
```

```
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => GetLinkReference(node).LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => GetLinkReference(node).RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  GetLinkReference(node).LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  GetLinkReference(node).RightAsSource = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
```

```
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => GetLinkReference(node).SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) =>
        ↪  GetLinkReference(node).SizeAsSource = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetTreeRoot() => GetHeaderReference().RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetBasePartValue(TLink link) => GetLinkReference(link).Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
```

```
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => LessThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && LessThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
        ↪  TLink secondSource, TLink secondTarget) => GreaterThan(firstSource, secondSource) ||
        ↪  (AreEqual(firstSource, secondSource) && GreaterThan(firstTarget, secondTarget));

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(TLink node)
        {
            ref var link = ref GetLinkReference(node);
            link.LeftAsSource = Zero;
            link.RightAsSource = Zero;
            link.SizeAsSource = Zero;
        }
    }
}
```

1.86 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksTargetsAvlBalancedTreeMethods.cs

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Generic
{
    /// <summary>
    /// <para>
    /// Represents the links targets avl balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksAvlBalancedTreeMethodsBase{TLink}"/>
    public unsafe class LinksTargetsAvlBalancedTreeMethods<TLink> :
    ↪  LinksAvlBalancedTreeMethodsBase<TLink>
    {
```

```
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="LinksTargetsAvlBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksTargetsAvlBalancedTreeMethods(LinksConstants<TLink> constants, byte* links,
        ↪  byte* header) : base(constants, links, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪  GetLinkReference(node).LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  GetLinkReference(node).RightAsTarget;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => GetLinkReference(node).LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
```

```
91          /// </para>
92          /// <para></para>
93          /// </summary>
94          /// <param name="node">
95          /// <para>The node.</para>
96          /// <para></para>
97          /// </param>
98          /// <returns>
99          /// <para>The link</para>
100         /// <para></para>
101         /// </returns>
102         [MethodImpl(MethodImplOptions.AggressiveInlining)]
103         protected override TLink GetRight(TLink node) => GetLinkReference(node).RightAsTarget;
104
105         /// <summary>
106         /// <para>
107         /// Sets the left using the specified node.
108         /// </para>
109         /// <para></para>
110         /// </summary>
111         /// <param name="node">
112         /// <para>The node.</para>
113         /// <para></para>
114         /// </param>
115         /// <param name="left">
116         /// <para>The left.</para>
117         /// <para></para>
118         /// </param>
119         [MethodImpl(MethodImplOptions.AggressiveInlining)]
120         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkReference(node).LeftAsTarget = left;
121
122         /// <summary>
123         /// <para>
124         /// Sets the right using the specified node.
125         /// </para>
126         /// <para></para>
127         /// </summary>
128         /// <param name="node">
129         /// <para>The node.</para>
130         /// <para></para>
131         /// </param>
132         /// <param name="right">
133         /// <para>The right.</para>
134         /// <para></para>
135         /// </param>
136         [MethodImpl(MethodImplOptions.AggressiveInlining)]
137         protected override void SetRight(TLink node, TLink right) =>
            ↪ GetLinkReference(node).RightAsTarget = right;
138
139         /// <summary>
140         /// <para>
141         /// Gets the size using the specified node.
142         /// </para>
143         /// <para></para>
144         /// </summary>
145         /// <param name="node">
146         /// <para>The node.</para>
147         /// <para></para>
148         /// </param>
149         /// <returns>
150         /// <para>The link</para>
151         /// <para></para>
152         /// </returns>
153         [MethodImpl(MethodImplOptions.AggressiveInlining)]
154         protected override TLink GetSize(TLink node) =>
            ↪ GetSizeValue(GetLinkReference(node).SizeAsTarget);
155
156         /// <summary>
157         /// <para>
158         /// Sets the size using the specified node.
159         /// </para>
160         /// <para></para>
161         /// </summary>
162         /// <param name="node">
163         /// <para>The node.</para>
164         /// <para></para>
165         /// </param>
```

```
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(TLink node, TLink size) => SetSizeValue(ref
        ↪  GetLinkReference(node).SizeAsTarget, size);

        /// <summary>
        /// <para>
        /// Determines whether this instance get left is child.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GetLeftIsChild(TLink node) =>
        ↪  GetLeftIsChildValue(GetLinkReference(node).SizeAsTarget);

        /// <summary>
        /// <para>
        /// Sets the left is child using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeftIsChild(TLink node, bool value) =>
        ↪  SetLeftIsChildValue(ref GetLinkReference(node).SizeAsTarget, value);

        /// <summary>
        /// <para>
        /// Determines whether this instance get right is child.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GetRightIsChild(TLink node) =>
        ↪  GetRightIsChildValue(GetLinkReference(node).SizeAsTarget);

        /// <summary>
        /// <para>
        /// Sets the right is child using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
239         protected override void SetRightIsChild(TLink node, bool value) =>
            ↪ SetRightIsChildValue(ref GetLinkReference(node).SizeAsTarget, value);
240
241         /// <summary>
242         /// <para>
243         /// Gets the balance using the specified node.
244         /// </para>
245         /// <para></para>
246         /// </summary>
247         /// <param name="node">
248         /// <para>The node.</para>
249         /// <para></para>
250         /// </param>
251         /// <returns>
252         /// <para>The sbyte</para>
253         /// <para></para>
254         /// </returns>
255         [MethodImpl(MethodImplOptions.AggressiveInlining)]
256         protected override sbyte GetBalance(TLink node) =>
            ↪ GetBalanceValue(GetLinkReference(node).SizeAsTarget);
257
258         /// <summary>
259         /// <para>
260         /// Sets the balance using the specified node.
261         /// </para>
262         /// <para></para>
263         /// </summary>
264         /// <param name="node">
265         /// <para>The node.</para>
266         /// <para></para>
267         /// </param>
268         /// <param name="value">
269         /// <para>The value.</para>
270         /// <para></para>
271         /// </param>
272         [MethodImpl(MethodImplOptions.AggressiveInlining)]
273         protected override void SetBalance(TLink node, sbyte value) => SetBalanceValue(ref
            ↪ GetLinkReference(node).SizeAsTarget, value);
274
275         /// <summary>
276         /// <para>
277         /// Gets the tree root.
278         /// </para>
279         /// <para></para>
280         /// </summary>
281         /// <returns>
282         /// <para>The link</para>
283         /// <para></para>
284         /// </returns>
285         [MethodImpl(MethodImplOptions.AggressiveInlining)]
286         protected override TLink GetTreeRoot() => GetHeaderReference().RootAsTarget;
287
288         /// <summary>
289         /// <para>
290         /// Gets the base part value using the specified link.
291         /// </para>
292         /// <para></para>
293         /// </summary>
294         /// <param name="link">
295         /// <para>The link.</para>
296         /// <para></para>
297         /// </param>
298         /// <returns>
299         /// <para>The link</para>
300         /// <para></para>
301         /// </returns>
302         [MethodImpl(MethodImplOptions.AggressiveInlining)]
303         protected override TLink GetBasePartValue(TLink link) => GetLinkReference(link).Target;
304
305         /// <summary>
306         /// <para>
307         /// Determines whether this instance first is to the left of second.
308         /// </para>
309         /// <para></para>
310         /// </summary>
311         /// <param name="firstSource">
312         /// <para>The first source.</para>
313         /// <para></para>
```

```
314             /// </param>
315             /// <param name="firstTarget">
316             /// <para>The first target.</para>
317             /// <para></para>
318             /// </param>
319             /// <param name="secondSource">
320             /// <para>The second source.</para>
321             /// <para></para>
322             /// </param>
323             /// <param name="secondTarget">
324             /// <para>The second target.</para>
325             /// <para></para>
326             /// </param>
327             /// <returns>
328             /// <para>The bool</para>
329             /// <para></para>
330             /// </returns>
331             [MethodImpl(MethodImplOptions.AggressiveInlining)]
332             protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
                ↪  TLink secondSource, TLink secondTarget) => LessThan(firstTarget, secondTarget) ||
                ↪  (AreEqual(firstTarget, secondTarget) && LessThan(firstSource, secondSource));
333
334             /// <summary>
335             /// <para>
336             /// Determines whether this instance first is to the right of second.
337             /// </para>
338             /// <para></para>
339             /// </summary>
340             /// <param name="firstSource">
341             /// <para>The first source.</para>
342             /// <para></para>
343             /// </param>
344             /// <param name="firstTarget">
345             /// <para>The first target.</para>
346             /// <para></para>
347             /// </param>
348             /// <param name="secondSource">
349             /// <para>The second source.</para>
350             /// <para></para>
351             /// </param>
352             /// <param name="secondTarget">
353             /// <para>The second target.</para>
354             /// <para></para>
355             /// </param>
356             /// <returns>
357             /// <para>The bool</para>
358             /// <para></para>
359             /// </returns>
360             [MethodImpl(MethodImplOptions.AggressiveInlining)]
361             protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
                ↪  TLink secondSource, TLink secondTarget) => GreaterThan(firstTarget, secondTarget) ||
                ↪  (AreEqual(firstTarget, secondTarget) && GreaterThan(firstSource, secondSource));
362
363             /// <summary>
364             /// <para>
365             /// Clears the node using the specified node.
366             /// </para>
367             /// <para></para>
368             /// </summary>
369             /// <param name="node">
370             /// <para>The node.</para>
371             /// <para></para>
372             /// </param>
373             [MethodImpl(MethodImplOptions.AggressiveInlining)]
374             protected override void ClearNode(TLink node)
375             {
376                 ref var link = ref GetLinkReference(node);
377                 link.LeftAsTarget = Zero;
378                 link.RightAsTarget = Zero;
379                 link.SizeAsTarget = Zero;
380             }
381         }
382     }
```

1.87 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksTargetsRecursionlessSizeBalancedTreeMetho

```
1   using System.Runtime.CompilerServices;
2
3   #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
```

```
4
5   namespace Platform.Data.Doublets.Memory.United.Generic
6   {
7       /// <summary>
8       /// <para>
9       /// Represents the links targets recursionless size balanced tree methods.
10      /// </para>
11      /// <para></para>
12      /// </summary>
13      /// <seealso cref="LinksRecursionlessSizeBalancedTreeMethodsBase{TLink}"/>
14      public unsafe class LinksTargetsRecursionlessSizeBalancedTreeMethods<TLink> :
        ↪  LinksRecursionlessSizeBalancedTreeMethodsBase<TLink>
15      {
16          /// <summary>
17          /// <para>
18          /// Initializes a new <see cref="LinksTargetsRecursionlessSizeBalancedTreeMethods"/>
            ↪  instance.
19          /// </para>
20          /// <para></para>
21          /// </summary>
22          /// <param name="constants">
23          /// <para>A constants.</para>
24          /// <para></para>
25          /// </param>
26          /// <param name="links">
27          /// <para>A links.</para>
28          /// <para></para>
29          /// </param>
30          /// <param name="header">
31          /// <para>A header.</para>
32          /// <para></para>
33          /// </param>
34          [MethodImpl(MethodImplOptions.AggressiveInlining)]
35          public LinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<TLink> constants,
            ↪  byte* links, byte* header) : base(constants, links, header) { }
36
37          /// <summary>
38          /// <para>
39          /// Gets the left reference using the specified node.
40          /// </para>
41          /// <para></para>
42          /// </summary>
43          /// <param name="node">
44          /// <para>The node.</para>
45          /// <para></para>
46          /// </param>
47          /// <returns>
48          /// <para>The ref link</para>
49          /// <para></para>
50          /// </returns>
51          [MethodImpl(MethodImplOptions.AggressiveInlining)]
52          protected override ref TLink GetLeftReference(TLink node) => ref
            ↪  GetLinkReference(node).LeftAsTarget;
53
54          /// <summary>
55          /// <para>
56          /// Gets the right reference using the specified node.
57          /// </para>
58          /// <para></para>
59          /// </summary>
60          /// <param name="node">
61          /// <para>The node.</para>
62          /// <para></para>
63          /// </param>
64          /// <returns>
65          /// <para>The ref link</para>
66          /// <para></para>
67          /// </returns>
68          [MethodImpl(MethodImplOptions.AggressiveInlining)]
69          protected override ref TLink GetRightReference(TLink node) => ref
            ↪  GetLinkReference(node).RightAsTarget;
70
71          /// <summary>
72          /// <para>
73          /// Gets the left using the specified node.
74          /// </para>
75          /// <para></para>
76          /// </summary>
```

```
77          /// <param name="node">
78          /// <para>The node.</para>
79          /// <para></para>
80          /// </param>
81          /// <returns>
82          /// <para>The link</para>
83          /// <para></para>
84          /// </returns>
85          [MethodImpl(MethodImplOptions.AggressiveInlining)]
86          protected override TLink GetLeft(TLink node) => GetLinkReference(node).LeftAsTarget;
87
88          /// <summary>
89          /// <para>
90          /// Gets the right using the specified node.
91          /// </para>
92          /// <para></para>
93          /// </summary>
94          /// <param name="node">
95          /// <para>The node.</para>
96          /// <para></para>
97          /// </param>
98          /// <returns>
99          /// <para>The link</para>
100         /// <para></para>
101         /// </returns>
102         [MethodImpl(MethodImplOptions.AggressiveInlining)]
103         protected override TLink GetRight(TLink node) => GetLinkReference(node).RightAsTarget;
104
105         /// <summary>
106         /// <para>
107         /// Sets the left using the specified node.
108         /// </para>
109         /// <para></para>
110         /// </summary>
111         /// <param name="node">
112         /// <para>The node.</para>
113         /// <para></para>
114         /// </param>
115         /// <param name="left">
116         /// <para>The left.</para>
117         /// <para></para>
118         /// </param>
119         [MethodImpl(MethodImplOptions.AggressiveInlining)]
120         protected override void SetLeft(TLink node, TLink left) =>
            ↪ GetLinkReference(node).LeftAsTarget = left;
121
122         /// <summary>
123         /// <para>
124         /// Sets the right using the specified node.
125         /// </para>
126         /// <para></para>
127         /// </summary>
128         /// <param name="node">
129         /// <para>The node.</para>
130         /// <para></para>
131         /// </param>
132         /// <param name="right">
133         /// <para>The right.</para>
134         /// <para></para>
135         /// </param>
136         [MethodImpl(MethodImplOptions.AggressiveInlining)]
137         protected override void SetRight(TLink node, TLink right) =>
            ↪ GetLinkReference(node).RightAsTarget = right;
138
139         /// <summary>
140         /// <para>
141         /// Gets the size using the specified node.
142         /// </para>
143         /// <para></para>
144         /// </summary>
145         /// <param name="node">
146         /// <para>The node.</para>
147         /// <para></para>
148         /// </param>
149         /// <returns>
150         /// <para>The link</para>
151         /// <para></para>
152         /// </returns>
```

```
153         [MethodImpl(MethodImplOptions.AggressiveInlining)]
154         protected override TLink GetSize(TLink node) => GetLinkReference(node).SizeAsTarget;
155
156         /// <summary>
157         /// <para>
158         /// Sets the size using the specified node.
159         /// </para>
160         /// <para></para>
161         /// </summary>
162         /// <param name="node">
163         /// <para>The node.</para>
164         /// <para></para>
165         /// </param>
166         /// <param name="size">
167         /// <para>The size.</para>
168         /// <para></para>
169         /// </param>
170         [MethodImpl(MethodImplOptions.AggressiveInlining)]
171         protected override void SetSize(TLink node, TLink size) =>
            ↪ GetLinkReference(node).SizeAsTarget = size;
172
173         /// <summary>
174         /// <para>
175         /// Gets the tree root.
176         /// </para>
177         /// <para></para>
178         /// </summary>
179         /// <returns>
180         /// <para>The link</para>
181         /// <para></para>
182         /// </returns>
183         [MethodImpl(MethodImplOptions.AggressiveInlining)]
184         protected override TLink GetTreeRoot() => GetHeaderReference().RootAsTarget;
185
186         /// <summary>
187         /// <para>
188         /// Gets the base part value using the specified link.
189         /// </para>
190         /// <para></para>
191         /// </summary>
192         /// <param name="link">
193         /// <para>The link.</para>
194         /// <para></para>
195         /// </param>
196         /// <returns>
197         /// <para>The link</para>
198         /// <para></para>
199         /// </returns>
200         [MethodImpl(MethodImplOptions.AggressiveInlining)]
201         protected override TLink GetBasePartValue(TLink link) => GetLinkReference(link).Target;
202
203         /// <summary>
204         /// <para>
205         /// Determines whether this instance first is to the left of second.
206         /// </para>
207         /// <para></para>
208         /// </summary>
209         /// <param name="firstSource">
210         /// <para>The first source.</para>
211         /// <para></para>
212         /// </param>
213         /// <param name="firstTarget">
214         /// <para>The first target.</para>
215         /// <para></para>
216         /// </param>
217         /// <param name="secondSource">
218         /// <para>The second source.</para>
219         /// <para></para>
220         /// </param>
221         /// <param name="secondTarget">
222         /// <para>The second target.</para>
223         /// <para></para>
224         /// </param>
225         /// <returns>
226         /// <para>The bool</para>
227         /// <para></para>
228         /// </returns>
229         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
230         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
            ↪  TLink secondSource, TLink secondTarget) => LessThan(firstTarget, secondTarget) ||
            ↪  (AreEqual(firstTarget, secondTarget) && LessThan(firstSource, secondSource));
231
232         /// <summary>
233         /// <para>
234         /// Determines whether this instance first is to the right of second.
235         /// </para>
236         /// <para></para>
237         /// </summary>
238         /// <param name="firstSource">
239         /// <para>The first source.</para>
240         /// <para></para>
241         /// </param>
242         /// <param name="firstTarget">
243         /// <para>The first target.</para>
244         /// <para></para>
245         /// </param>
246         /// <param name="secondSource">
247         /// <para>The second source.</para>
248         /// <para></para>
249         /// </param>
250         /// <param name="secondTarget">
251         /// <para>The second target.</para>
252         /// <para></para>
253         /// </param>
254         /// <returns>
255         /// <para>The bool</para>
256         /// <para></para>
257         /// </returns>
258         [MethodImpl(MethodImplOptions.AggressiveInlining)]
259         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
            ↪  TLink secondSource, TLink secondTarget) => GreaterThan(firstTarget, secondTarget) ||
            ↪  (AreEqual(firstTarget, secondTarget) && GreaterThan(firstSource, secondSource));
260
261         /// <summary>
262         /// <para>
263         /// Clears the node using the specified node.
264         /// </para>
265         /// <para></para>
266         /// </summary>
267         /// <param name="node">
268         /// <para>The node.</para>
269         /// <para></para>
270         /// </param>
271         [MethodImpl(MethodImplOptions.AggressiveInlining)]
272         protected override void ClearNode(TLink node)
273         {
274             ref var link = ref GetLinkReference(node);
275             link.LeftAsTarget = Zero;
276             link.RightAsTarget = Zero;
277             link.SizeAsTarget = Zero;
278         }
279     }
280 }
```

1.88 ./csharp/Platform.Data.Doublets/Memory/United/Generic/LinksTargetsSizeBalancedTreeMethods.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.Data.Doublets.Memory.United.Generic
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the links targets size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="LinksSizeBalancedTreeMethodsBase{TLink}"/>
14     public unsafe class LinksTargetsSizeBalancedTreeMethods<TLink> :
       ↪  LinksSizeBalancedTreeMethodsBase<TLink>
15     {
16         /// <summary>
17         /// <para>
18         /// Initializes a new <see cref="LinksTargetsSizeBalancedTreeMethods"/> instance.
19         /// </para>
20         /// <para></para>
```

```
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public LinksTargetsSizeBalancedTreeMethods(LinksConstants<TLink> constants, byte* links,
        ↪  byte* header) : base(constants, links, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetLeftReference(TLink node) => ref
        ↪  GetLinkReference(node).LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref TLink GetRightReference(TLink node) => ref
        ↪  GetLinkReference(node).RightAsTarget;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetLeft(TLink node) => GetLinkReference(node).LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetRight(TLink node) => GetLinkReference(node).RightAsTarget;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(TLink node, TLink left) =>
        ↪  GetLinkReference(node).LeftAsTarget = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(TLink node, TLink right) =>
        ↪  GetLinkReference(node).RightAsTarget = right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override TLink GetSize(TLink node) => GetLinkReference(node).SizeAsTarget;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
171         protected override void SetSize(TLink node, TLink size) =>
            ↪ GetLinkReference(node).SizeAsTarget = size;
172
173         /// <summary>
174         /// <para>
175         /// Gets the tree root.
176         /// </para>
177         /// <para></para>
178         /// </summary>
179         /// <returns>
180         /// <para>The link</para>
181         /// <para></para>
182         /// </returns>
183         [MethodImpl(MethodImplOptions.AggressiveInlining)]
184         protected override TLink GetTreeRoot() => GetHeaderReference().RootAsTarget;
185
186         /// <summary>
187         /// <para>
188         /// Gets the base part value using the specified link.
189         /// </para>
190         /// <para></para>
191         /// </summary>
192         /// <param name="link">
193         /// <para>The link.</para>
194         /// <para></para>
195         /// </param>
196         /// <returns>
197         /// <para>The link</para>
198         /// <para></para>
199         /// </returns>
200         [MethodImpl(MethodImplOptions.AggressiveInlining)]
201         protected override TLink GetBasePartValue(TLink link) => GetLinkReference(link).Target;
202
203         /// <summary>
204         /// <para>
205         /// Determines whether this instance first is to the left of second.
206         /// </para>
207         /// <para></para>
208         /// </summary>
209         /// <param name="firstSource">
210         /// <para>The first source.</para>
211         /// <para></para>
212         /// </param>
213         /// <param name="firstTarget">
214         /// <para>The first target.</para>
215         /// <para></para>
216         /// </param>
217         /// <param name="secondSource">
218         /// <para>The second source.</para>
219         /// <para></para>
220         /// </param>
221         /// <param name="secondTarget">
222         /// <para>The second target.</para>
223         /// <para></para>
224         /// </param>
225         /// <returns>
226         /// <para>The bool</para>
227         /// <para></para>
228         /// </returns>
229         [MethodImpl(MethodImplOptions.AggressiveInlining)]
230         protected override bool FirstIsToTheLeftOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget) => LessThan(firstTarget, secondTarget) ||
            ↪ (AreEqual(firstTarget, secondTarget) && LessThan(firstSource, secondSource));
231
232         /// <summary>
233         /// <para>
234         /// Determines whether this instance first is to the right of second.
235         /// </para>
236         /// <para></para>
237         /// </summary>
238         /// <param name="firstSource">
239         /// <para>The first source.</para>
240         /// <para></para>
241         /// </param>
242         /// <param name="firstTarget">
243         /// <para>The first target.</para>
244         /// <para></para>
245         /// </param>
```

```
246         /// <param name="secondSource">
247         /// <para>The second source.</para>
248         /// <para></para>
249         /// </param>
250         /// <param name="secondTarget">
251         /// <para>The second target.</para>
252         /// <para></para>
253         /// </param>
254         /// <returns>
255         /// <para>The bool</para>
256         /// <para></para>
257         /// </returns>
258         [MethodImpl(MethodImplOptions.AggressiveInlining)]
259         protected override bool FirstIsToTheRightOfSecond(TLink firstSource, TLink firstTarget,
            ↪ TLink secondSource, TLink secondTarget) => GreaterThan(firstTarget, secondTarget) ||
            ↪ (AreEqual(firstTarget, secondTarget) && GreaterThan(firstSource, secondSource));
260
261         /// <summary>
262         /// <para>
263         /// Clears the node using the specified node.
264         /// </para>
265         /// <para></para>
266         /// </summary>
267         /// <param name="node">
268         /// <para>The node.</para>
269         /// <para></para>
270         /// </param>
271         [MethodImpl(MethodImplOptions.AggressiveInlining)]
272         protected override void ClearNode(TLink node)
273         {
274             ref var link = ref GetLinkReference(node);
275             link.LeftAsTarget = Zero;
276             link.RightAsTarget = Zero;
277             link.SizeAsTarget = Zero;
278         }
279     }
280 }
```

1.89 ./csharp/Platform.Data.Doublets/Memory/United/Generic/UnitedMemoryLinks.cs

```
1  using System;
2  using System.Runtime.CompilerServices;
3  using Platform.Singletons;
4  using Platform.Memory;
5  using static System.Runtime.CompilerServices.Unsafe;
6
7  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
8
9  namespace Platform.Data.Doublets.Memory.United.Generic
10 {
11     /// <summary>
12     /// <para>
13     /// Represents the united memory links.
14     /// </para>
15     /// <para></para>
16     /// </summary>
17     /// <seealso cref="UnitedMemoryLinksBase{TLink}"/>
18     public unsafe class UnitedMemoryLinks<TLink> : UnitedMemoryLinksBase<TLink>
19     {
20         private readonly Func<ILinksTreeMethods<TLink>> _createSourceTreeMethods;
21         private readonly Func<ILinksTreeMethods<TLink>> _createTargetTreeMethods;
22         private byte* _header;
23         private byte* _links;
24
25         /// <summary>
26         /// <para>
27         /// Initializes a new <see cref="UnitedMemoryLinks"/> instance.
28         /// </para>
29         /// <para></para>
30         /// </summary>
31         /// <param name="address">
32         /// <para>A address.</para>
33         /// <para></para>
34         /// </param>
35         [MethodImpl(MethodImplOptions.AggressiveInlining)]
36         public UnitedMemoryLinks(string address) : this(address, DefaultLinksSizeStep) { }
37
38         /// <summary>
39         /// Создаёт экземпляр базы данных Links в файле по указанному адресу, с указанным
            ↪ минимальным шагом расширения базы данных.
```

```
40          /// </summary>
41          /// <param name="address">Полный пусть к файлу базы данных.</param>
42          /// <param name="memoryReservationStep">Минимальный шаг расширения базы данных в
            ↪  байтах.</param>
43          [MethodImpl(MethodImplOptions.AggressiveInlining)]
44          public UnitedMemoryLinks(string address, long memoryReservationStep) : this(new
            ↪  FileMappedResizableDirectMemory(address, memoryReservationStep),
            ↪  memoryReservationStep) { }
45
46          /// <summary>
47          /// <para>
48          /// Initializes a new <see cref="UnitedMemoryLinks"/> instance.
49          /// </para>
50          /// <para></para>
51          /// </summary>
52          /// <param name="memory">
53          /// <para>A memory.</para>
54          /// <para></para>
55          /// </param>
56          [MethodImpl(MethodImplOptions.AggressiveInlining)]
57          public UnitedMemoryLinks(IResizableDirectMemory memory) : this(memory,
            ↪  DefaultLinksSizeStep) { }
58
59          /// <summary>
60          /// <para>
61          /// Initializes a new <see cref="UnitedMemoryLinks"/> instance.
62          /// </para>
63          /// <para></para>
64          /// </summary>
65          /// <param name="memory">
66          /// <para>A memory.</para>
67          /// <para></para>
68          /// </param>
69          /// <param name="memoryReservationStep">
70          /// <para>A memory reservation step.</para>
71          /// <para></para>
72          /// </param>
73          [MethodImpl(MethodImplOptions.AggressiveInlining)]
74          public UnitedMemoryLinks(IResizableDirectMemory memory, long memoryReservationStep) :
            ↪  this(memory, memoryReservationStep, Default<LinksConstants<TLink>>.Instance,
            ↪  IndexTreeType.Default) { }
75
76          /// <summary>
77          /// <para>
78          /// Initializes a new <see cref="UnitedMemoryLinks"/> instance.
79          /// </para>
80          /// <para></para>
81          /// </summary>
82          /// <param name="memory">
83          /// <para>A memory.</para>
84          /// <para></para>
85          /// </param>
86          /// <param name="memoryReservationStep">
87          /// <para>A memory reservation step.</para>
88          /// <para></para>
89          /// </param>
90          /// <param name="constants">
91          /// <para>A constants.</para>
92          /// <para></para>
93          /// </param>
94          /// <param name="indexTreeType">
95          /// <para>A index tree type.</para>
96          /// <para></para>
97          /// </param>
98          [MethodImpl(MethodImplOptions.AggressiveInlining)]
99          public UnitedMemoryLinks(IResizableDirectMemory memory, long memoryReservationStep,
            ↪  LinksConstants<TLink> constants, IndexTreeType indexTreeType) : base(memory,
            ↪  memoryReservationStep, constants)
100         {
101             if (indexTreeType == IndexTreeType.SizedAndThreadedAVLBalancedTree)
102             {
103                 _createSourceTreeMethods = () => new
                    ↪  LinksSourcesAvlBalancedTreeMethods<TLink>(Constants, _links, _header);
104                 _createTargetTreeMethods = () => new
                    ↪  LinksTargetsAvlBalancedTreeMethods<TLink>(Constants, _links, _header);
105             }
106             else
```

```
107             {
108                 _createSourceTreeMethods = () => new
                    ↪ LinksSourcesSizeBalancedTreeMethods<TLink>(Constants, _links, _header);
109                 _createTargetTreeMethods = () => new
                    ↪ LinksTargetsSizeBalancedTreeMethods<TLink>(Constants, _links, _header);
110             }
111             Init(memory, memoryReservationStep);
112         }
113 
114         /// <summary>
115         /// <para>
116         /// Sets the pointers using the specified memory.
117         /// </para>
118         /// <para></para>
119         /// </summary>
120         /// <param name="memory">
121         /// <para>The memory.</para>
122         /// <para></para>
123         /// </param>
124         [MethodImpl(MethodImplOptions.AggressiveInlining)]
125         protected override void SetPointers(IResizableDirectMemory memory)
126         {
127             _links = (byte*)memory.Pointer;
128             _header = _links;
129             SourcesTreeMethods = _createSourceTreeMethods();
130             TargetsTreeMethods = _createTargetTreeMethods();
131             UnusedLinksListMethods = new UnusedLinksListMethods<TLink>(_links, _header);
132         }
133 
134         /// <summary>
135         /// <para>
136         /// Resets the pointers.
137         /// </para>
138         /// <para></para>
139         /// </summary>
140         [MethodImpl(MethodImplOptions.AggressiveInlining)]
141         protected override void ResetPointers()
142         {
143             base.ResetPointers();
144             _links = null;
145             _header = null;
146         }
147 
148         /// <summary>
149         /// <para>
150         /// Gets the header reference.
151         /// </para>
152         /// <para></para>
153         /// </summary>
154         /// <returns>
155         /// <para>A ref links header of t link</para>
156         /// <para></para>
157         /// </returns>
158         [MethodImpl(MethodImplOptions.AggressiveInlining)]
159         protected override ref LinksHeader<TLink> GetHeaderReference() => ref
            ↪ AsRef<LinksHeader<TLink>>(_header);
160 
161         /// <summary>
162         /// <para>
163         /// Gets the link reference using the specified link index.
164         /// </para>
165         /// <para></para>
166         /// </summary>
167         /// <param name="linkIndex">
168         /// <para>The link index.</para>
169         /// <para></para>
170         /// </param>
171         /// <returns>
172         /// <para>A ref raw link of t link</para>
173         /// <para></para>
174         /// </returns>
175         [MethodImpl(MethodImplOptions.AggressiveInlining)]
176         protected override ref RawLink<TLink> GetLinkReference(TLink linkIndex) => ref
            ↪ AsRef<RawLink<TLink>>(_links + (LinkSizeInBytes * ConvertToInt64(linkIndex)));
177     }
178 }
```

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Disposables;
using Platform.Singletons;
using Platform.Converters;
using Platform.Numbers;
using Platform.Memory;
using Platform.Data.Exceptions;
using Platform.Delegates;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Generic
{
    /// <summary>
    /// <para>
    /// Represents the united memory links base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="DisposableBase"/>
    /// <seealso cref="ILinks{TLink}"/>
    public abstract class UnitedMemoryLinksBase<TLink> : DisposableBase, ILinks<TLink>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;
        private static readonly Comparer<TLink> _comparer = Comparer<TLink>.Default;
        private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
        ↪  UncheckedConverter<TLink, long>.Default;
        private static readonly UncheckedConverter<long, TLink> _int64ToAddressConverter =
        ↪  UncheckedConverter<long, TLink>.Default;
        private static readonly TLink _zero = default;
        private static readonly TLink _one = Arithmetic.Increment(_zero);

        /// <summary>Возвращает размер одной связи в байтах.</summary>
        /// <remarks>
        /// Используется только во вне класса, не рекомедуется использовать внутри.
        /// Так как во вне не обязательно будет доступен unsafe C#.
        /// </remarks>
        public static readonly long LinkSizeInBytes = RawLink<TLink>.SizeInBytes;

        /// <summary>
        /// <para>
        /// The size in bytes.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly long LinkHeaderSizeInBytes = LinksHeader<TLink>.SizeInBytes;

        /// <summary>
        /// <para>
        /// The link size in bytes.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly long DefaultLinksSizeStep = LinkSizeInBytes * 1024 * 1024;

        /// <summary>
        /// <para>
        /// The memory.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly IResizableDirectMemory _memory;
        /// <summary>
        /// <para>
        /// The memory reservation step.
        /// </para>
        /// <para></para>
        /// </summary>
        protected readonly long _memoryReservationStep;

        /// <summary>
        /// <para>
        /// The targets tree methods.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
77          protected ILinksTreeMethods<TLink> TargetsTreeMethods;
78          /// <summary>
79          /// <para>
80          /// The sources tree methods.
81          /// </para>
82          /// <para></para>
83          /// </summary>
84          protected ILinksTreeMethods<TLink> SourcesTreeMethods;
85          // TODO: Возможно чтобы гарантированно проверять на то, является ли связь удалённой,
            ↪  нужно использовать не список а дерево, так как так можно быстрее проверить на
            ↪  наличие связи внутри
86          /// <summary>
87          /// <para>
88          /// The unused links list methods.
89          /// </para>
90          /// <para></para>
91          /// </summary>
92          protected ILinksListMethods<TLink> UnusedLinksListMethods;
93
94          /// <summary>
95          /// Возвращает общее число связей находящихся в хранилище.
96          /// </summary>
97          protected virtual TLink Total
98          {
99              [MethodImpl(MethodImplOptions.AggressiveInlining)]
100             get
101             {
102                 ref var header = ref GetHeaderReference();
103                 return Subtract(header.AllocatedLinks, header.FreeLinks);
104             }
105         }
106
107         /// <summary>
108         /// <para>
109         /// Gets the constants value.
110         /// </para>
111         /// <para></para>
112         /// </summary>
113         public virtual LinksConstants<TLink> Constants
114         {
115             [MethodImpl(MethodImplOptions.AggressiveInlining)]
116             get;
117         }
118
119         /// <summary>
120         /// <para>
121         /// Initializes a new <see cref="UnitedMemoryLinksBase"/> instance.
122         /// </para>
123         /// <para></para>
124         /// </summary>
125         /// <param name="memory">
126         /// <para>A memory.</para>
127         /// <para></para>
128         /// </param>
129         /// <param name="memoryReservationStep">
130         /// <para>A memory reservation step.</para>
131         /// <para></para>
132         /// </param>
133         /// <param name="constants">
134         /// <para>A constants.</para>
135         /// <para></para>
136         /// </param>
137         [MethodImpl(MethodImplOptions.AggressiveInlining)]
138         protected UnitedMemoryLinksBase(IResizableDirectMemory memory, long
            ↪  memoryReservationStep, LinksConstants<TLink> constants)
139         {
140             _memory = memory;
141             _memoryReservationStep = memoryReservationStep;
142             Constants = constants;
143         }
144
145         /// <summary>
146         /// <para>
147         /// Initializes a new <see cref="UnitedMemoryLinksBase"/> instance.
148         /// </para>
149         /// <para></para>
150         /// </summary>
151         /// <param name="memory">
152         /// <para>A memory.</para>
```

```
153         /// <para></para>
154         /// </param>
155         /// <param name="memoryReservationStep">
156         /// <para>A memory reservation step.</para>
157         /// <para></para>
158         /// </param>
159         [MethodImpl(MethodImplOptions.AggressiveInlining)]
160         protected UnitedMemoryLinksBase(IResizableDirectMemory memory, long
            ↪ memoryReservationStep) : this(memory, memoryReservationStep,
            ↪ Default<LinksConstants<TLink>>.Instance) { }
161
162         /// <summary>
163         /// <para>
164         /// Inits the memory.
165         /// </para>
166         /// <para></para>
167         /// </summary>
168         /// <param name="memory">
169         /// <para>The memory.</para>
170         /// <para></para>
171         /// </param>
172         /// <param name="memoryReservationStep">
173         /// <para>The memory reservation step.</para>
174         /// <para></para>
175         /// </param>
176         [MethodImpl(MethodImplOptions.AggressiveInlining)]
177         protected virtual void Init(IResizableDirectMemory memory, long memoryReservationStep)
178         {
179             if (memory.ReservedCapacity < memoryReservationStep)
180             {
181                 memory.ReservedCapacity = memoryReservationStep;
182             }
183             SetPointers(memory);
184             ref var header = ref GetHeaderReference();
185             // Гарантия корректности _memory.UsedCapacity относительно _header->AllocatedLinks
186             memory.UsedCapacity = (ConvertToInt64(header.AllocatedLinks) * LinkSizeInBytes) +
                ↪ LinkHeaderSizeInBytes;
187             // Гарантия корректности _header->ReservedLinks относительно _memory.ReservedCapacity
188             header.ReservedLinks = ConvertToAddress((memory.ReservedCapacity -
                ↪ LinkHeaderSizeInBytes) / LinkSizeInBytes);
189         }
190
191         /// <summary>
192         /// <para>
193         /// Counts the substitution.
194         /// </para>
195         /// <para></para>
196         /// </summary>
197         /// <param name="restriction">
198         /// <para>The substitution.</para>
199         /// <para></para>
200         /// </param>
201         /// <exception cref="NotSupportedException">
202         /// <para>Другие размеры и способы ограничений не поддерживаются.</para>
203         /// <para></para>
204         /// </exception>
205         /// <returns>
206         /// <para>The link</para>
207         /// <para></para>
208         /// </returns>
209         [MethodImpl(MethodImplOptions.AggressiveInlining)]
210         public virtual TLink Count(IList<TLink>? restriction)
211         {
212             // Если нет ограничений, тогда возвращаем общее число связей находящихся в хранилище.
213             if (restriction.Count == 0)
214             {
215                 return Total;
216             }
217             var constants = Constants;
218             var any = constants.Any;
219             var index = restriction[constants.IndexPart];
220             if (restriction.Count == 1)
221             {
222                 if (AreEqual(index, any))
223                 {
224                     return Total;
225                 }
226                 return Exists(index) ? GetOne() : GetZero();
```

```
227                 }
228                 if (restriction.Count == 2)
229                 {
230                     var value = restriction[1];
231                     if (AreEqual(index, any))
232                     {
233                         if (AreEqual(value, any))
234                         {
235                             return Total; // Any - как отсутствие ограничения
236                         }
237                         return Add(SourcesTreeMethods.CountUsages(value),
                            ↪  TargetsTreeMethods.CountUsages(value));
238                     }
239                     else
240                     {
241                         if (!Exists(index))
242                         {
243                             return GetZero();
244                         }
245                         if (AreEqual(value, any))
246                         {
247                             return GetOne();
248                         }
249                         ref var storedLinkValue = ref GetLinkReference(index);
250                         if (AreEqual(storedLinkValue.Source, value) ||
                            ↪  AreEqual(storedLinkValue.Target, value))
251                         {
252                             return GetOne();
253                         }
254                         return GetZero();
255                     }
256                 }
257                 if (restriction.Count == 3)
258                 {
259                     var source = restriction[constants.SourcePart];
260                     var target = restriction[constants.TargetPart];
261                     if (AreEqual(index, any))
262                     {
263                         if (AreEqual(source, any) && AreEqual(target, any))
264                         {
265                             return Total;
266                         }
267                         else if (AreEqual(source, any))
268                         {
269                             return TargetsTreeMethods.CountUsages(target);
270                         }
271                         else if (AreEqual(target, any))
272                         {
273                             return SourcesTreeMethods.CountUsages(source);
274                         }
275                         else //if(source != Any && target != Any)
276                         {
277                             // Эквивалент Exists(source, target) => Count(Any, source, target) > 0
278                             var link = SourcesTreeMethods.Search(source, target);
279                             return AreEqual(link, constants.Null) ? GetZero() : GetOne();
280                         }
281                     }
282                     else
283                     {
284                         if (!Exists(index))
285                         {
286                             return GetZero();
287                         }
288                         if (AreEqual(source, any) && AreEqual(target, any))
289                         {
290                             return GetOne();
291                         }
292                         ref var storedLinkValue = ref GetLinkReference(index);
293                         if (!AreEqual(source, any) && !AreEqual(target, any))
294                         {
295                             if (AreEqual(storedLinkValue.Source, source) &&
                                ↪  AreEqual(storedLinkValue.Target, target))
296                             {
297                                 return GetOne();
298                             }
299                             return GetZero();
300                         }
301                         var value = default(TLink);
```

```
                    if (AreEqual(source, any))
                    {
                        value = target;
                    }
                    if (AreEqual(target, any))
                    {
                        value = source;
                    }
                    if (AreEqual(storedLinkValue.Source, value) ||
                    ↪  AreEqual(storedLinkValue.Target, value))
                    {
                        return GetOne();
                    }
                    return GetZero();
                }
            }
            throw new NotSupportedException("Другие размеры и способы ограничений не
            ↪  поддерживаются.");
        }

        /// <summary>
        /// <para>
        /// Eaches the handler.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="handler">
        /// <para>The handler.</para>
        /// <para></para>
        /// </param>
        /// <param name="restriction">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <exception cref="NotSupportedException">
        /// <para>Другие размеры и способы ограничений не поддерживаются.</para>
        /// <para></para>
        /// </exception>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public virtual TLink Each(IList<TLink> restriction, ReadHandler<TLink>? handler)
        {
            var constants = Constants;
            var @break = constants.Break;
            if (restriction.Count == 0)
            {
                for (var link = GetOne(); LessOrEqualThan(link,
                ↪  GetHeaderReference().AllocatedLinks); link = Increment(link))
                {
                    if (Exists(link) && AreEqual(handler(GetLinkStruct(link)), @break))
                    {
                        return @break;
                    }
                }
                return @break;
            }
            var @continue = constants.Continue;
            var any = constants.Any;
            var index = restriction[constants.IndexPart];
            if (restriction.Count == 1)
            {
                if (AreEqual(index, any))
                {
                    return Each(Array.Empty<TLink>(), handler);
                }
                if (!Exists(index))
                {
                    return @continue;
                }
                return handler(GetLinkStruct(index));
            }
            if (restriction.Count == 2)
            {
                var value = restriction[1];
                if (AreEqual(index, any))
```

```
            {
                if (AreEqual(value, any))
                {
                    return Each(Array.Empty<TLink>(), handler);
                }
                if (AreEqual(Each(new Link<TLink>(index, value, any), handler), @break))
                {
                    return @break;
                }
                return Each(new Link<TLink>(index, any, value), handler);
            }
            else
            {
                if (!Exists(index))
                {
                    return @continue;
                }
                if (AreEqual(value, any))
                {
                    return handler(GetLinkStruct(index));
                }
                ref var storedLinkValue = ref GetLinkReference(index);
                if (AreEqual(storedLinkValue.Source, value) ||
                    AreEqual(storedLinkValue.Target, value))
                {
                    return handler(GetLinkStruct(index));
                }
                return @continue;
            }
        }
        if (restriction.Count == 3)
        {
            var source = restriction[constants.SourcePart];
            var target = restriction[constants.TargetPart];
            if (AreEqual(index, any))
            {
                if (AreEqual(source, any) && AreEqual(target, any))
                {
                    return Each(Array.Empty<TLink>(), handler);
                }
                else if (AreEqual(source, any))
                {
                    return TargetsTreeMethods.EachUsage(target, handler);
                }
                else if (AreEqual(target, any))
                {
                    return SourcesTreeMethods.EachUsage(source, handler);
                }
                else //if(source != Any && target != Any)
                {
                    var link = SourcesTreeMethods.Search(source, target);
                    return AreEqual(link, constants.Null) ? @continue :
                    ↪  handler(GetLinkStruct(link));
                }
            }
            else
            {
                if (!Exists(index))
                {
                    return @continue;
                }
                if (AreEqual(source, any) && AreEqual(target, any))
                {
                    return handler(GetLinkStruct(index));
                }
                ref var storedLinkValue = ref GetLinkReference(index);
                if (!AreEqual(source, any) && !AreEqual(target, any))
                {
                    if (AreEqual(storedLinkValue.Source, source) &&
                        AreEqual(storedLinkValue.Target, target))
                    {
                        return handler(GetLinkStruct(index));
                    }
                    return @continue;
                }
                var value = default(TLink);
                if (AreEqual(source, any))
                {
```

```
454                         value = target;
455                     }
456                     if (AreEqual(target, any))
457                     {
458                         value = source;
459                     }
460                     if (AreEqual(storedLinkValue.Source, value) ||
461                         AreEqual(storedLinkValue.Target, value))
462                     {
463                         return handler(GetLinkStruct(index));
464                     }
465                     return @continue;
466                 }
467             }
468             throw new NotSupportedException("Другие размеры и способы ограничений не
                ↪ поддерживаются.");
469         }
470 
471         /// <remarks>
472         /// TODO: Возможно можно перемещать значения, если указан индекс, но значение существует
                ↪ в другом месте (но не в менеджере памяти, а в логике Links)
473         /// </remarks>
474         [MethodImpl(MethodImplOptions.AggressiveInlining)]
475         public virtual TLink Update(IList<TLink> restriction, IList<TLink> substitution,
                ↪ WriteHandler<TLink> handler)
476         {
477             var constants = Constants;
478             var @null = constants.Null;
479             var linkIndex = restriction[constants.IndexPart];
480             var before = GetLinkStruct(linkIndex);
481             ref var link = ref GetLinkReference(linkIndex);
482             ref var header = ref GetHeaderReference();
483             ref var firstAsSource = ref header.RootAsSource;
484             ref var firstAsTarget = ref header.RootAsTarget;
485             // Будет корректно работать только в том случае, если пространство выделенной связи
                ↪ предварительно заполнено нулями
486             if (!AreEqual(link.Source, @null))
487             {
488                 SourcesTreeMethods.Detach(ref firstAsSource, linkIndex);
489             }
490             if (!AreEqual(link.Target, @null))
491             {
492                 TargetsTreeMethods.Detach(ref firstAsTarget, linkIndex);
493             }
494             link.Source = substitution[constants.SourcePart];
495             link.Target = substitution[constants.TargetPart];
496             if (!AreEqual(link.Source, @null))
497             {
498                 SourcesTreeMethods.Attach(ref firstAsSource, linkIndex);
499             }
500             if (!AreEqual(link.Target, @null))
501             {
502                 TargetsTreeMethods.Attach(ref firstAsTarget, linkIndex);
503             }
504             return handler != null ? handler(before, GetLinkStruct(linkIndex)) :
                ↪ Constants.Continue;
505         }
506 
507         /// <remarks>
508         /// TODO: Возможно нужно будет заполнение нулями, если внешнее API ими не заполняет
                ↪ пространство
509         /// </remarks>
510         [MethodImpl(MethodImplOptions.AggressiveInlining)]
511         public virtual TLink Create(IList<TLink> substitution, WriteHandler<TLink> handler)
512         {
513             ref var header = ref GetHeaderReference();
514             var freeLink = header.FirstFreeLink;
515             if (!AreEqual(freeLink, Constants.Null))
516             {
517                 UnusedLinksListMethods.Detach(freeLink);
518             }
519             else
520             {
521                 var maximumPossibleInnerReference = Constants.InternalReferencesRange.Maximum;
522                 if (GreaterThan(header.AllocatedLinks, maximumPossibleInnerReference))
523                 {
524                     throw new LinksLimitReachedException<TLink>(maximumPossibleInnerReference);
525                 }
```

```
                if (GreaterOrEqualThan(header.AllocatedLinks, Decrement(header.ReservedLinks)))
                {
                    _memory.ReservedCapacity += _memoryReservationStep;
                    SetPointers(_memory);
                    header = ref GetHeaderReference();
                    header.ReservedLinks = ConvertToAddress(_memory.ReservedCapacity /
                    ↪  LinkSizeInBytes);
                }
                freeLink = header.AllocatedLinks = Increment(header.AllocatedLinks);
                _memory.UsedCapacity += LinkSizeInBytes;
            }
            return handler != null ? handler(null, new Link<TLink>(freeLink, Constants.Null,
            ↪  Constants.Null)) : Constants.Continue;
        }

        /// <summary>
        /// <para>
        /// Deletes the substitution.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public virtual TLink Delete(IList<TLink> restriction, WriteHandler<TLink> handler)
        {
            ref var header = ref GetHeaderReference();
            var link = restriction[Constants.IndexPart];
            var before = GetLinkStruct(link);
            if (LessThan(link, header.AllocatedLinks))
            {
                UnusedLinksListMethods.AttachAsFirst(link);
                return handler != null ? handler(before, null) : Constants.Continue;
            }
            else if (AreEqual(link, header.AllocatedLinks))
            {
                header.AllocatedLinks = Decrement(header.AllocatedLinks);
                _memory.UsedCapacity -= LinkSizeInBytes;
                // Убираем все связи, находящиеся в списке свободных в конце файла, до тех пор,
                ↪  пока не дойдём до первой существующей связи
                // Позволяет оптимизировать количество выделенных связей (AllocatedLinks)
                while (GreaterThan(header.AllocatedLinks, GetZero()) &&
                ↪  IsUnusedLink(header.AllocatedLinks))
                {
                    UnusedLinksListMethods.Detach(header.AllocatedLinks);
                    header.AllocatedLinks = Decrement(header.AllocatedLinks);
                    _memory.UsedCapacity -= LinkSizeInBytes;
                }
                return handler != null ? handler(before, null) : Constants.Continue;
            }
            return Constants.Continue;
        }

        /// <summary>
        /// <para>
        /// Gets the link struct using the specified link index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A list of t link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public IList<TLink> GetLinkStruct(TLink linkIndex)
        {
            ref var link = ref GetLinkReference(linkIndex);
            return new Link<TLink>(linkIndex, link.Source, link.Target);
        }

        /// <remarks>
```

```
599             /// TODO: Возможно это должно быть событием, вызываемым из IMemory, в том случае, если
                ↪  адрес реально поменялся
600             ///
601             /// Указатель this.links может быть в том же месте,
602             /// так как 0-я связь не используется и имеет такой же размер как Header,
603             /// поэтому header размещается в том же месте, что и 0-я связь
604             /// </remarks>
605             [MethodImpl(MethodImplOptions.AggressiveInlining)]
606             protected abstract void SetPointers(IResizableDirectMemory memory);
607
608             /// <summary>
609             /// <para>
610             /// Resets the pointers.
611             /// </para>
612             /// <para></para>
613             /// </summary>
614             [MethodImpl(MethodImplOptions.AggressiveInlining)]
615             protected virtual void ResetPointers()
616             {
617                 SourcesTreeMethods = null;
618                 TargetsTreeMethods = null;
619                 UnusedLinksListMethods = null;
620             }
621
622             /// <summary>
623             /// <para>
624             /// Gets the header reference.
625             /// </para>
626             /// <para></para>
627             /// </summary>
628             /// <returns>
629             /// <para>A ref links header of t link</para>
630             /// <para></para>
631             /// </returns>
632             [MethodImpl(MethodImplOptions.AggressiveInlining)]
633             protected abstract ref LinksHeader<TLink> GetHeaderReference();
634
635             /// <summary>
636             /// <para>
637             /// Gets the link reference using the specified link index.
638             /// </para>
639             /// <para></para>
640             /// </summary>
641             /// <param name="linkIndex">
642             /// <para>The link index.</para>
643             /// <para></para>
644             /// </param>
645             /// <returns>
646             /// <para>A ref raw link of t link</para>
647             /// <para></para>
648             /// </returns>
649             [MethodImpl(MethodImplOptions.AggressiveInlining)]
650             protected abstract ref RawLink<TLink> GetLinkReference(TLink linkIndex);
651
652             /// <summary>
653             /// <para>
654             /// Determines whether this instance exists.
655             /// </para>
656             /// <para></para>
657             /// </summary>
658             /// <param name="link">
659             /// <para>The link.</para>
660             /// <para></para>
661             /// </param>
662             /// <returns>
663             /// <para>The bool</para>
664             /// <para></para>
665             /// </returns>
666             [MethodImpl(MethodImplOptions.AggressiveInlining)]
667             protected virtual bool Exists(TLink link)
668                 => GreaterOrEqualThan(link, Constants.InternalReferencesRange.Minimum)
669                 && LessOrEqualThan(link, GetHeaderReference().AllocatedLinks)
670                 && !IsUnusedLink(link);
671
672             /// <summary>
673             /// <para>
674             /// Determines whether this instance is unused link.
675             /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual bool IsUnusedLink(TLink linkIndex)
        {
            if (!AreEqual(GetHeaderReference().FirstFreeLink, linkIndex)) // May be this check
            ↪  is not needed
            {
                ref var link = ref GetLinkReference(linkIndex);
                return AreEqual(link.SizeAsSource, default) && !AreEqual(link.Source, default);
            }
            else
            {
                return true;
            }
        }

        /// <summary>
        /// <para>
        /// Gets the one.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink GetOne() => _one;

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink GetZero() => default;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual bool AreEqual(TLink first, TLink second) =>
        ↪  _equalityComparer.Equals(first, second);

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
```

```
752         /// </summary>
753         /// <param name="first">
754         /// <para>The first.</para>
755         /// <para></para>
756         /// </param>
757         /// <param name="second">
758         /// <para>The second.</para>
759         /// <para></para>
760         /// </param>
761         /// <returns>
762         /// <para>The bool</para>
763         /// <para></para>
764         /// </returns>
765         [MethodImpl(MethodImplOptions.AggressiveInlining)]
766         protected virtual bool LessThan(TLink first, TLink second) => _comparer.Compare(first,
          ↪  second) < 0;
767
768         /// <summary>
769         /// <para>
770         /// Determines whether this instance less or equal than.
771         /// </para>
772         /// <para></para>
773         /// </summary>
774         /// <param name="first">
775         /// <para>The first.</para>
776         /// <para></para>
777         /// </param>
778         /// <param name="second">
779         /// <para>The second.</para>
780         /// <para></para>
781         /// </param>
782         /// <returns>
783         /// <para>The bool</para>
784         /// <para></para>
785         /// </returns>
786         [MethodImpl(MethodImplOptions.AggressiveInlining)]
787         protected virtual bool LessOrEqualThan(TLink first, TLink second) =>
          ↪  _comparer.Compare(first, second) <= 0;
788
789         /// <summary>
790         /// <para>
791         /// Determines whether this instance greater than.
792         /// </para>
793         /// <para></para>
794         /// </summary>
795         /// <param name="first">
796         /// <para>The first.</para>
797         /// <para></para>
798         /// </param>
799         /// <param name="second">
800         /// <para>The second.</para>
801         /// <para></para>
802         /// </param>
803         /// <returns>
804         /// <para>The bool</para>
805         /// <para></para>
806         /// </returns>
807         [MethodImpl(MethodImplOptions.AggressiveInlining)]
808         protected virtual bool GreaterThan(TLink first, TLink second) =>
          ↪  _comparer.Compare(first, second) > 0;
809
810         /// <summary>
811         /// <para>
812         /// Determines whether this instance greater or equal than.
813         /// </para>
814         /// <para></para>
815         /// </summary>
816         /// <param name="first">
817         /// <para>The first.</para>
818         /// <para></para>
819         /// </param>
820         /// <param name="second">
821         /// <para>The second.</para>
822         /// <para></para>
823         /// </param>
824         /// <returns>
825         /// <para>The bool</para>
826         /// <para></para>
```

```
827             /// </returns>
828             [MethodImpl(MethodImplOptions.AggressiveInlining)]
829             protected virtual bool GreaterOrEqualThan(TLink first, TLink second) =>
                ↪  _comparer.Compare(first, second) >= 0;
830
831             /// <summary>
832             /// <para>
833             /// Converts the to int 64 using the specified value.
834             /// </para>
835             /// <para></para>
836             /// </summary>
837             /// <param name="value">
838             /// <para>The value.</para>
839             /// <para></para>
840             /// </param>
841             /// <returns>
842             /// <para>The long</para>
843             /// <para></para>
844             /// </returns>
845             [MethodImpl(MethodImplOptions.AggressiveInlining)]
846             protected virtual long ConvertToInt64(TLink value) =>
                ↪  _addressToInt64Converter.Convert(value);
847
848             /// <summary>
849             /// <para>
850             /// Converts the to address using the specified value.
851             /// </para>
852             /// <para></para>
853             /// </summary>
854             /// <param name="value">
855             /// <para>The value.</para>
856             /// <para></para>
857             /// </param>
858             /// <returns>
859             /// <para>The link</para>
860             /// <para></para>
861             /// </returns>
862             [MethodImpl(MethodImplOptions.AggressiveInlining)]
863             protected virtual TLink ConvertToAddress(long value) =>
                ↪  _int64ToAddressConverter.Convert(value);
864
865             /// <summary>
866             /// <para>
867             /// Adds the first.
868             /// </para>
869             /// <para></para>
870             /// </summary>
871             /// <param name="first">
872             /// <para>The first.</para>
873             /// <para></para>
874             /// </param>
875             /// <param name="second">
876             /// <para>The second.</para>
877             /// <para></para>
878             /// </param>
879             /// <returns>
880             /// <para>The link</para>
881             /// <para></para>
882             /// </returns>
883             [MethodImpl(MethodImplOptions.AggressiveInlining)]
884             protected virtual TLink Add(TLink first, TLink second) => Arithmetic<TLink>.Add(first,
                ↪  second);
885
886             /// <summary>
887             /// <para>
888             /// Subtracts the first.
889             /// </para>
890             /// <para></para>
891             /// </summary>
892             /// <param name="first">
893             /// <para>The first.</para>
894             /// <para></para>
895             /// </param>
896             /// <param name="second">
897             /// <para>The second.</para>
898             /// <para></para>
899             /// </param>
900             /// <returns>
```

```
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink Subtract(TLink first, TLink second) =>
        ↪  Arithmetic<TLink>.Subtract(first, second);

        /// <summary>
        /// <para>
        /// Increments the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink Increment(TLink link) => Arithmetic<TLink>.Increment(link);

        /// <summary>
        /// <para>
        /// Decrements the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected virtual TLink Decrement(TLink link) => Arithmetic<TLink>.Decrement(link);

        #region Disposable

        /// <summary>
        /// <para>
        /// Gets the allow multiple dispose calls value.
        /// </para>
        /// <para></para>
        /// </summary>
        protected override bool AllowMultipleDisposeCalls
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get => true;
        }

        /// <summary>
        /// <para>
        /// Disposes the manual.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="manual">
        /// <para>The manual.</para>
        /// <para></para>
        /// </param>
        /// <param name="wasDisposed">
        /// <para>The was disposed.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void Dispose(bool manual, bool wasDisposed)
        {
            if (!wasDisposed)
            {
                ResetPointers();
                _memory.DisposeIfPossible();
            }
        }
```

```
978
979         #endregion
980     }
981 }
```

1.91 ./csharp/Platform.Data.Doublets/Memory/United/Generic/UnusedLinksListMethods.cs

```
1  using System.Runtime.CompilerServices;
2  using Platform.Collections.Methods.Lists;
3  using Platform.Converters;
4  using static System.Runtime.CompilerServices.Unsafe;
5
6  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
7
8  namespace Platform.Data.Doublets.Memory.United.Generic
9  {
10     /// <summary>
11     /// <para>
12     /// Represents the unused links list methods.
13     /// </para>
14     /// <para></para>
15     /// </summary>
16     /// <seealso cref="AbsoluteCircularDoublyLinkedListMethods{TLink}"/>
17     /// <seealso cref="ILinksListMethods{TLink}"/>
18     public unsafe class UnusedLinksListMethods<TLink> :
       ↪  AbsoluteCircularDoublyLinkedListMethods<TLink>, ILinksListMethods<TLink>
19     {
20         private static readonly UncheckedConverter<TLink, long> _addressToInt64Converter =
           ↪  UncheckedConverter<TLink, long>.Default;
21         private readonly byte* _links;
22         private readonly byte* _header;
23
24         /// <summary>
25         /// <para>
26         /// Initializes a new <see cref="UnusedLinksListMethods"/> instance.
27         /// </para>
28         /// <para></para>
29         /// </summary>
30         /// <param name="links">
31         /// <para>A links.</para>
32         /// <para></para>
33         /// </param>
34         /// <param name="header">
35         /// <para>A header.</para>
36         /// <para></para>
37         /// </param>
38         [MethodImpl(MethodImplOptions.AggressiveInlining)]
39         public UnusedLinksListMethods(byte* links, byte* header)
40         {
41             _links = links;
42             _header = header;
43         }
44
45         /// <summary>
46         /// <para>
47         /// Gets the header reference.
48         /// </para>
49         /// <para></para>
50         /// </summary>
51         /// <returns>
52         /// <para>A ref links header of t link</para>
53         /// <para></para>
54         /// </returns>
55         [MethodImpl(MethodImplOptions.AggressiveInlining)]
56         protected virtual ref LinksHeader<TLink> GetHeaderReference() => ref
           ↪  AsRef<LinksHeader<TLink>>(_header);
57
58         /// <summary>
59         /// <para>
60         /// Gets the link reference using the specified link.
61         /// </para>
62         /// <para></para>
63         /// </summary>
64         /// <param name="link">
65         /// <para>The link.</para>
66         /// <para></para>
67         /// </param>
68         /// <returns>
69         /// <para>A ref raw link of t link</para>
70         /// <para></para>
```

```
71          /// </returns>
72          [MethodImpl(MethodImplOptions.AggressiveInlining)]
73          protected virtual ref RawLink<TLink> GetLinkReference(TLink link) => ref
            ↪  AsRef<RawLink<TLink>>(_links + (RawLink<TLink>.SizeInBytes *
            ↪  _addressToInt64Converter.Convert(link)));
74
75          /// <summary>
76          /// <para>
77          /// Gets the first.
78          /// </para>
79          /// <para></para>
80          /// </summary>
81          /// <returns>
82          /// <para>The link</para>
83          /// <para></para>
84          /// </returns>
85          [MethodImpl(MethodImplOptions.AggressiveInlining)]
86          protected override TLink GetFirst() => GetHeaderReference().FirstFreeLink;
87
88          /// <summary>
89          /// <para>
90          /// Gets the last.
91          /// </para>
92          /// <para></para>
93          /// </summary>
94          /// <returns>
95          /// <para>The link</para>
96          /// <para></para>
97          /// </returns>
98          [MethodImpl(MethodImplOptions.AggressiveInlining)]
99          protected override TLink GetLast() => GetHeaderReference().LastFreeLink;
100
101         /// <summary>
102         /// <para>
103         /// Gets the previous using the specified element.
104         /// </para>
105         /// <para></para>
106         /// </summary>
107         /// <param name="element">
108         /// <para>The element.</para>
109         /// <para></para>
110         /// </param>
111         /// <returns>
112         /// <para>The link</para>
113         /// <para></para>
114         /// </returns>
115         [MethodImpl(MethodImplOptions.AggressiveInlining)]
116         protected override TLink GetPrevious(TLink element) => GetLinkReference(element).Source;
117
118         /// <summary>
119         /// <para>
120         /// Gets the next using the specified element.
121         /// </para>
122         /// <para></para>
123         /// </summary>
124         /// <param name="element">
125         /// <para>The element.</para>
126         /// <para></para>
127         /// </param>
128         /// <returns>
129         /// <para>The link</para>
130         /// <para></para>
131         /// </returns>
132         [MethodImpl(MethodImplOptions.AggressiveInlining)]
133         protected override TLink GetNext(TLink element) => GetLinkReference(element).Target;
134
135         /// <summary>
136         /// <para>
137         /// Gets the size.
138         /// </para>
139         /// <para></para>
140         /// </summary>
141         /// <returns>
142         /// <para>The link</para>
143         /// <para></para>
144         /// </returns>
145         [MethodImpl(MethodImplOptions.AggressiveInlining)]
146         protected override TLink GetSize() => GetHeaderReference().FreeLinks;
```

```
147
148         /// <summary>
149         /// <para>
150         /// Sets the first using the specified element.
151         /// </para>
152         /// <para></para>
153         /// </summary>
154         /// <param name="element">
155         /// <para>The element.</para>
156         /// <para></para>
157         /// </param>
158         [MethodImpl(MethodImplOptions.AggressiveInlining)]
159         protected override void SetFirst(TLink element) => GetHeaderReference().FirstFreeLink =
            ↪ element;
160
161         /// <summary>
162         /// <para>
163         /// Sets the last using the specified element.
164         /// </para>
165         /// <para></para>
166         /// </summary>
167         /// <param name="element">
168         /// <para>The element.</para>
169         /// <para></para>
170         /// </param>
171         [MethodImpl(MethodImplOptions.AggressiveInlining)]
172         protected override void SetLast(TLink element) => GetHeaderReference().LastFreeLink =
            ↪ element;
173
174         /// <summary>
175         /// <para>
176         /// Sets the previous using the specified element.
177         /// </para>
178         /// <para></para>
179         /// </summary>
180         /// <param name="element">
181         /// <para>The element.</para>
182         /// <para></para>
183         /// </param>
184         /// <param name="previous">
185         /// <para>The previous.</para>
186         /// <para></para>
187         /// </param>
188         [MethodImpl(MethodImplOptions.AggressiveInlining)]
189         protected override void SetPrevious(TLink element, TLink previous) =>
            ↪ GetLinkReference(element).Source = previous;
190
191         /// <summary>
192         /// <para>
193         /// Sets the next using the specified element.
194         /// </para>
195         /// <para></para>
196         /// </summary>
197         /// <param name="element">
198         /// <para>The element.</para>
199         /// <para></para>
200         /// </param>
201         /// <param name="next">
202         /// <para>The next.</para>
203         /// <para></para>
204         /// </param>
205         [MethodImpl(MethodImplOptions.AggressiveInlining)]
206         protected override void SetNext(TLink element, TLink next) =>
            ↪ GetLinkReference(element).Target = next;
207
208         /// <summary>
209         /// <para>
210         /// Sets the size using the specified size.
211         /// </para>
212         /// <para></para>
213         /// </summary>
214         /// <param name="size">
215         /// <para>The size.</para>
216         /// <para></para>
217         /// </param>
218         [MethodImpl(MethodImplOptions.AggressiveInlining)]
219         protected override void SetSize(TLink size) => GetHeaderReference().FreeLinks = size;
220     }
```

```
}
```

1.92 ./csharp/Platform.Data.Doublets/Memory/United/RawLink.cs

```
using Platform.Unsafe;
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United
{
    /// <summary>
    /// <para>
    /// The raw link.
    /// </para>
    /// <para></para>
    /// </summary>
    public struct RawLink<TLink> : IEquatable<RawLink<TLink>>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;

        /// <summary>
        /// <para>
        /// The size.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly long SizeInBytes = Structure<RawLink<TLink>>.Size;

        /// <summary>
        /// <para>
        /// The source.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink Source;
        /// <summary>
        /// <para>
        /// The target.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink Target;
        /// <summary>
        /// <para>
        /// The left as source.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink LeftAsSource;
        /// <summary>
        /// <para>
        /// The right as source.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink RightAsSource;
        /// <summary>
        /// <para>
        /// The size as source.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink SizeAsSource;
        /// <summary>
        /// <para>
        /// The left as target.
        /// </para>
        /// <para></para>
        /// </summary>
        public TLink LeftAsTarget;
        /// <summary>
        /// <para>
        /// The right as target.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
76          public TLink RightAsTarget;
77          /// <summary>
78          /// <para>
79          /// The size as target.
80          /// </para>
81          /// <para></para>
82          /// </summary>
83          public TLink SizeAsTarget;
84
85          /// <summary>
86          /// <para>
87          /// Determines whether this instance equals.
88          /// </para>
89          /// <para></para>
90          /// </summary>
91          /// <param name="obj">
92          /// <para>The obj.</para>
93          /// <para></para>
94          /// </param>
95          /// <returns>
96          /// <para>The bool</para>
97          /// <para></para>
98          /// </returns>
99          [MethodImpl(MethodImplOptions.AggressiveInlining)]
100         public override bool Equals(object obj) => obj is RawLink<TLink> link ? Equals(link) :
            ↪  false;
101
102         /// <summary>
103         /// <para>
104         /// Determines whether this instance equals.
105         /// </para>
106         /// <para></para>
107         /// </summary>
108         /// <param name="other">
109         /// <para>The other.</para>
110         /// <para></para>
111         /// </param>
112         /// <returns>
113         /// <para>The bool</para>
114         /// <para></para>
115         /// </returns>
116         [MethodImpl(MethodImplOptions.AggressiveInlining)]
117         public bool Equals(RawLink<TLink> other)
118             => _equalityComparer.Equals(Source, other.Source)
119             && _equalityComparer.Equals(Target, other.Target)
120             && _equalityComparer.Equals(LeftAsSource, other.LeftAsSource)
121             && _equalityComparer.Equals(RightAsSource, other.RightAsSource)
122             && _equalityComparer.Equals(SizeAsSource, other.SizeAsSource)
123             && _equalityComparer.Equals(LeftAsTarget, other.LeftAsTarget)
124             && _equalityComparer.Equals(RightAsTarget, other.RightAsTarget)
125             && _equalityComparer.Equals(SizeAsTarget, other.SizeAsTarget);
126
127         /// <summary>
128         /// <para>
129         /// Gets the hash code.
130         /// </para>
131         /// <para></para>
132         /// </summary>
133         /// <returns>
134         /// <para>The int</para>
135         /// <para></para>
136         /// </returns>
137         [MethodImpl(MethodImplOptions.AggressiveInlining)]
138         public override int GetHashCode() => (Source, Target, LeftAsSource, RightAsSource,
            ↪  SizeAsSource, LeftAsTarget, RightAsTarget, SizeAsTarget).GetHashCode();
139
140         [MethodImpl(MethodImplOptions.AggressiveInlining)]
141         public static bool operator ==(RawLink<TLink> left, RawLink<TLink> right) =>
            ↪  left.Equals(right);
142
143         [MethodImpl(MethodImplOptions.AggressiveInlining)]
144         public static bool operator !=(RawLink<TLink> left, RawLink<TLink> right) => !(left ==
            ↪  right);
145     }
146 }
```

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.United.Generic;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 links recursionless size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksRecursionlessSizeBalancedTreeMethodsBase{uint}"/>
    public unsafe abstract class UInt32LinksRecursionlessSizeBalancedTreeMethodsBase :
    ↪ LinksRecursionlessSizeBalancedTreeMethodsBase<uint>
    {
        /// <summary>
        /// <para>
        /// The links.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLink<uint>* Links;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly LinksHeader<uint>* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32LinksRecursionlessSizeBalancedTreeMethodsBase"/>
        ↪ instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        protected UInt32LinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<uint>
        ↪ constants, RawLink<uint>* links, LinksHeader<uint>* header)
            : base(constants, (byte*)links, (byte*)header)
        {
            Links = links;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetZero() => 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
```

```
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(uint value) => value == 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(uint first, uint second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(uint value) => value > 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(uint first, uint second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
```

```
153         /// <para>The first.</para>
154         /// <para></para>
155         /// </param>
156         /// <param name="second">
157         /// <para>The second.</para>
158         /// <para></para>
159         /// </param>
160         /// <returns>
161         /// <para>The bool</para>
162         /// <para></para>
163         /// </returns>
164         [MethodImpl(MethodImplOptions.AggressiveInlining)]
165         protected override bool GreaterOrEqualThan(uint first, uint second) => first >= second;
166 
167         /// <summary>
168         /// <para>
169         /// Determines whether this instance greater or equal than zero.
170         /// </para>
171         /// <para></para>
172         /// </summary>
173         /// <param name="value">
174         /// <para>The value.</para>
175         /// <para></para>
176         /// </param>
177         /// <returns>
178         /// <para>The bool</para>
179         /// <para></para>
180         /// </returns>
181         [MethodImpl(MethodImplOptions.AggressiveInlining)]
182         protected override bool GreaterOrEqualThanZero(uint value) => true; // value >= 0 is
            ↪  always true for uint
183 
184         /// <summary>
185         /// <para>
186         /// Determines whether this instance less or equal than zero.
187         /// </para>
188         /// <para></para>
189         /// </summary>
190         /// <param name="value">
191         /// <para>The value.</para>
192         /// <para></para>
193         /// </param>
194         /// <returns>
195         /// <para>The bool</para>
196         /// <para></para>
197         /// </returns>
198         [MethodImpl(MethodImplOptions.AggressiveInlining)]
199         protected override bool LessOrEqualThanZero(uint value) => value == 0U; // value is
            ↪  always >= 0 for uint
200 
201         /// <summary>
202         /// <para>
203         /// Determines whether this instance less or equal than.
204         /// </para>
205         /// <para></para>
206         /// </summary>
207         /// <param name="first">
208         /// <para>The first.</para>
209         /// <para></para>
210         /// </param>
211         /// <param name="second">
212         /// <para>The second.</para>
213         /// <para></para>
214         /// </param>
215         /// <returns>
216         /// <para>The bool</para>
217         /// <para></para>
218         /// </returns>
219         [MethodImpl(MethodImplOptions.AggressiveInlining)]
220         protected override bool LessOrEqualThan(uint first, uint second) => first <= second;
221 
222         /// <summary>
223         /// <para>
224         /// Determines whether this instance less than zero.
225         /// </para>
226         /// <para></para>
227         /// </summary>
228         /// <param name="value">
```

```
229         /// <para>The value.</para>
230         /// <para></para>
231         /// </param>
232         /// <returns>
233         /// <para>The bool</para>
234         /// <para></para>
235         /// </returns>
236         [MethodImpl(MethodImplOptions.AggressiveInlining)]
237         protected override bool LessThanZero(uint value) => false; // value < 0 is always false
            ↪  for uint
238
239         /// <summary>
240         /// <para>
241         /// Determines whether this instance less than.
242         /// </para>
243         /// <para></para>
244         /// </summary>
245         /// <param name="first">
246         /// <para>The first.</para>
247         /// <para></para>
248         /// </param>
249         /// <param name="second">
250         /// <para>The second.</para>
251         /// <para></para>
252         /// </param>
253         /// <returns>
254         /// <para>The bool</para>
255         /// <para></para>
256         /// </returns>
257         [MethodImpl(MethodImplOptions.AggressiveInlining)]
258         protected override bool LessThan(uint first, uint second) => first < second;
259
260         /// <summary>
261         /// <para>
262         /// Increments the value.
263         /// </para>
264         /// <para></para>
265         /// </summary>
266         /// <param name="value">
267         /// <para>The value.</para>
268         /// <para></para>
269         /// </param>
270         /// <returns>
271         /// <para>The uint</para>
272         /// <para></para>
273         /// </returns>
274         [MethodImpl(MethodImplOptions.AggressiveInlining)]
275         protected override uint Increment(uint value) => ++value;
276
277         /// <summary>
278         /// <para>
279         /// Decrements the value.
280         /// </para>
281         /// <para></para>
282         /// </summary>
283         /// <param name="value">
284         /// <para>The value.</para>
285         /// <para></para>
286         /// </param>
287         /// <returns>
288         /// <para>The uint</para>
289         /// <para></para>
290         /// </returns>
291         [MethodImpl(MethodImplOptions.AggressiveInlining)]
292         protected override uint Decrement(uint value) => --value;
293
294         /// <summary>
295         /// <para>
296         /// Adds the first.
297         /// </para>
298         /// <para></para>
299         /// </summary>
300         /// <param name="first">
301         /// <para>The first.</para>
302         /// <para></para>
303         /// </param>
304         /// <param name="second">
305         /// <para>The second.</para>
```

```
306             /// <para></para>
307             /// </param>
308             /// <returns>
309             /// <para>The uint</para>
310             /// <para></para>
311             /// </returns>
312             [MethodImpl(MethodImplOptions.AggressiveInlining)]
313             protected override uint Add(uint first, uint second) => first + second;
314
315             /// <summary>
316             /// <para>
317             /// Subtracts the first.
318             /// </para>
319             /// <para></para>
320             /// </summary>
321             /// <param name="first">
322             /// <para>The first.</para>
323             /// <para></para>
324             /// </param>
325             /// <param name="second">
326             /// <para>The second.</para>
327             /// <para></para>
328             /// </param>
329             /// <returns>
330             /// <para>The uint</para>
331             /// <para></para>
332             /// </returns>
333             [MethodImpl(MethodImplOptions.AggressiveInlining)]
334             protected override uint Subtract(uint first, uint second) => first - second;
335
336             /// <summary>
337             /// <para>
338             /// Determines whether this instance first is to the left of second.
339             /// </para>
340             /// <para></para>
341             /// </summary>
342             /// <param name="first">
343             /// <para>The first.</para>
344             /// <para></para>
345             /// </param>
346             /// <param name="second">
347             /// <para>The second.</para>
348             /// <para></para>
349             /// </param>
350             /// <returns>
351             /// <para>The bool</para>
352             /// <para></para>
353             /// </returns>
354             [MethodImpl(MethodImplOptions.AggressiveInlining)]
355             protected override bool FirstIsToTheLeftOfSecond(uint first, uint second)
356             {
357                 ref var firstLink = ref Links[first];
358                 ref var secondLink = ref Links[second];
359                 return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                    ↪  secondLink.Source, secondLink.Target);
360             }
361
362             /// <summary>
363             /// <para>
364             /// Determines whether this instance first is to the right of second.
365             /// </para>
366             /// <para></para>
367             /// </summary>
368             /// <param name="first">
369             /// <para>The first.</para>
370             /// <para></para>
371             /// </param>
372             /// <param name="second">
373             /// <para>The second.</para>
374             /// <para></para>
375             /// </param>
376             /// <returns>
377             /// <para>The bool</para>
378             /// <para></para>
379             /// </returns>
380             [MethodImpl(MethodImplOptions.AggressiveInlining)]
381             protected override bool FirstIsToTheRightOfSecond(uint first, uint second)
382             {
```

```
            ref var firstLink = ref Links[first];
            ref var secondLink = ref Links[second];
            return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<uint> GetHeaderReference() => ref *Header;

        /// <summary>
        /// <para>
        /// Gets the link reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link of uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLink<uint> GetLinkReference(uint link) => ref Links[link];
    }
}
```

1.94 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt32LinksSizeBalancedTreeMethodsBase.cs

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.United.Generic;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 links size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksSizeBalancedTreeMethodsBase{uint}"/>
    public unsafe abstract class UInt32LinksSizeBalancedTreeMethodsBase :
    ↪  LinksSizeBalancedTreeMethodsBase<uint>
    {
        /// <summary>
        /// <para>
        /// The links.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLink<uint>* Links;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly LinksHeader<uint>* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32LinksSizeBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
```

```
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        protected UInt32LinksSizeBalancedTreeMethodsBase(LinksConstants<uint> constants,
        ↪  RawLink<uint>* links, LinksHeader<uint>* header)
            : base(constants, (byte*)links, (byte*)header)
        {
            Links = links;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetZero() => 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(uint value) => value == 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(uint first, uint second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
```

```
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(uint value) => value > 0U;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(uint first, uint second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(uint first, uint second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(uint value) => true; // value >= 0 is
        ↪  always true for uint

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
```

```
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThanZero(uint value) => value == 0U; // value is
        ↪  always >= 0 for uint

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(uint first, uint second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThanZero(uint value) => false; // value < 0 is always false
        ↪  for uint

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(uint first, uint second) => first < second;

        /// <summary>
        /// <para>
        /// Increments the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
```

```
270         /// <returns>
271         /// <para>The uint</para>
272         /// <para></para>
273         /// </returns>
274         [MethodImpl(MethodImplOptions.AggressiveInlining)]
275         protected override uint Increment(uint value) => ++value;
276 
277         /// <summary>
278         /// <para>
279         /// Decrements the value.
280         /// </para>
281         /// <para></para>
282         /// </summary>
283         /// <param name="value">
284         /// <para>The value.</para>
285         /// <para></para>
286         /// </param>
287         /// <returns>
288         /// <para>The uint</para>
289         /// <para></para>
290         /// </returns>
291         [MethodImpl(MethodImplOptions.AggressiveInlining)]
292         protected override uint Decrement(uint value) => --value;
293 
294         /// <summary>
295         /// <para>
296         /// Adds the first.
297         /// </para>
298         /// <para></para>
299         /// </summary>
300         /// <param name="first">
301         /// <para>The first.</para>
302         /// <para></para>
303         /// </param>
304         /// <param name="second">
305         /// <para>The second.</para>
306         /// <para></para>
307         /// </param>
308         /// <returns>
309         /// <para>The uint</para>
310         /// <para></para>
311         /// </returns>
312         [MethodImpl(MethodImplOptions.AggressiveInlining)]
313         protected override uint Add(uint first, uint second) => first + second;
314 
315         /// <summary>
316         /// <para>
317         /// Subtracts the first.
318         /// </para>
319         /// <para></para>
320         /// </summary>
321         /// <param name="first">
322         /// <para>The first.</para>
323         /// <para></para>
324         /// </param>
325         /// <param name="second">
326         /// <para>The second.</para>
327         /// <para></para>
328         /// </param>
329         /// <returns>
330         /// <para>The uint</para>
331         /// <para></para>
332         /// </returns>
333         [MethodImpl(MethodImplOptions.AggressiveInlining)]
334         protected override uint Subtract(uint first, uint second) => first - second;
335 
336         /// <summary>
337         /// <para>
338         /// Determines whether this instance first is to the left of second.
339         /// </para>
340         /// <para></para>
341         /// </summary>
342         /// <param name="first">
343         /// <para>The first.</para>
344         /// <para></para>
345         /// </param>
346         /// <param name="second">
347         /// <para>The second.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(uint first, uint second)
        {
            ref var firstLink = ref Links[first];
            ref var secondLink = ref Links[second];
            return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(uint first, uint second)
        {
            ref var firstLink = ref Links[first];
            ref var secondLink = ref Links[second];
            return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<uint> GetHeaderReference() => ref *Header;

        /// <summary>
        /// <para>
        /// Gets the link reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link of uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLink<uint> GetLinkReference(uint link) => ref Links[link];
    }
}
```

1.95 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt32LinksSourcesRecursionlessSizeBalancedTre

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
```

```
4
5   namespace Platform.Data.Doublets.Memory.United.Specific
6   {
7       /// <summary>
8       /// <para>
9       /// Represents the int 32 links sources recursionless size balanced tree methods.
10      /// </para>
11      /// <para></para>
12      /// </summary>
13      /// <seealso cref="UInt32LinksRecursionlessSizeBalancedTreeMethodsBase"/>
14      public unsafe class UInt32LinksSourcesRecursionlessSizeBalancedTreeMethods :
        ↪  UInt32LinksRecursionlessSizeBalancedTreeMethodsBase
15      {
16          /// <summary>
17          /// <para>
18          /// Initializes a new <see
            ↪  cref="UInt32LinksSourcesRecursionlessSizeBalancedTreeMethods"/> instance.
19          /// </para>
20          /// <para></para>
21          /// </summary>
22          /// <param name="constants">
23          /// <para>A constants.</para>
24          /// <para></para>
25          /// </param>
26          /// <param name="links">
27          /// <para>A links.</para>
28          /// <para></para>
29          /// </param>
30          /// <param name="header">
31          /// <para>A header.</para>
32          /// <para></para>
33          /// </param>
34          public UInt32LinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<uint>
            ↪  constants, RawLink<uint>* links, LinksHeader<uint>* header) : base(constants, links,
            ↪  header) { }
35
36          /// <summary>
37          /// <para>
38          /// Gets the left reference using the specified node.
39          /// </para>
40          /// <para></para>
41          /// </summary>
42          /// <param name="node">
43          /// <para>The node.</para>
44          /// <para></para>
45          /// </param>
46          /// <returns>
47          /// <para>The ref uint</para>
48          /// <para></para>
49          /// </returns>
50          [MethodImpl(MethodImplOptions.AggressiveInlining)]
51          protected override ref uint GetLeftReference(uint node) => ref Links[node].LeftAsSource;
52
53          /// <summary>
54          /// <para>
55          /// Gets the right reference using the specified node.
56          /// </para>
57          /// <para></para>
58          /// </summary>
59          /// <param name="node">
60          /// <para>The node.</para>
61          /// <para></para>
62          /// </param>
63          /// <returns>
64          /// <para>The ref uint</para>
65          /// <para></para>
66          /// </returns>
67          [MethodImpl(MethodImplOptions.AggressiveInlining)]
68          protected override ref uint GetRightReference(uint node) => ref
            ↪  Links[node].RightAsSource;
69
70          /// <summary>
71          /// <para>
72          /// Gets the left using the specified node.
73          /// </para>
74          /// <para></para>
75          /// </summary>
76          /// <param name="node">
```

```
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetLeft(uint node) => Links[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetRight(uint node) => Links[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(uint node, uint left) => Links[node].LeftAsSource = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(uint node, uint right) => Links[node].RightAsSource =
        ↪  right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetSize(uint node) => Links[node].SizeAsSource;
```

```
154
155         /// <summary>
156         /// <para>
157         /// Sets the size using the specified node.
158         /// </para>
159         /// <para></para>
160         /// </summary>
161         /// <param name="node">
162         /// <para>The node.</para>
163         /// <para></para>
164         /// </param>
165         /// <param name="size">
166         /// <para>The size.</para>
167         /// <para></para>
168         /// </param>
169         [MethodImpl(MethodImplOptions.AggressiveInlining)]
170         protected override void SetSize(uint node, uint size) => Links[node].SizeAsSource = size;
171
172         /// <summary>
173         /// <para>
174         /// Gets the tree root.
175         /// </para>
176         /// <para></para>
177         /// </summary>
178         /// <returns>
179         /// <para>The uint</para>
180         /// <para></para>
181         /// </returns>
182         [MethodImpl(MethodImplOptions.AggressiveInlining)]
183         protected override uint GetTreeRoot() => Header->RootAsSource;
184
185         /// <summary>
186         /// <para>
187         /// Gets the base part value using the specified link.
188         /// </para>
189         /// <para></para>
190         /// </summary>
191         /// <param name="link">
192         /// <para>The link.</para>
193         /// <para></para>
194         /// </param>
195         /// <returns>
196         /// <para>The uint</para>
197         /// <para></para>
198         /// </returns>
199         [MethodImpl(MethodImplOptions.AggressiveInlining)]
200         protected override uint GetBasePartValue(uint link) => Links[link].Source;
201
202         /// <summary>
203         /// <para>
204         /// Determines whether this instance first is to the left of second.
205         /// </para>
206         /// <para></para>
207         /// </summary>
208         /// <param name="firstSource">
209         /// <para>The first source.</para>
210         /// <para></para>
211         /// </param>
212         /// <param name="firstTarget">
213         /// <para>The first target.</para>
214         /// <para></para>
215         /// </param>
216         /// <param name="secondSource">
217         /// <para>The second source.</para>
218         /// <para></para>
219         /// </param>
220         /// <param name="secondTarget">
221         /// <para>The second target.</para>
222         /// <para></para>
223         /// </param>
224         /// <returns>
225         /// <para>The bool</para>
226         /// <para></para>
227         /// </returns>
228         [MethodImpl(MethodImplOptions.AggressiveInlining)]
229         protected override bool FirstIsToTheLeftOfSecond(uint firstSource, uint firstTarget,
          ↪  uint secondSource, uint secondTarget)
```

```
            => firstSource < secondSource || (firstSource == secondSource && firstTarget <
            ↪  secondTarget);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(uint firstSource, uint firstTarget,
        ↪  uint secondSource, uint secondTarget)
            => firstSource > secondSource || (firstSource == secondSource && firstTarget >
            ↪  secondTarget);

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(uint node)
        {
            ref var link = ref Links[node];
            link.LeftAsSource = 0U;
            link.RightAsSource = 0U;
            link.SizeAsSource = 0U;
        }
    }
}
```

1.96 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt32LinksSourcesSizeBalancedTreeMethods.cs

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 links sources size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt32LinksSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt32LinksSourcesSizeBalancedTreeMethods :
    ↪  UInt32LinksSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32LinksSourcesSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
```

```
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        public UInt32LinksSourcesSizeBalancedTreeMethods(LinksConstants<uint> constants,
        ↪  RawLink<uint>* links, LinksHeader<uint>* header) : base(constants, links, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref uint GetLeftReference(uint node) => ref Links[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref uint GetRightReference(uint node) => ref
        ↪  Links[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetLeft(uint node) => Links[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
```

```
97          /// <returns>
98          /// <para>The uint</para>
99          /// <para></para>
100         /// </returns>
101         [MethodImpl(MethodImplOptions.AggressiveInlining)]
102         protected override uint GetRight(uint node) => Links[node].RightAsSource;
103
104         /// <summary>
105         /// <para>
106         /// Sets the left using the specified node.
107         /// </para>
108         /// <para></para>
109         /// </summary>
110         /// <param name="node">
111         /// <para>The node.</para>
112         /// <para></para>
113         /// </param>
114         /// <param name="left">
115         /// <para>The left.</para>
116         /// <para></para>
117         /// </param>
118         [MethodImpl(MethodImplOptions.AggressiveInlining)]
119         protected override void SetLeft(uint node, uint left) => Links[node].LeftAsSource = left;
120
121         /// <summary>
122         /// <para>
123         /// Sets the right using the specified node.
124         /// </para>
125         /// <para></para>
126         /// </summary>
127         /// <param name="node">
128         /// <para>The node.</para>
129         /// <para></para>
130         /// </param>
131         /// <param name="right">
132         /// <para>The right.</para>
133         /// <para></para>
134         /// </param>
135         [MethodImpl(MethodImplOptions.AggressiveInlining)]
136         protected override void SetRight(uint node, uint right) => Links[node].RightAsSource =
            ↪  right;
137
138         /// <summary>
139         /// <para>
140         /// Gets the size using the specified node.
141         /// </para>
142         /// <para></para>
143         /// </summary>
144         /// <param name="node">
145         /// <para>The node.</para>
146         /// <para></para>
147         /// </param>
148         /// <returns>
149         /// <para>The uint</para>
150         /// <para></para>
151         /// </returns>
152         [MethodImpl(MethodImplOptions.AggressiveInlining)]
153         protected override uint GetSize(uint node) => Links[node].SizeAsSource;
154
155         /// <summary>
156         /// <para>
157         /// Sets the size using the specified node.
158         /// </para>
159         /// <para></para>
160         /// </summary>
161         /// <param name="node">
162         /// <para>The node.</para>
163         /// <para></para>
164         /// </param>
165         /// <param name="size">
166         /// <para>The size.</para>
167         /// <para></para>
168         /// </param>
169         [MethodImpl(MethodImplOptions.AggressiveInlining)]
170         protected override void SetSize(uint node, uint size) => Links[node].SizeAsSource = size;
171
172         /// <summary>
173         /// <para>
```

```
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetTreeRoot() => Header->RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetBasePartValue(uint link) => Links[link].Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(uint firstSource, uint firstTarget,
        ↪  uint secondSource, uint secondTarget)
            => firstSource < secondSource || (firstSource == secondSource && firstTarget <
            ↪  secondTarget);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
```

```
250         /// <param name="secondTarget">
251         /// <para>The second target.</para>
252         /// <para></para>
253         /// </param>
254         /// <returns>
255         /// <para>The bool</para>
256         /// <para></para>
257         /// </returns>
258         [MethodImpl(MethodImplOptions.AggressiveInlining)]
259         protected override bool FirstIsToTheRightOfSecond(uint firstSource, uint firstTarget,
            ↪ uint secondSource, uint secondTarget)
260             => firstSource > secondSource || (firstSource == secondSource && firstTarget >
                ↪ secondTarget);
261 
262         /// <summary>
263         /// <para>
264         /// Clears the node using the specified node.
265         /// </para>
266         /// <para></para>
267         /// </summary>
268         /// <param name="node">
269         /// <para>The node.</para>
270         /// <para></para>
271         /// </param>
272         [MethodImpl(MethodImplOptions.AggressiveInlining)]
273         protected override void ClearNode(uint node)
274         {
275             ref var link = ref Links[node];
276             link.LeftAsSource = 0U;
277             link.RightAsSource = 0U;
278             link.SizeAsSource = 0U;
279         }
280     }
281 }
```

1.97 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt32LinksTargetsRecursionlessSizeBalancedTre

```
1  using System.Runtime.CompilerServices;
2  
3  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4  
5  namespace Platform.Data.Doublets.Memory.United.Specific
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the int 32 links targets recursionless size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="UInt32LinksRecursionlessSizeBalancedTreeMethodsBase"/>
14     public unsafe class UInt32LinksTargetsRecursionlessSizeBalancedTreeMethods :
        ↪ UInt32LinksRecursionlessSizeBalancedTreeMethodsBase
15     {
16         /// <summary>
17         /// <para>
18         /// Initializes a new <see
            ↪ cref="UInt32LinksTargetsRecursionlessSizeBalancedTreeMethods"/> instance.
19         /// </para>
20         /// <para></para>
21         /// </summary>
22         /// <param name="constants">
23         /// <para>A constants.</para>
24         /// <para></para>
25         /// </param>
26         /// <param name="links">
27         /// <para>A links.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="header">
31         /// <para>A header.</para>
32         /// <para></para>
33         /// </param>
34         public UInt32LinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<uint>
            ↪ constants, RawLink<uint>* links, LinksHeader<uint>* header) : base(constants, links,
            ↪ header) { }
35 
36         /// <summary>
37         /// <para>
38         /// Gets the left reference using the specified node.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref uint GetLeftReference(uint node) => ref Links[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref uint GetRightReference(uint node) => ref
        ↪  Links[node].RightAsTarget;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetLeft(uint node) => Links[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetRight(uint node) => Links[node].RightAsTarget;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
```

```
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(uint node, uint left) => Links[node].LeftAsTarget = left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(uint node, uint right) => Links[node].RightAsTarget =
        ↪  right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetSize(uint node) => Links[node].SizeAsTarget;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(uint node, uint size) => Links[node].SizeAsTarget = size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetTreeRoot() => Header->RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetBasePartValue(uint link) => Links[link].Target;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(uint firstSource, uint firstTarget,
        ↪  uint secondSource, uint secondTarget)
            => firstTarget < secondTarget || (firstTarget == secondTarget && firstSource <
            ↪  secondSource);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(uint firstSource, uint firstTarget,
        ↪  uint secondSource, uint secondTarget)
            => firstTarget > secondTarget || (firstTarget == secondTarget && firstSource >
            ↪  secondSource);

        /// <summary>
        /// <para>
        /// Clears the node using the specified node.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void ClearNode(uint node)
        {
            ref var link = ref Links[node];
            link.LeftAsTarget = 0U;
            link.RightAsTarget = 0U;
            link.SizeAsTarget = 0U;
        }
    }
}
```

1.98 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt32LinksTargetsSizeBalancedTreeMethods.cs

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 32 links targets size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt32LinksSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt32LinksTargetsSizeBalancedTreeMethods :
    ↪  UInt32LinksSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32LinksTargetsSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        public UInt32LinksTargetsSizeBalancedTreeMethods(LinksConstants<uint> constants,
        ↪  RawLink<uint>* links, LinksHeader<uint>* header) : base(constants, links, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref uint GetLeftReference(uint node) => ref Links[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
59          /// <param name="node">
60          /// <para>The node.</para>
61          /// <para></para>
62          /// </param>
63          /// <returns>
64          /// <para>The ref uint</para>
65          /// <para></para>
66          /// </returns>
67          [MethodImpl(MethodImplOptions.AggressiveInlining)]
68          protected override ref uint GetRightReference(uint node) => ref
            ↪  Links[node].RightAsTarget;
69
70          /// <summary>
71          /// <para>
72          /// Gets the left using the specified node.
73          /// </para>
74          /// <para></para>
75          /// </summary>
76          /// <param name="node">
77          /// <para>The node.</para>
78          /// <para></para>
79          /// </param>
80          /// <returns>
81          /// <para>The uint</para>
82          /// <para></para>
83          /// </returns>
84          [MethodImpl(MethodImplOptions.AggressiveInlining)]
85          protected override uint GetLeft(uint node) => Links[node].LeftAsTarget;
86
87          /// <summary>
88          /// <para>
89          /// Gets the right using the specified node.
90          /// </para>
91          /// <para></para>
92          /// </summary>
93          /// <param name="node">
94          /// <para>The node.</para>
95          /// <para></para>
96          /// </param>
97          /// <returns>
98          /// <para>The uint</para>
99          /// <para></para>
100         /// </returns>
101         [MethodImpl(MethodImplOptions.AggressiveInlining)]
102         protected override uint GetRight(uint node) => Links[node].RightAsTarget;
103
104         /// <summary>
105         /// <para>
106         /// Sets the left using the specified node.
107         /// </para>
108         /// <para></para>
109         /// </summary>
110         /// <param name="node">
111         /// <para>The node.</para>
112         /// <para></para>
113         /// </param>
114         /// <param name="left">
115         /// <para>The left.</para>
116         /// <para></para>
117         /// </param>
118         [MethodImpl(MethodImplOptions.AggressiveInlining)]
119         protected override void SetLeft(uint node, uint left) => Links[node].LeftAsTarget = left;
120
121         /// <summary>
122         /// <para>
123         /// Sets the right using the specified node.
124         /// </para>
125         /// <para></para>
126         /// </summary>
127         /// <param name="node">
128         /// <para>The node.</para>
129         /// <para></para>
130         /// </param>
131         /// <param name="right">
132         /// <para>The right.</para>
133         /// <para></para>
134         /// </param>
135         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
136         protected override void SetRight(uint node, uint right) => Links[node].RightAsTarget =
            ↪ right;
137
138         /// <summary>
139         /// <para>
140         /// Gets the size using the specified node.
141         /// </para>
142         /// <para></para>
143         /// </summary>
144         /// <param name="node">
145         /// <para>The node.</para>
146         /// <para></para>
147         /// </param>
148         /// <returns>
149         /// <para>The uint</para>
150         /// <para></para>
151         /// </returns>
152         [MethodImpl(MethodImplOptions.AggressiveInlining)]
153         protected override uint GetSize(uint node) => Links[node].SizeAsTarget;
154
155         /// <summary>
156         /// <para>
157         /// Sets the size using the specified node.
158         /// </para>
159         /// <para></para>
160         /// </summary>
161         /// <param name="node">
162         /// <para>The node.</para>
163         /// <para></para>
164         /// </param>
165         /// <param name="size">
166         /// <para>The size.</para>
167         /// <para></para>
168         /// </param>
169         [MethodImpl(MethodImplOptions.AggressiveInlining)]
170         protected override void SetSize(uint node, uint size) => Links[node].SizeAsTarget = size;
171
172         /// <summary>
173         /// <para>
174         /// Gets the tree root.
175         /// </para>
176         /// <para></para>
177         /// </summary>
178         /// <returns>
179         /// <para>The uint</para>
180         /// <para></para>
181         /// </returns>
182         [MethodImpl(MethodImplOptions.AggressiveInlining)]
183         protected override uint GetTreeRoot() => Header->RootAsTarget;
184
185         /// <summary>
186         /// <para>
187         /// Gets the base part value using the specified link.
188         /// </para>
189         /// <para></para>
190         /// </summary>
191         /// <param name="link">
192         /// <para>The link.</para>
193         /// <para></para>
194         /// </param>
195         /// <returns>
196         /// <para>The uint</para>
197         /// <para></para>
198         /// </returns>
199         [MethodImpl(MethodImplOptions.AggressiveInlining)]
200         protected override uint GetBasePartValue(uint link) => Links[link].Target;
201
202         /// <summary>
203         /// <para>
204         /// Determines whether this instance first is to the left of second.
205         /// </para>
206         /// <para></para>
207         /// </summary>
208         /// <param name="firstSource">
209         /// <para>The first source.</para>
210         /// <para></para>
211         /// </param>
212         /// <param name="firstTarget">
```

```
213         /// <para>The first target.</para>
214         /// <para></para>
215         /// </param>
216         /// <param name="secondSource">
217         /// <para>The second source.</para>
218         /// <para></para>
219         /// </param>
220         /// <param name="secondTarget">
221         /// <para>The second target.</para>
222         /// <para></para>
223         /// </param>
224         /// <returns>
225         /// <para>The bool</para>
226         /// <para></para>
227         /// </returns>
228         [MethodImpl(MethodImplOptions.AggressiveInlining)]
229         protected override bool FirstIsToTheLeftOfSecond(uint firstSource, uint firstTarget,
            ↪ uint secondSource, uint secondTarget)
230             => firstTarget < secondTarget || (firstTarget == secondTarget && firstSource <
                ↪ secondSource);
231 
232         /// <summary>
233         /// <para>
234         /// Determines whether this instance first is to the right of second.
235         /// </para>
236         /// <para></para>
237         /// </summary>
238         /// <param name="firstSource">
239         /// <para>The first source.</para>
240         /// <para></para>
241         /// </param>
242         /// <param name="firstTarget">
243         /// <para>The first target.</para>
244         /// <para></para>
245         /// </param>
246         /// <param name="secondSource">
247         /// <para>The second source.</para>
248         /// <para></para>
249         /// </param>
250         /// <param name="secondTarget">
251         /// <para>The second target.</para>
252         /// <para></para>
253         /// </param>
254         /// <returns>
255         /// <para>The bool</para>
256         /// <para></para>
257         /// </returns>
258         [MethodImpl(MethodImplOptions.AggressiveInlining)]
259         protected override bool FirstIsToTheRightOfSecond(uint firstSource, uint firstTarget,
            ↪ uint secondSource, uint secondTarget)
260             => firstTarget > secondTarget || (firstTarget == secondTarget && firstSource >
                ↪ secondSource);
261 
262         /// <summary>
263         /// <para>
264         /// Clears the node using the specified node.
265         /// </para>
266         /// <para></para>
267         /// </summary>
268         /// <param name="node">
269         /// <para>The node.</para>
270         /// <para></para>
271         /// </param>
272         [MethodImpl(MethodImplOptions.AggressiveInlining)]
273         protected override void ClearNode(uint node)
274         {
275             ref var link = ref Links[node];
276             link.LeftAsTarget = 0U;
277             link.RightAsTarget = 0U;
278             link.SizeAsTarget = 0U;
279         }
280     }
281 }
```

1.99 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt32UnitedMemoryLinks.cs

```
1  using System;
2  using System.Runtime.CompilerServices;
3  using Platform.Memory;
```

```
using Platform.Singletons;
using Platform.Data.Doublets.Memory.United.Generic;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Specific
{
    /// <summary>
    /// <para>Represents a low-level implementation of direct access to resizable memory, for organizing the storage of links with addresses represented as <see cref="uint" />.</para>
    /// <para>Представляет низкоуровневую реализация прямого доступа к памяти с переменным размером, для организации хранения связей с адресами представленными в виде <see cref="uint"/>.</para>
    /// </summary>
    public unsafe class UInt32UnitedMemoryLinks : UnitedMemoryLinksBase<uint>
    {
        private readonly Func<ILinksTreeMethods<uint>> _createSourceTreeMethods;
        private readonly Func<ILinksTreeMethods<uint>> _createTargetTreeMethods;
        private LinksHeader<uint>* _header;
        private RawLink<uint>* _links;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32UnitedMemoryLinks"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="address">
        /// <para>A address.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt32UnitedMemoryLinks(string address) : this(address, DefaultLinksSizeStep) { }

        /// <summary>
        /// Создаёт экземпляр базы данных Links в файле по указанному адресу, с указанным минимальным шагом расширения базы данных.
        /// </summary>
        /// <param name="address">Полный пусть к файлу базы данных.</param>
        /// <param name="memoryReservationStep">Минимальный шаг расширения базы данных в байтах.</param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt32UnitedMemoryLinks(string address, long memoryReservationStep) : this(new FileMappedResizableDirectMemory(address, memoryReservationStep), memoryReservationStep) { }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32UnitedMemoryLinks"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="memory">
        /// <para>A memory.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt32UnitedMemoryLinks(IResizableDirectMemory memory) : this(memory, DefaultLinksSizeStep) { }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt32UnitedMemoryLinks"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="memory">
        /// <para>A memory.</para>
        /// <para></para>
        /// </param>
        /// <param name="memoryReservationStep">
        /// <para>A memory reservation step.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt32UnitedMemoryLinks(IResizableDirectMemory memory, long memoryReservationStep) : this(memory, memoryReservationStep, Default<LinksConstants<uint>>.Instance, IndexTreeType.Default) { }
```

```
72
73          /// <summary>
74          /// <para>
75          /// Initializes a new <see cref="UInt32UnitedMemoryLinks"/> instance.
76          /// </para>
77          /// <para></para>
78          /// </summary>
79          /// <param name="memory">
80          /// <para>A memory.</para>
81          /// <para></para>
82          /// </param>
83          /// <param name="memoryReservationStep">
84          /// <para>A memory reservation step.</para>
85          /// <para></para>
86          /// </param>
87          /// <param name="constants">
88          /// <para>A constants.</para>
89          /// <para></para>
90          /// </param>
91          /// <param name="indexTreeType">
92          /// <para>A index tree type.</para>
93          /// <para></para>
94          /// </param>
95          [MethodImpl(MethodImplOptions.AggressiveInlining)]
96          public UInt32UnitedMemoryLinks(IResizableDirectMemory memory, long
            ↪  memoryReservationStep, LinksConstants<uint> constants, IndexTreeType indexTreeType)
            ↪  : base(memory, memoryReservationStep, constants)
97          {
98              if (indexTreeType == IndexTreeType.SizeBalancedTree)
99              {
100                 _createSourceTreeMethods = () => new
                    ↪  UInt32LinksSourcesSizeBalancedTreeMethods(Constants, _links, _header);
101                 _createTargetTreeMethods = () => new
                    ↪  UInt32LinksTargetsSizeBalancedTreeMethods(Constants, _links, _header);
102             }
103             else
104             {
105                 _createSourceTreeMethods = () => new
                    ↪  UInt32LinksSourcesRecursionlessSizeBalancedTreeMethods(Constants, _links,
                    ↪  _header);
106                 _createTargetTreeMethods = () => new
                    ↪  UInt32LinksTargetsRecursionlessSizeBalancedTreeMethods(Constants, _links,
                    ↪  _header);
107             }
108             Init(memory, memoryReservationStep);
109         }
110
111         /// <summary>
112         /// <para>
113         /// Sets the pointers using the specified memory.
114         /// </para>
115         /// <para></para>
116         /// </summary>
117         /// <param name="memory">
118         /// <para>The memory.</para>
119         /// <para></para>
120         /// </param>
121         [MethodImpl(MethodImplOptions.AggressiveInlining)]
122         protected override void SetPointers(IResizableDirectMemory memory)
123         {
124             _header = (LinksHeader<uint>*)memory.Pointer;
125             _links = (RawLink<uint>*)memory.Pointer;
126             SourcesTreeMethods = _createSourceTreeMethods();
127             TargetsTreeMethods = _createTargetTreeMethods();
128             UnusedLinksListMethods = new UInt32UnusedLinksListMethods(_links, _header);
129         }
130
131         /// <summary>
132         /// <para>
133         /// Resets the pointers.
134         /// </para>
135         /// <para></para>
136         /// </summary>
137         [MethodImpl(MethodImplOptions.AggressiveInlining)]
138         protected override void ResetPointers()
139         {
140             base.ResetPointers();
```

```
            _links = null;
            _header = null;
        }

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<uint> GetHeaderReference() => ref *_header;

        /// <summary>
        /// <para>
        /// Gets the link reference using the specified link index.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link of uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLink<uint> GetLinkReference(uint linkIndex) => ref
        ↪  _links[linkIndex];

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(uint first, uint second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(uint first, uint second) => first < second;

        /// <summary>
```

```
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(uint first, uint second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(uint first, uint second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(uint first, uint second) => first >= second;

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetZero() => 0U;

        /// <summary>
        /// <para>
        /// Gets the one.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint GetOne() => 1U;

        /// <summary>
        /// <para>
        /// Converts the to int 64 using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The long</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override long ConvertToInt64(uint value) => (long)value;

        /// <summary>
        /// <para>
        /// Converts the to address using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint ConvertToAddress(long value) => (uint)value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override uint Add(uint first, uint second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
```

```
374         /// </param>
375         /// <returns>
376         /// <para>The uint</para>
377         /// <para></para>
378         /// </returns>
379         [MethodImpl(MethodImplOptions.AggressiveInlining)]
380         protected override uint Subtract(uint first, uint second) => first - second;
381 
382         /// <summary>
383         /// <para>
384         /// Increments the link.
385         /// </para>
386         /// <para></para>
387         /// </summary>
388         /// <param name="link">
389         /// <para>The link.</para>
390         /// <para></para>
391         /// </param>
392         /// <returns>
393         /// <para>The uint</para>
394         /// <para></para>
395         /// </returns>
396         [MethodImpl(MethodImplOptions.AggressiveInlining)]
397         protected override uint Increment(uint link) => ++link;
398 
399         /// <summary>
400         /// <para>
401         /// Decrements the link.
402         /// </para>
403         /// <para></para>
404         /// </summary>
405         /// <param name="link">
406         /// <para>The link.</para>
407         /// <para></para>
408         /// </param>
409         /// <returns>
410         /// <para>The uint</para>
411         /// <para></para>
412         /// </returns>
413         [MethodImpl(MethodImplOptions.AggressiveInlining)]
414         protected override uint Decrement(uint link) => --link;
415     }
416 }
```

1.100 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt32UnusedLinksListMethods.cs

```
1  using System.Runtime.CompilerServices;
2  using Platform.Data.Doublets.Memory.United.Generic;
3 
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5 
6  namespace Platform.Data.Doublets.Memory.United.Specific
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 32 unused links list methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
14     /// <seealso cref="UnusedLinksListMethods{uint}"/>
15     public unsafe class UInt32UnusedLinksListMethods : UnusedLinksListMethods<uint>
16     {
17         private readonly RawLink<uint>* _links;
18         private readonly LinksHeader<uint>* _header;
19 
20         /// <summary>
21         /// <para>
22         /// Initializes a new <see cref="UInt32UnusedLinksListMethods"/> instance.
23         /// </para>
24         /// <para></para>
25         /// </summary>
26         /// <param name="links">
27         /// <para>A links.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="header">
31         /// <para>A header.</para>
32         /// <para></para>
33         /// </param>
34         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
        public UInt32UnusedLinksListMethods(RawLink<uint>* links, LinksHeader<uint>* header)
            : base((byte*)links, (byte*)header)
        {
            _links = links;
            _header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the link reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link of uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLink<uint> GetLinkReference(uint link) => ref _links[link];

        /// <summary>
        /// <para>
        /// Gets the header reference.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>A ref links header of uint</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<uint> GetHeaderReference() => ref *_header;
    }
}
```

1.101 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64LinksAvlBalancedTreeMethodsBase.cs

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.United.Generic;
using static System.Runtime.CompilerServices.Unsafe;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 links avl balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksAvlBalancedTreeMethodsBase{ulong}"/>
    public unsafe abstract class UInt64LinksAvlBalancedTreeMethodsBase :
    ↪ LinksAvlBalancedTreeMethodsBase<ulong>
    {
        /// <summary>
        /// <para>
        /// The links.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLink<ulong>* Links;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly LinksHeader<ulong>* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64LinksAvlBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        protected UInt64LinksAvlBalancedTreeMethodsBase(LinksConstants<ulong> constants,
        ↪  RawLink<ulong>* links, LinksHeader<ulong>* header)
            : base(constants, (byte*)links, (byte*)header)
        {
            Links = links;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetZero() => 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(ulong value) => value == 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(ulong first, ulong second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
```

```
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(ulong value) => value > 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(ulong first, ulong second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(ulong value) => true; // value >= 0 is
        ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThanZero(ulong value) => value == 0UL; // value is
        ↪  always >= 0 for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThanZero(ulong value) => false; // value < 0 is always false
        ↪  for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(ulong first, ulong second) => first < second;

        /// <summary>
        /// <para>
        /// Increments the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
```

```
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Increment(ulong value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Decrement(ulong value) => --value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Add(ulong first, ulong second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Subtract(ulong first, ulong second) => first - second;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
```

```
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(ulong first, ulong second)
        {
            ref var firstLink = ref Links[first];
            ref var secondLink = ref Links[second];
            return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheRightOfSecond(ulong first, ulong second)
        {
            ref var firstLink = ref Links[first];
            ref var secondLink = ref Links[second];
            return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
            ↪  secondLink.Source, secondLink.Target);
        }

        /// <summary>
        /// <para>
        /// Gets the size value using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetSizeValue(ulong value) => (value & 4294967264UL) >> 5;

        /// <summary>
        /// <para>
        /// Sets the size value using the specified stored value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="storedValue">
        /// <para>The stored value.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSizeValue(ref ulong storedValue, ulong size) => storedValue =
        ↪  storedValue & 31UL | (size & 134217727UL) << 5;
```

```
422
423         /// <summary>
424         /// <para>
425         /// Determines whether this instance get left is child value.
426         /// </para>
427         /// <para></para>
428         /// </summary>
429         /// <param name="value">
430         /// <para>The value.</para>
431         /// <para></para>
432         /// </param>
433         /// <returns>
434         /// <para>The bool</para>
435         /// <para></para>
436         /// </returns>
437         [MethodImpl(MethodImplOptions.AggressiveInlining)]
438         protected override bool GetLeftIsChildValue(ulong value) => (value & 16UL) >> 4 == 1UL;
439
440         /// <summary>
441         /// <para>
442         /// Sets the left is child value using the specified stored value.
443         /// </para>
444         /// <para></para>
445         /// </summary>
446         /// <param name="storedValue">
447         /// <para>The stored value.</para>
448         /// <para></para>
449         /// </param>
450         /// <param name="value">
451         /// <para>The value.</para>
452         /// <para></para>
453         /// </param>
454         [MethodImpl(MethodImplOptions.AggressiveInlining)]
455         protected override void SetLeftIsChildValue(ref ulong storedValue, bool value) =>
             ↪  storedValue = storedValue & 4294967279UL | (As<bool, byte>(ref value) & 1UL) << 4;
456
457         /// <summary>
458         /// <para>
459         /// Determines whether this instance get right is child value.
460         /// </para>
461         /// <para></para>
462         /// </summary>
463         /// <param name="value">
464         /// <para>The value.</para>
465         /// <para></para>
466         /// </param>
467         /// <returns>
468         /// <para>The bool</para>
469         /// <para></para>
470         /// </returns>
471         [MethodImpl(MethodImplOptions.AggressiveInlining)]
472         protected override bool GetRightIsChildValue(ulong value) => (value & 8UL) >> 3 == 1UL;
473
474         /// <summary>
475         /// <para>
476         /// Sets the right is child value using the specified stored value.
477         /// </para>
478         /// <para></para>
479         /// </summary>
480         /// <param name="storedValue">
481         /// <para>The stored value.</para>
482         /// <para></para>
483         /// </param>
484         /// <param name="value">
485         /// <para>The value.</para>
486         /// <para></para>
487         /// </param>
488         [MethodImpl(MethodImplOptions.AggressiveInlining)]
489         protected override void SetRightIsChildValue(ref ulong storedValue, bool value) =>
             ↪  storedValue = storedValue & 4294967287UL | (As<bool, byte>(ref value) & 1UL) << 3;
490
491         /// <summary>
492         /// <para>
493         /// Gets the balance value using the specified value.
494         /// </para>
495         /// <para></para>
496         /// </summary>
497         /// <param name="value">
```

```
498             /// <para>The value.</para>
499             /// <para></para>
500             /// </param>
501             /// <returns>
502             /// <para>The sbyte</para>
503             /// <para></para>
504             /// </returns>
505             [MethodImpl(MethodImplOptions.AggressiveInlining)]
506             protected override sbyte GetBalanceValue(ulong value) => unchecked((sbyte)(value & 7UL |
                ↪  0xF8UL * ((value & 4UL) >> 2))); // if negative, then continue ones to the end of
                ↪  sbyte
507
508             /// <summary>
509             /// <para>
510             /// Sets the balance value using the specified stored value.
511             /// </para>
512             /// <para></para>
513             /// </summary>
514             /// <param name="storedValue">
515             /// <para>The stored value.</para>
516             /// <para></para>
517             /// </param>
518             /// <param name="value">
519             /// <para>The value.</para>
520             /// <para></para>
521             /// </param>
522             [MethodImpl(MethodImplOptions.AggressiveInlining)]
523             protected override void SetBalanceValue(ref ulong storedValue, sbyte value) =>
                ↪  storedValue = unchecked(storedValue & 4294967288UL | (ulong)((byte)value >> 5 & 4 |
                ↪  value & 3) & 7UL);
524
525             /// <summary>
526             /// <para>
527             /// Gets the header reference.
528             /// </para>
529             /// <para></para>
530             /// </summary>
531             /// <returns>
532             /// <para>A ref links header of ulong</para>
533             /// <para></para>
534             /// </returns>
535             [MethodImpl(MethodImplOptions.AggressiveInlining)]
536             protected override ref LinksHeader<ulong> GetHeaderReference() => ref *Header;
537
538             /// <summary>
539             /// <para>
540             /// Gets the link reference using the specified link.
541             /// </para>
542             /// <para></para>
543             /// </summary>
544             /// <param name="link">
545             /// <para>The link.</para>
546             /// <para></para>
547             /// </param>
548             /// <returns>
549             /// <para>A ref raw link of ulong</para>
550             /// <para></para>
551             /// </returns>
552             [MethodImpl(MethodImplOptions.AggressiveInlining)]
553             protected override ref RawLink<ulong> GetLinkReference(ulong link) => ref Links[link];
554         }
555     }
```

1.102 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64LinksRecursionlessSizeBalancedTreeMeth

```
1   using System.Runtime.CompilerServices;
2   using Platform.Data.Doublets.Memory.United.Generic;
3
4   #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6   namespace Platform.Data.Doublets.Memory.United.Specific
7   {
8       /// <summary>
9       /// <para>
10      /// Represents the int 64 links recursionless size balanced tree methods base.
11      /// </para>
12      /// <para></para>
13      /// </summary>
14      /// <seealso cref="LinksRecursionlessSizeBalancedTreeMethodsBase{ulong}"/>
```

```
15      public unsafe abstract class UInt64LinksRecursionlessSizeBalancedTreeMethodsBase :
        ↪ LinksRecursionlessSizeBalancedTreeMethodsBase<ulong>
16      {
17          /// <summary>
18          /// <para>
19          /// The links.
20          /// </para>
21          /// <para></para>
22          /// </summary>
23          protected new readonly RawLink<ulong>* Links;
24          /// <summary>
25          /// <para>
26          /// The header.
27          /// </para>
28          /// <para></para>
29          /// </summary>
30          protected new readonly LinksHeader<ulong>* Header;
31
32          /// <summary>
33          /// <para>
34          /// Initializes a new <see cref="UInt64LinksRecursionlessSizeBalancedTreeMethodsBase"/>
            ↪ instance.
35          /// </para>
36          /// <para></para>
37          /// </summary>
38          /// <param name="constants">
39          /// <para>A constants.</para>
40          /// <para></para>
41          /// </param>
42          /// <param name="links">
43          /// <para>A links.</para>
44          /// <para></para>
45          /// </param>
46          /// <param name="header">
47          /// <para>A header.</para>
48          /// <para></para>
49          /// </param>
50          protected UInt64LinksRecursionlessSizeBalancedTreeMethodsBase(LinksConstants<ulong>
            ↪ constants, RawLink<ulong>* links, LinksHeader<ulong>* header)
51              : base(constants, (byte*)links, (byte*)header)
52          {
53              Links = links;
54              Header = header;
55          }
56
57          /// <summary>
58          /// <para>
59          /// Gets the zero.
60          /// </para>
61          /// <para></para>
62          /// </summary>
63          /// <returns>
64          /// <para>The ulong</para>
65          /// <para></para>
66          /// </returns>
67          [MethodImpl(MethodImplOptions.AggressiveInlining)]
68          protected override ulong GetZero() => OUL;
69
70          /// <summary>
71          /// <para>
72          /// Determines whether this instance equal to zero.
73          /// </para>
74          /// <para></para>
75          /// </summary>
76          /// <param name="value">
77          /// <para>The value.</para>
78          /// <para></para>
79          /// </param>
80          /// <returns>
81          /// <para>The bool</para>
82          /// <para></para>
83          /// </returns>
84          [MethodImpl(MethodImplOptions.AggressiveInlining)]
85          protected override bool EqualToZero(ulong value) => value == OUL;
86
87          /// <summary>
88          /// <para>
89          /// Determines whether this instance are equal.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(ulong first, ulong second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(ulong value) => value > 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(ulong first, ulong second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;

        /// <summary>
```

```
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(ulong value) => true; // value >= 0 is
        ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThanZero(ulong value) => value == 0UL; // value is
        ↪  always >= 0 for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThanZero(ulong value) => false; // value < 0 is always false
        ↪  for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(ulong first, ulong second) => first < second;

        /// <summary>
        /// <para>
        /// Increments the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Increment(ulong value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Decrement(ulong value) => --value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Add(ulong first, ulong second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
321             /// <param name="first">
322             /// <para>The first.</para>
323             /// <para></para>
324             /// </param>
325             /// <param name="second">
326             /// <para>The second.</para>
327             /// <para></para>
328             /// </param>
329             /// <returns>
330             /// <para>The ulong</para>
331             /// <para></para>
332             /// </returns>
333             [MethodImpl(MethodImplOptions.AggressiveInlining)]
334             protected override ulong Subtract(ulong first, ulong second) => first - second;
335
336             /// <summary>
337             /// <para>
338             /// Determines whether this instance first is to the left of second.
339             /// </para>
340             /// <para></para>
341             /// </summary>
342             /// <param name="first">
343             /// <para>The first.</para>
344             /// <para></para>
345             /// </param>
346             /// <param name="second">
347             /// <para>The second.</para>
348             /// <para></para>
349             /// </param>
350             /// <returns>
351             /// <para>The bool</para>
352             /// <para></para>
353             /// </returns>
354             [MethodImpl(MethodImplOptions.AggressiveInlining)]
355             protected override bool FirstIsToTheLeftOfSecond(ulong first, ulong second)
356             {
357                 ref var firstLink = ref Links[first];
358                 ref var secondLink = ref Links[second];
359                 return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                    ↪  secondLink.Source, secondLink.Target);
360             }
361
362             /// <summary>
363             /// <para>
364             /// Determines whether this instance first is to the right of second.
365             /// </para>
366             /// <para></para>
367             /// </summary>
368             /// <param name="first">
369             /// <para>The first.</para>
370             /// <para></para>
371             /// </param>
372             /// <param name="second">
373             /// <para>The second.</para>
374             /// <para></para>
375             /// </param>
376             /// <returns>
377             /// <para>The bool</para>
378             /// <para></para>
379             /// </returns>
380             [MethodImpl(MethodImplOptions.AggressiveInlining)]
381             protected override bool FirstIsToTheRightOfSecond(ulong first, ulong second)
382             {
383                 ref var firstLink = ref Links[first];
384                 ref var secondLink = ref Links[second];
385                 return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
                    ↪  secondLink.Source, secondLink.Target);
386             }
387
388             /// <summary>
389             /// <para>
390             /// Gets the header reference.
391             /// </para>
392             /// <para></para>
393             /// </summary>
394             /// <returns>
395             /// <para>A ref links header of ulong</para>
396             /// <para></para>
```

```
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref LinksHeader<ulong> GetHeaderReference() => ref *Header;

        /// <summary>
        /// <para>
        /// Gets the link reference using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A ref raw link of ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref RawLink<ulong> GetLinkReference(ulong link) => ref Links[link];
    }
}
```

1.103 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64LinksSizeBalancedTreeMethodsBase.cs

```
using System.Runtime.CompilerServices;
using Platform.Data.Doublets.Memory.United.Generic;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 links size balanced tree methods base.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksSizeBalancedTreeMethodsBase{ulong}"/>
    public unsafe abstract class UInt64LinksSizeBalancedTreeMethodsBase :
    ↪ LinksSizeBalancedTreeMethodsBase<ulong>
    {
        /// <summary>
        /// <para>
        /// The links.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly RawLink<ulong>* Links;
        /// <summary>
        /// <para>
        /// The header.
        /// </para>
        /// <para></para>
        /// </summary>
        protected new readonly LinksHeader<ulong>* Header;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64LinksSizeBalancedTreeMethodsBase"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        protected UInt64LinksSizeBalancedTreeMethodsBase(LinksConstants<ulong> constants,
        ↪ RawLink<ulong>* links, LinksHeader<ulong>* header)
            : base(constants, (byte*)links, (byte*)header)
        {
```

```
            Links = links;
            Header = header;
        }

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetZero() => 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance equal to zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool EqualToZero(ulong value) => value == 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance are equal.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(ulong first, ulong second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThanZero(ulong value) => value > 0UL;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(ulong first, ulong second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThanZero(ulong value) => true; // value >= 0 is
        ↪  always true for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThanZero(ulong value) => value == 0UL; // value is
        ↪  always >= 0 for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThanZero(ulong value) => false; // value < 0 is always false
        ↪  for ulong

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(ulong first, ulong second) => first < second;

        /// <summary>
        /// <para>
        /// Increments the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Increment(ulong value) => ++value;

        /// <summary>
        /// <para>
        /// Decrements the value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
```

```
284             /// <para>The value.</para>
285             /// <para></para>
286             /// </param>
287             /// <returns>
288             /// <para>The ulong</para>
289             /// <para></para>
290             /// </returns>
291             [MethodImpl(MethodImplOptions.AggressiveInlining)]
292             protected override ulong Decrement(ulong value) => --value;
293
294             /// <summary>
295             /// <para>
296             /// Adds the first.
297             /// </para>
298             /// <para></para>
299             /// </summary>
300             /// <param name="first">
301             /// <para>The first.</para>
302             /// <para></para>
303             /// </param>
304             /// <param name="second">
305             /// <para>The second.</para>
306             /// <para></para>
307             /// </param>
308             /// <returns>
309             /// <para>The ulong</para>
310             /// <para></para>
311             /// </returns>
312             [MethodImpl(MethodImplOptions.AggressiveInlining)]
313             protected override ulong Add(ulong first, ulong second) => first + second;
314
315             /// <summary>
316             /// <para>
317             /// Subtracts the first.
318             /// </para>
319             /// <para></para>
320             /// </summary>
321             /// <param name="first">
322             /// <para>The first.</para>
323             /// <para></para>
324             /// </param>
325             /// <param name="second">
326             /// <para>The second.</para>
327             /// <para></para>
328             /// </param>
329             /// <returns>
330             /// <para>The ulong</para>
331             /// <para></para>
332             /// </returns>
333             [MethodImpl(MethodImplOptions.AggressiveInlining)]
334             protected override ulong Subtract(ulong first, ulong second) => first - second;
335
336             /// <summary>
337             /// <para>
338             /// Determines whether this instance first is to the left of second.
339             /// </para>
340             /// <para></para>
341             /// </summary>
342             /// <param name="first">
343             /// <para>The first.</para>
344             /// <para></para>
345             /// </param>
346             /// <param name="second">
347             /// <para>The second.</para>
348             /// <para></para>
349             /// </param>
350             /// <returns>
351             /// <para>The bool</para>
352             /// <para></para>
353             /// </returns>
354             [MethodImpl(MethodImplOptions.AggressiveInlining)]
355             protected override bool FirstIsToTheLeftOfSecond(ulong first, ulong second)
356             {
357                 ref var firstLink = ref Links[first];
358                 ref var secondLink = ref Links[second];
359                 return FirstIsToTheLeftOfSecond(firstLink.Source, firstLink.Target,
                    ↪  secondLink.Source, secondLink.Target);
360             }
```

```
361
362         /// <summary>
363         /// <para>
364         /// Determines whether this instance first is to the right of second.
365         /// </para>
366         /// <para></para>
367         /// </summary>
368         /// <param name="first">
369         /// <para>The first.</para>
370         /// <para></para>
371         /// </param>
372         /// <param name="second">
373         /// <para>The second.</para>
374         /// <para></para>
375         /// </param>
376         /// <returns>
377         /// <para>The bool</para>
378         /// <para></para>
379         /// </returns>
380         [MethodImpl(MethodImplOptions.AggressiveInlining)]
381         protected override bool FirstIsToTheRightOfSecond(ulong first, ulong second)
382         {
383             ref var firstLink = ref Links[first];
384             ref var secondLink = ref Links[second];
385             return FirstIsToTheRightOfSecond(firstLink.Source, firstLink.Target,
                ↪  secondLink.Source, secondLink.Target);
386         }
387
388         /// <summary>
389         /// <para>
390         /// Gets the header reference.
391         /// </para>
392         /// <para></para>
393         /// </summary>
394         /// <returns>
395         /// <para>A ref links header of ulong</para>
396         /// <para></para>
397         /// </returns>
398         [MethodImpl(MethodImplOptions.AggressiveInlining)]
399         protected override ref LinksHeader<ulong> GetHeaderReference() => ref *Header;
400
401         /// <summary>
402         /// <para>
403         /// Gets the link reference using the specified link.
404         /// </para>
405         /// <para></para>
406         /// </summary>
407         /// <param name="link">
408         /// <para>The link.</para>
409         /// <para></para>
410         /// </param>
411         /// <returns>
412         /// <para>A ref raw link of ulong</para>
413         /// <para></para>
414         /// </returns>
415         [MethodImpl(MethodImplOptions.AggressiveInlining)]
416         protected override ref RawLink<ulong> GetLinkReference(ulong link) => ref Links[link];
417     }
418 }
```

1.104 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64LinksSourcesAvlBalancedTreeMethods.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.Data.Doublets.Memory.United.Specific
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the int 64 links sources avl balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="UInt64LinksAvlBalancedTreeMethodsBase"/>
14     public unsafe class UInt64LinksSourcesAvlBalancedTreeMethods :
       ↪  UInt64LinksAvlBalancedTreeMethodsBase
15     {
16         /// <summary>
```

```
        /// <para>
        /// Initializes a new <see cref="UInt64LinksSourcesAvlBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        public UInt64LinksSourcesAvlBalancedTreeMethods(LinksConstants<ulong> constants,
        ↪  RawLink<ulong>* links, LinksHeader<ulong>* header) : base(constants, links, header)
        ↪  { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetLeftReference(ulong node) => ref
        ↪  Links[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetRightReference(ulong node) => ref
        ↪  Links[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetLeft(ulong node) => Links[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
```

```
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetRight(ulong node) => Links[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(ulong node, ulong left) => Links[node].LeftAsSource =
        ↪  left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(ulong node, ulong right) => Links[node].RightAsSource =
        ↪  right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetSize(ulong node) => GetSizeValue(Links[node].SizeAsSource);

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
```

```
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(ulong node, ulong size) => SetSizeValue(ref
        ↪  Links[node].SizeAsSource, size);

        /// <summary>
        /// <para>
        /// Determines whether this instance get left is child.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GetLeftIsChild(ulong node) =>
        ↪  GetLeftIsChildValue(Links[node].SizeAsSource);

        //[MethodImpl(MethodImplOptions.AggressiveInlining)]
        //protected override bool GetLeftIsChild(ulong node) => IsChild(node, GetLeft(node));

        /// <summary>
        /// <para>
        /// Sets the left is child using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeftIsChild(ulong node, bool value) =>
        ↪  SetLeftIsChildValue(ref Links[node].SizeAsSource, value);

        /// <summary>
        /// <para>
        /// Determines whether this instance get right is child.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GetRightIsChild(ulong node) =>
        ↪  GetRightIsChildValue(Links[node].SizeAsSource);

        //[MethodImpl(MethodImplOptions.AggressiveInlining)]
        //protected override bool GetRightIsChild(ulong node) => IsChild(node, GetRight(node));

        /// <summary>
        /// <para>
        /// Sets the right is child using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
```

```
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRightIsChild(ulong node, bool value) =>
        ↪  SetRightIsChildValue(ref Links[node].SizeAsSource, value);

        /// <summary>
        /// <para>
        /// Gets the balance using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The sbyte</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override sbyte GetBalance(ulong node) =>
        ↪  GetBalanceValue(Links[node].SizeAsSource);

        /// <summary>
        /// <para>
        /// Sets the balance using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetBalance(ulong node, sbyte value) => SetBalanceValue(ref
        ↪  Links[node].SizeAsSource, value);

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetTreeRoot() => Header->RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetBasePartValue(ulong link) => Links[link].Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
```

```
316             /// <param name="firstSource">
317             /// <para>The first source.</para>
318             /// <para></para>
319             /// </param>
320             /// <param name="firstTarget">
321             /// <para>The first target.</para>
322             /// <para></para>
323             /// </param>
324             /// <param name="secondSource">
325             /// <para>The second source.</para>
326             /// <para></para>
327             /// </param>
328             /// <param name="secondTarget">
329             /// <para>The second target.</para>
330             /// <para></para>
331             /// </param>
332             /// <returns>
333             /// <para>The bool</para>
334             /// <para></para>
335             /// </returns>
336             [MethodImpl(MethodImplOptions.AggressiveInlining)]
337             protected override bool FirstIsToTheLeftOfSecond(ulong firstSource, ulong firstTarget,
                ↪  ulong secondSource, ulong secondTarget)
338                 => firstSource < secondSource || (firstSource == secondSource && firstTarget <
                    ↪  secondTarget);
339
340             /// <summary>
341             /// <para>
342             /// Determines whether this instance first is to the right of second.
343             /// </para>
344             /// <para></para>
345             /// </summary>
346             /// <param name="firstSource">
347             /// <para>The first source.</para>
348             /// <para></para>
349             /// </param>
350             /// <param name="firstTarget">
351             /// <para>The first target.</para>
352             /// <para></para>
353             /// </param>
354             /// <param name="secondSource">
355             /// <para>The second source.</para>
356             /// <para></para>
357             /// </param>
358             /// <param name="secondTarget">
359             /// <para>The second target.</para>
360             /// <para></para>
361             /// </param>
362             /// <returns>
363             /// <para>The bool</para>
364             /// <para></para>
365             /// </returns>
366             [MethodImpl(MethodImplOptions.AggressiveInlining)]
367             protected override bool FirstIsToTheRightOfSecond(ulong firstSource, ulong firstTarget,
                ↪  ulong secondSource, ulong secondTarget)
368                 => firstSource > secondSource || (firstSource == secondSource && firstTarget >
                    ↪  secondTarget);
369
370             /// <summary>
371             /// <para>
372             /// Clears the node using the specified node.
373             /// </para>
374             /// <para></para>
375             /// </summary>
376             /// <param name="node">
377             /// <para>The node.</para>
378             /// <para></para>
379             /// </param>
380             [MethodImpl(MethodImplOptions.AggressiveInlining)]
381             protected override void ClearNode(ulong node)
382             {
383                 ref var link = ref Links[node];
384                 link.LeftAsSource = OUL;
385                 link.RightAsSource = OUL;
386                 link.SizeAsSource = OUL;
387             }
388         }
389     }
```

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Memory.United.Specific
{
    /// <summary>
    /// <para>
    /// Represents the int 64 links sources recursionless size balanced tree methods.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="UInt64LinksRecursionlessSizeBalancedTreeMethodsBase"/>
    public unsafe class UInt64LinksSourcesRecursionlessSizeBalancedTreeMethods :
    ↪ UInt64LinksRecursionlessSizeBalancedTreeMethodsBase
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see
        ↪ cref="UInt64LinksSourcesRecursionlessSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        public UInt64LinksSourcesRecursionlessSizeBalancedTreeMethods(LinksConstants<ulong>
        ↪ constants, RawLink<ulong>* links, LinksHeader<ulong>* header) : base(constants,
        ↪ links, header) { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetLeftReference(ulong node) => ref
        ↪ Links[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetRightReference(ulong node) => ref
        ↪ Links[node].RightAsSource;

        /// <summary>
        /// <para>
```

```
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetLeft(ulong node) => Links[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetRight(ulong node) => Links[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(ulong node, ulong left) => Links[node].LeftAsSource =
        ↪  left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(ulong node, ulong right) => Links[node].RightAsSource =
        ↪  right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
```

```
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetSize(ulong node) => Links[node].SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(ulong node, ulong size) => Links[node].SizeAsSource =
        ↪  size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetTreeRoot() => Header->RootAsSource;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetBasePartValue(ulong link) => Links[link].Source;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
```

```
225         /// <para>The bool</para>
226         /// <para></para>
227         /// </returns>
228         [MethodImpl(MethodImplOptions.AggressiveInlining)]
229         protected override bool FirstIsToTheLeftOfSecond(ulong firstSource, ulong firstTarget,
            ↪ ulong secondSource, ulong secondTarget)
230             => firstSource < secondSource || (firstSource == secondSource && firstTarget <
                ↪ secondTarget);
231 
232         /// <summary>
233         /// <para>
234         /// Determines whether this instance first is to the right of second.
235         /// </para>
236         /// <para></para>
237         /// </summary>
238         /// <param name="firstSource">
239         /// <para>The first source.</para>
240         /// <para></para>
241         /// </param>
242         /// <param name="firstTarget">
243         /// <para>The first target.</para>
244         /// <para></para>
245         /// </param>
246         /// <param name="secondSource">
247         /// <para>The second source.</para>
248         /// <para></para>
249         /// </param>
250         /// <param name="secondTarget">
251         /// <para>The second target.</para>
252         /// <para></para>
253         /// </param>
254         /// <returns>
255         /// <para>The bool</para>
256         /// <para></para>
257         /// </returns>
258         [MethodImpl(MethodImplOptions.AggressiveInlining)]
259         protected override bool FirstIsToTheRightOfSecond(ulong firstSource, ulong firstTarget,
            ↪ ulong secondSource, ulong secondTarget)
260             => firstSource > secondSource || (firstSource == secondSource && firstTarget >
                ↪ secondTarget);
261 
262         /// <summary>
263         /// <para>
264         /// Clears the node using the specified node.
265         /// </para>
266         /// <para></para>
267         /// </summary>
268         /// <param name="node">
269         /// <para>The node.</para>
270         /// <para></para>
271         /// </param>
272         [MethodImpl(MethodImplOptions.AggressiveInlining)]
273         protected override void ClearNode(ulong node)
274         {
275             ref var link = ref Links[node];
276             link.LeftAsSource = 0UL;
277             link.RightAsSource = 0UL;
278             link.SizeAsSource = 0UL;
279         }
280     }
281 }
```

1.106 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64LinksSourcesSizeBalancedTreeMethods.c

```
1  using System.Runtime.CompilerServices;
2  
3  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4  
5  namespace Platform.Data.Doublets.Memory.United.Specific
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the int 64 links sources size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="UInt64LinksSizeBalancedTreeMethodsBase"/>
14     public unsafe class UInt64LinksSourcesSizeBalancedTreeMethods :
       ↪ UInt64LinksSizeBalancedTreeMethodsBase
```

```
    {
        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64LinksSourcesSizeBalancedTreeMethods"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="constants">
        /// <para>A constants.</para>
        /// <para></para>
        /// </param>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="header">
        /// <para>A header.</para>
        /// <para></para>
        /// </param>
        public UInt64LinksSourcesSizeBalancedTreeMethods(LinksConstants<ulong> constants,
        ↪  RawLink<ulong>* links, LinksHeader<ulong>* header) : base(constants, links, header)
        ↪  { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetLeftReference(ulong node) => ref
        ↪  Links[node].LeftAsSource;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetRightReference(ulong node) => ref
        ↪  Links[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetLeft(ulong node) => Links[node].LeftAsSource;

        /// <summary>
        /// <para>
```

```
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetRight(ulong node) => Links[node].RightAsSource;

        /// <summary>
        /// <para>
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(ulong node, ulong left) => Links[node].LeftAsSource =
        ↪  left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(ulong node, ulong right) => Links[node].RightAsSource =
        ↪  right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetSize(ulong node) => Links[node].SizeAsSource;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
```

```
165         /// <param name="size">
166         /// <para>The size.</para>
167         /// <para></para>
168         /// </param>
169         [MethodImpl(MethodImplOptions.AggressiveInlining)]
170         protected override void SetSize(ulong node, ulong size) => Links[node].SizeAsSource =
            ↪ size;
171
172         /// <summary>
173         /// <para>
174         /// Gets the tree root.
175         /// </para>
176         /// <para></para>
177         /// </summary>
178         /// <returns>
179         /// <para>The ulong</para>
180         /// <para></para>
181         /// </returns>
182         [MethodImpl(MethodImplOptions.AggressiveInlining)]
183         protected override ulong GetTreeRoot() => Header->RootAsSource;
184
185         /// <summary>
186         /// <para>
187         /// Gets the base part value using the specified link.
188         /// </para>
189         /// <para></para>
190         /// </summary>
191         /// <param name="link">
192         /// <para>The link.</para>
193         /// <para></para>
194         /// </param>
195         /// <returns>
196         /// <para>The ulong</para>
197         /// <para></para>
198         /// </returns>
199         [MethodImpl(MethodImplOptions.AggressiveInlining)]
200         protected override ulong GetBasePartValue(ulong link) => Links[link].Source;
201
202         /// <summary>
203         /// <para>
204         /// Determines whether this instance first is to the left of second.
205         /// </para>
206         /// <para></para>
207         /// </summary>
208         /// <param name="firstSource">
209         /// <para>The first source.</para>
210         /// <para></para>
211         /// </param>
212         /// <param name="firstTarget">
213         /// <para>The first target.</para>
214         /// <para></para>
215         /// </param>
216         /// <param name="secondSource">
217         /// <para>The second source.</para>
218         /// <para></para>
219         /// </param>
220         /// <param name="secondTarget">
221         /// <para>The second target.</para>
222         /// <para></para>
223         /// </param>
224         /// <returns>
225         /// <para>The bool</para>
226         /// <para></para>
227         /// </returns>
228         [MethodImpl(MethodImplOptions.AggressiveInlining)]
229         protected override bool FirstIsToTheLeftOfSecond(ulong firstSource, ulong firstTarget,
            ↪ ulong secondSource, ulong secondTarget)
230             => firstSource < secondSource || (firstSource == secondSource && firstTarget <
                ↪ secondTarget);
231
232         /// <summary>
233         /// <para>
234         /// Determines whether this instance first is to the right of second.
235         /// </para>
236         /// <para></para>
237         /// </summary>
238         /// <param name="firstSource">
239         /// <para>The first source.</para>
```

```
240         /// <para></para>
241         /// </param>
242         /// <param name="firstTarget">
243         /// <para>The first target.</para>
244         /// <para></para>
245         /// </param>
246         /// <param name="secondSource">
247         /// <para>The second source.</para>
248         /// <para></para>
249         /// </param>
250         /// <param name="secondTarget">
251         /// <para>The second target.</para>
252         /// <para></para>
253         /// </param>
254         /// <returns>
255         /// <para>The bool</para>
256         /// <para></para>
257         /// </returns>
258         [MethodImpl(MethodImplOptions.AggressiveInlining)]
259         protected override bool FirstIsToTheRightOfSecond(ulong firstSource, ulong firstTarget,
          ↪  ulong secondSource, ulong secondTarget)
260             => firstSource > secondSource || (firstSource == secondSource && firstTarget >
              ↪  secondTarget);
261
262         /// <summary>
263         /// <para>
264         /// Clears the node using the specified node.
265         /// </para>
266         /// <para></para>
267         /// </summary>
268         /// <param name="node">
269         /// <para>The node.</para>
270         /// <para></para>
271         /// </param>
272         [MethodImpl(MethodImplOptions.AggressiveInlining)]
273         protected override void ClearNode(ulong node)
274         {
275             ref var link = ref Links[node];
276             link.LeftAsSource = OUL;
277             link.RightAsSource = OUL;
278             link.SizeAsSource = OUL;
279         }
280     }
281 }
```

1.107 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64LinksTargetsAvlBalancedTreeMethods.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.Data.Doublets.Memory.United.Specific
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the int 64 links targets avl balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="UInt64LinksAvlBalancedTreeMethodsBase"/>
14     public unsafe class UInt64LinksTargetsAvlBalancedTreeMethods :
       ↪  UInt64LinksAvlBalancedTreeMethodsBase
15     {
16         /// <summary>
17         /// <para>
18         /// Initializes a new <see cref="UInt64LinksTargetsAvlBalancedTreeMethods"/> instance.
19         /// </para>
20         /// <para></para>
21         /// </summary>
22         /// <param name="constants">
23         /// <para>A constants.</para>
24         /// <para></para>
25         /// </param>
26         /// <param name="links">
27         /// <para>A links.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="header">
31         /// <para>A header.</para>
```

```
        /// <para></para>
        /// </param>
        public UInt64LinksTargetsAvlBalancedTreeMethods(LinksConstants<ulong> constants,
        ↪  RawLink<ulong>* links, LinksHeader<ulong>* header) : base(constants, links, header)
        ↪  { }

        /// <summary>
        /// <para>
        /// Gets the left reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetLeftReference(ulong node) => ref
        ↪  Links[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right reference using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ref ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ref ulong GetRightReference(ulong node) => ref
        ↪  Links[node].RightAsTarget;

        /// <summary>
        /// <para>
        /// Gets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetLeft(ulong node) => Links[node].LeftAsTarget;

        /// <summary>
        /// <para>
        /// Gets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetRight(ulong node) => Links[node].RightAsTarget;

        /// <summary>
        /// <para>
```

```
        /// Sets the left using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(ulong node, ulong left) => Links[node].LeftAsTarget =
        ↪  left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(ulong node, ulong right) => Links[node].RightAsTarget =
        ↪  right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetSize(ulong node) => GetSizeValue(Links[node].SizeAsTarget);

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(ulong node, ulong size) => SetSizeValue(ref
        ↪  Links[node].SizeAsTarget, size);

        /// <summary>
        /// <para>
        /// Determines whether this instance get left is child.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
```

```
181             /// </param>
182             /// <returns>
183             /// <para>The bool</para>
184             /// <para></para>
185             /// </returns>
186             [MethodImpl(MethodImplOptions.AggressiveInlining)]
187             protected override bool GetLeftIsChild(ulong node) =>
                ↪ GetLeftIsChildValue(Links[node].SizeAsTarget);
188
189             /// <summary>
190             /// <para>
191             /// Sets the left is child using the specified node.
192             /// </para>
193             /// <para></para>
194             /// </summary>
195             /// <param name="node">
196             /// <para>The node.</para>
197             /// <para></para>
198             /// </param>
199             /// <param name="value">
200             /// <para>The value.</para>
201             /// <para></para>
202             /// </param>
203             [MethodImpl(MethodImplOptions.AggressiveInlining)]
204             protected override void SetLeftIsChild(ulong node, bool value) =>
                ↪ SetLeftIsChildValue(ref Links[node].SizeAsTarget, value);
205
206             /// <summary>
207             /// <para>
208             /// Determines whether this instance get right is child.
209             /// </para>
210             /// <para></para>
211             /// </summary>
212             /// <param name="node">
213             /// <para>The node.</para>
214             /// <para></para>
215             /// </param>
216             /// <returns>
217             /// <para>The bool</para>
218             /// <para></para>
219             /// </returns>
220             [MethodImpl(MethodImplOptions.AggressiveInlining)]
221             protected override bool GetRightIsChild(ulong node) =>
                ↪ GetRightIsChildValue(Links[node].SizeAsTarget);
222
223             /// <summary>
224             /// <para>
225             /// Sets the right is child using the specified node.
226             /// </para>
227             /// <para></para>
228             /// </summary>
229             /// <param name="node">
230             /// <para>The node.</para>
231             /// <para></para>
232             /// </param>
233             /// <param name="value">
234             /// <para>The value.</para>
235             /// <para></para>
236             /// </param>
237             [MethodImpl(MethodImplOptions.AggressiveInlining)]
238             protected override void SetRightIsChild(ulong node, bool value) =>
                ↪ SetRightIsChildValue(ref Links[node].SizeAsTarget, value);
239
240             /// <summary>
241             /// <para>
242             /// Gets the balance using the specified node.
243             /// </para>
244             /// <para></para>
245             /// </summary>
246             /// <param name="node">
247             /// <para>The node.</para>
248             /// <para></para>
249             /// </param>
250             /// <returns>
251             /// <para>The sbyte</para>
252             /// <para></para>
253             /// </returns>
254             [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
255         protected override sbyte GetBalance(ulong node) =>
            ↪ GetBalanceValue(Links[node].SizeAsTarget);
256
257         /// <summary>
258         /// <para>
259         /// Sets the balance using the specified node.
260         /// </para>
261         /// <para></para>
262         /// </summary>
263         /// <param name="node">
264         /// <para>The node.</para>
265         /// <para></para>
266         /// </param>
267         /// <param name="value">
268         /// <para>The value.</para>
269         /// <para></para>
270         /// </param>
271         [MethodImpl(MethodImplOptions.AggressiveInlining)]
272         protected override void SetBalance(ulong node, sbyte value) => SetBalanceValue(ref
            ↪ Links[node].SizeAsTarget, value);
273
274         /// <summary>
275         /// <para>
276         /// Gets the tree root.
277         /// </para>
278         /// <para></para>
279         /// </summary>
280         /// <returns>
281         /// <para>The ulong</para>
282         /// <para></para>
283         /// </returns>
284         [MethodImpl(MethodImplOptions.AggressiveInlining)]
285         protected override ulong GetTreeRoot() => Header->RootAsTarget;
286
287         /// <summary>
288         /// <para>
289         /// Gets the base part value using the specified link.
290         /// </para>
291         /// <para></para>
292         /// </summary>
293         /// <param name="link">
294         /// <para>The link.</para>
295         /// <para></para>
296         /// </param>
297         /// <returns>
298         /// <para>The ulong</para>
299         /// <para></para>
300         /// </returns>
301         [MethodImpl(MethodImplOptions.AggressiveInlining)]
302         protected override ulong GetBasePartValue(ulong link) => Links[link].Target;
303
304         /// <summary>
305         /// <para>
306         /// Determines whether this instance first is to the left of second.
307         /// </para>
308         /// <para></para>
309         /// </summary>
310         /// <param name="firstSource">
311         /// <para>The first source.</para>
312         /// <para></para>
313         /// </param>
314         /// <param name="firstTarget">
315         /// <para>The first target.</para>
316         /// <para></para>
317         /// </param>
318         /// <param name="secondSource">
319         /// <para>The second source.</para>
320         /// <para></para>
321         /// </param>
322         /// <param name="secondTarget">
323         /// <para>The second target.</para>
324         /// <para></para>
325         /// </param>
326         /// <returns>
327         /// <para>The bool</para>
328         /// <para></para>
329         /// </returns>
330         [MethodImpl(MethodImplOptions.AggressiveInlining)]
```

```
331         protected override bool FirstIsToTheLeftOfSecond(ulong firstSource, ulong firstTarget,
            ↪  ulong secondSource, ulong secondTarget)
332             => firstTarget < secondTarget || (firstTarget == secondTarget && firstSource <
                ↪  secondSource);
333 
334         /// <summary>
335         /// <para>
336         /// Determines whether this instance first is to the right of second.
337         /// </para>
338         /// <para></para>
339         /// </summary>
340         /// <param name="firstSource">
341         /// <para>The first source.</para>
342         /// <para></para>
343         /// </param>
344         /// <param name="firstTarget">
345         /// <para>The first target.</para>
346         /// <para></para>
347         /// </param>
348         /// <param name="secondSource">
349         /// <para>The second source.</para>
350         /// <para></para>
351         /// </param>
352         /// <param name="secondTarget">
353         /// <para>The second target.</para>
354         /// <para></para>
355         /// </param>
356         /// <returns>
357         /// <para>The bool</para>
358         /// <para></para>
359         /// </returns>
360         [MethodImpl(MethodImplOptions.AggressiveInlining)]
361         protected override bool FirstIsToTheRightOfSecond(ulong firstSource, ulong firstTarget,
            ↪  ulong secondSource, ulong secondTarget)
362             => firstTarget > secondTarget || (firstTarget == secondTarget && firstSource >
                ↪  secondSource);
363 
364         /// <summary>
365         /// <para>
366         /// Clears the node using the specified node.
367         /// </para>
368         /// <para></para>
369         /// </summary>
370         /// <param name="node">
371         /// <para>The node.</para>
372         /// <para></para>
373         /// </param>
374         [MethodImpl(MethodImplOptions.AggressiveInlining)]
375         protected override void ClearNode(ulong node)
376         {
377             ref var link = ref Links[node];
378             link.LeftAsTarget = OUL;
379             link.RightAsTarget = OUL;
380             link.SizeAsTarget = OUL;
381         }
382     }
383 }
```

1.108 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64LinksTargetsRecursionlessSizeBalancedTr

```
1  using System.Runtime.CompilerServices;
2  
3  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
4  
5  namespace Platform.Data.Doublets.Memory.United.Specific
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the int 64 links targets recursionless size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="UInt64LinksRecursionlessSizeBalancedTreeMethodsBase"/>
14     public unsafe class UInt64LinksTargetsRecursionlessSizeBalancedTreeMethods :
       ↪  UInt64LinksRecursionlessSizeBalancedTreeMethodsBase
15     {
16         /// <summary>
17         /// <para>
```

```
18          /// Initializes a new <see
            ↪  cref="UInt64LinksTargetsRecursionlessSizeBalancedTreeMethods"/> instance.
19          /// </para>
20          /// <para></para>
21          /// </summary>
22          /// <param name="constants">
23          /// <para>A constants.</para>
24          /// <para></para>
25          /// </param>
26          /// <param name="links">
27          /// <para>A links.</para>
28          /// <para></para>
29          /// </param>
30          /// <param name="header">
31          /// <para>A header.</para>
32          /// <para></para>
33          /// </param>
34          public UInt64LinksTargetsRecursionlessSizeBalancedTreeMethods(LinksConstants<ulong>
            ↪  constants, RawLink<ulong>* links, LinksHeader<ulong>* header) : base(constants,
            ↪  links, header) { }
35
36          /// <summary>
37          /// <para>
38          /// Gets the left reference using the specified node.
39          /// </para>
40          /// <para></para>
41          /// </summary>
42          /// <param name="node">
43          /// <para>The node.</para>
44          /// <para></para>
45          /// </param>
46          /// <returns>
47          /// <para>The ref ulong</para>
48          /// <para></para>
49          /// </returns>
50          [MethodImpl(MethodImplOptions.AggressiveInlining)]
51          protected override ref ulong GetLeftReference(ulong node) => ref
            ↪  Links[node].LeftAsTarget;
52
53          /// <summary>
54          /// <para>
55          /// Gets the right reference using the specified node.
56          /// </para>
57          /// <para></para>
58          /// </summary>
59          /// <param name="node">
60          /// <para>The node.</para>
61          /// <para></para>
62          /// </param>
63          /// <returns>
64          /// <para>The ref ulong</para>
65          /// <para></para>
66          /// </returns>
67          [MethodImpl(MethodImplOptions.AggressiveInlining)]
68          protected override ref ulong GetRightReference(ulong node) => ref
            ↪  Links[node].RightAsTarget;
69
70          /// <summary>
71          /// <para>
72          /// Gets the left using the specified node.
73          /// </para>
74          /// <para></para>
75          /// </summary>
76          /// <param name="node">
77          /// <para>The node.</para>
78          /// <para></para>
79          /// </param>
80          /// <returns>
81          /// <para>The ulong</para>
82          /// <para></para>
83          /// </returns>
84          [MethodImpl(MethodImplOptions.AggressiveInlining)]
85          protected override ulong GetLeft(ulong node) => Links[node].LeftAsTarget;
86
87          /// <summary>
88          /// <para>
89          /// Gets the right using the specified node.
```

```
90          /// </para>
91          /// <para></para>
92          /// </summary>
93          /// <param name="node">
94          /// <para>The node.</para>
95          /// <para></para>
96          /// </param>
97          /// <returns>
98          /// <para>The ulong</para>
99          /// <para></para>
100         /// </returns>
101         [MethodImpl(MethodImplOptions.AggressiveInlining)]
102         protected override ulong GetRight(ulong node) => Links[node].RightAsTarget;
103
104         /// <summary>
105         /// <para>
106         /// Sets the left using the specified node.
107         /// </para>
108         /// <para></para>
109         /// </summary>
110         /// <param name="node">
111         /// <para>The node.</para>
112         /// <para></para>
113         /// </param>
114         /// <param name="left">
115         /// <para>The left.</para>
116         /// <para></para>
117         /// </param>
118         [MethodImpl(MethodImplOptions.AggressiveInlining)]
119         protected override void SetLeft(ulong node, ulong left) => Links[node].LeftAsTarget =
            ↪ left;
120
121         /// <summary>
122         /// <para>
123         /// Sets the right using the specified node.
124         /// </para>
125         /// <para></para>
126         /// </summary>
127         /// <param name="node">
128         /// <para>The node.</para>
129         /// <para></para>
130         /// </param>
131         /// <param name="right">
132         /// <para>The right.</para>
133         /// <para></para>
134         /// </param>
135         [MethodImpl(MethodImplOptions.AggressiveInlining)]
136         protected override void SetRight(ulong node, ulong right) => Links[node].RightAsTarget =
            ↪ right;
137
138         /// <summary>
139         /// <para>
140         /// Gets the size using the specified node.
141         /// </para>
142         /// <para></para>
143         /// </summary>
144         /// <param name="node">
145         /// <para>The node.</para>
146         /// <para></para>
147         /// </param>
148         /// <returns>
149         /// <para>The ulong</para>
150         /// <para></para>
151         /// </returns>
152         [MethodImpl(MethodImplOptions.AggressiveInlining)]
153         protected override ulong GetSize(ulong node) => Links[node].SizeAsTarget;
154
155         /// <summary>
156         /// <para>
157         /// Sets the size using the specified node.
158         /// </para>
159         /// <para></para>
160         /// </summary>
161         /// <param name="node">
162         /// <para>The node.</para>
163         /// <para></para>
164         /// </param>
165         /// <param name="size">
```

```
166         /// <para>The size.</para>
167         /// <para></para>
168         /// </param>
169         [MethodImpl(MethodImplOptions.AggressiveInlining)]
170         protected override void SetSize(ulong node, ulong size) => Links[node].SizeAsTarget =
            ↪ size;
171
172         /// <summary>
173         /// <para>
174         /// Gets the tree root.
175         /// </para>
176         /// <para></para>
177         /// </summary>
178         /// <returns>
179         /// <para>The ulong</para>
180         /// <para></para>
181         /// </returns>
182         [MethodImpl(MethodImplOptions.AggressiveInlining)]
183         protected override ulong GetTreeRoot() => Header->RootAsTarget;
184
185         /// <summary>
186         /// <para>
187         /// Gets the base part value using the specified link.
188         /// </para>
189         /// <para></para>
190         /// </summary>
191         /// <param name="link">
192         /// <para>The link.</para>
193         /// <para></para>
194         /// </param>
195         /// <returns>
196         /// <para>The ulong</para>
197         /// <para></para>
198         /// </returns>
199         [MethodImpl(MethodImplOptions.AggressiveInlining)]
200         protected override ulong GetBasePartValue(ulong link) => Links[link].Target;
201
202         /// <summary>
203         /// <para>
204         /// Determines whether this instance first is to the left of second.
205         /// </para>
206         /// <para></para>
207         /// </summary>
208         /// <param name="firstSource">
209         /// <para>The first source.</para>
210         /// <para></para>
211         /// </param>
212         /// <param name="firstTarget">
213         /// <para>The first target.</para>
214         /// <para></para>
215         /// </param>
216         /// <param name="secondSource">
217         /// <para>The second source.</para>
218         /// <para></para>
219         /// </param>
220         /// <param name="secondTarget">
221         /// <para>The second target.</para>
222         /// <para></para>
223         /// </param>
224         /// <returns>
225         /// <para>The bool</para>
226         /// <para></para>
227         /// </returns>
228         [MethodImpl(MethodImplOptions.AggressiveInlining)]
229         protected override bool FirstIsToTheLeftOfSecond(ulong firstSource, ulong firstTarget,
            ↪ ulong secondSource, ulong secondTarget)
230             => firstTarget < secondTarget || (firstTarget == secondTarget && firstSource <
                ↪ secondSource);
231
232         /// <summary>
233         /// <para>
234         /// Determines whether this instance first is to the right of second.
235         /// </para>
236         /// <para></para>
237         /// </summary>
238         /// <param name="firstSource">
239         /// <para>The first source.</para>
240         /// <para></para>
```

```
241         /// </param>
242         /// <param name="firstTarget">
243         /// <para>The first target.</para>
244         /// <para></para>
245         /// </param>
246         /// <param name="secondSource">
247         /// <para>The second source.</para>
248         /// <para></para>
249         /// </param>
250         /// <param name="secondTarget">
251         /// <para>The second target.</para>
252         /// <para></para>
253         /// </param>
254         /// <returns>
255         /// <para>The bool</para>
256         /// <para></para>
257         /// </returns>
258         [MethodImpl(MethodImplOptions.AggressiveInlining)]
259         protected override bool FirstIsToTheRightOfSecond(ulong firstSource, ulong firstTarget,
          ↪  ulong secondSource, ulong secondTarget)
260             => firstTarget > secondTarget || (firstTarget == secondTarget && firstSource >
              ↪  secondSource);
261 
262         /// <summary>
263         /// <para>
264         /// Clears the node using the specified node.
265         /// </para>
266         /// <para></para>
267         /// </summary>
268         /// <param name="node">
269         /// <para>The node.</para>
270         /// <para></para>
271         /// </param>
272         [MethodImpl(MethodImplOptions.AggressiveInlining)]
273         protected override void ClearNode(ulong node)
274         {
275             ref var link = ref Links[node];
276             link.LeftAsTarget = OUL;
277             link.RightAsTarget = OUL;
278             link.SizeAsTarget = OUL;
279         }
280     }
281 }
```

1.109 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64LinksTargetsSizeBalancedTreeMethods.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.Data.Doublets.Memory.United.Specific
6  {
7      /// <summary>
8      /// <para>
9      /// Represents the int 64 links targets size balanced tree methods.
10     /// </para>
11     /// <para></para>
12     /// </summary>
13     /// <seealso cref="UInt64LinksSizeBalancedTreeMethodsBase"/>
14     public unsafe class UInt64LinksTargetsSizeBalancedTreeMethods :
       ↪  UInt64LinksSizeBalancedTreeMethodsBase
15     {
16         /// <summary>
17         /// <para>
18         /// Initializes a new <see cref="UInt64LinksTargetsSizeBalancedTreeMethods"/> instance.
19         /// </para>
20         /// <para></para>
21         /// </summary>
22         /// <param name="constants">
23         /// <para>A constants.</para>
24         /// <para></para>
25         /// </param>
26         /// <param name="links">
27         /// <para>A links.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="header">
31         /// <para>A header.</para>
32         /// <para></para>
```

```
33          /// </param>
34          public UInt64LinksTargetsSizeBalancedTreeMethods(LinksConstants<ulong> constants,
            ↪  RawLink<ulong>* links, LinksHeader<ulong>* header) : base(constants, links, header)
            ↪  { }
35
36          /// <summary>
37          /// <para>
38          /// Gets the left reference using the specified node.
39          /// </para>
40          /// <para></para>
41          /// </summary>
42          /// <param name="node">
43          /// <para>The node.</para>
44          /// <para></para>
45          /// </param>
46          /// <returns>
47          /// <para>The ref ulong</para>
48          /// <para></para>
49          /// </returns>
50          [MethodImpl(MethodImplOptions.AggressiveInlining)]
51          protected override ref ulong GetLeftReference(ulong node) => ref
            ↪  Links[node].LeftAsTarget;
52
53          /// <summary>
54          /// <para>
55          /// Gets the right reference using the specified node.
56          /// </para>
57          /// <para></para>
58          /// </summary>
59          /// <param name="node">
60          /// <para>The node.</para>
61          /// <para></para>
62          /// </param>
63          /// <returns>
64          /// <para>The ref ulong</para>
65          /// <para></para>
66          /// </returns>
67          [MethodImpl(MethodImplOptions.AggressiveInlining)]
68          protected override ref ulong GetRightReference(ulong node) => ref
            ↪  Links[node].RightAsTarget;
69
70          /// <summary>
71          /// <para>
72          /// Gets the left using the specified node.
73          /// </para>
74          /// <para></para>
75          /// </summary>
76          /// <param name="node">
77          /// <para>The node.</para>
78          /// <para></para>
79          /// </param>
80          /// <returns>
81          /// <para>The ulong</para>
82          /// <para></para>
83          /// </returns>
84          [MethodImpl(MethodImplOptions.AggressiveInlining)]
85          protected override ulong GetLeft(ulong node) => Links[node].LeftAsTarget;
86
87          /// <summary>
88          /// <para>
89          /// Gets the right using the specified node.
90          /// </para>
91          /// <para></para>
92          /// </summary>
93          /// <param name="node">
94          /// <para>The node.</para>
95          /// <para></para>
96          /// </param>
97          /// <returns>
98          /// <para>The ulong</para>
99          /// <para></para>
100         /// </returns>
101         [MethodImpl(MethodImplOptions.AggressiveInlining)]
102         protected override ulong GetRight(ulong node) => Links[node].RightAsTarget;
103
104         /// <summary>
105         /// <para>
106         /// Sets the left using the specified node.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="left">
        /// <para>The left.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetLeft(ulong node, ulong left) => Links[node].LeftAsTarget =
        ↪  left;

        /// <summary>
        /// <para>
        /// Sets the right using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="right">
        /// <para>The right.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetRight(ulong node, ulong right) => Links[node].RightAsTarget =
        ↪  right;

        /// <summary>
        /// <para>
        /// Gets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetSize(ulong node) => Links[node].SizeAsTarget;

        /// <summary>
        /// <para>
        /// Sets the size using the specified node.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="node">
        /// <para>The node.</para>
        /// <para></para>
        /// </param>
        /// <param name="size">
        /// <para>The size.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override void SetSize(ulong node, ulong size) => Links[node].SizeAsTarget =
        ↪  size;

        /// <summary>
        /// <para>
        /// Gets the tree root.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
```

```
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetTreeRoot() => Header->RootAsTarget;

        /// <summary>
        /// <para>
        /// Gets the base part value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetBasePartValue(ulong link) => Links[link].Target;

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the left of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool FirstIsToTheLeftOfSecond(ulong firstSource, ulong firstTarget,
        ↪  ulong secondSource, ulong secondTarget)
            => firstTarget < secondTarget || (firstTarget == secondTarget && firstSource <
            ↪  secondSource);

        /// <summary>
        /// <para>
        /// Determines whether this instance first is to the right of second.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="firstSource">
        /// <para>The first source.</para>
        /// <para></para>
        /// </param>
        /// <param name="firstTarget">
        /// <para>The first target.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondSource">
        /// <para>The second source.</para>
        /// <para></para>
        /// </param>
        /// <param name="secondTarget">
        /// <para>The second target.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
```

```
258         [MethodImpl(MethodImplOptions.AggressiveInlining)]
259         protected override bool FirstIsToTheRightOfSecond(ulong firstSource, ulong firstTarget,
            ↪  ulong secondSource, ulong secondTarget)
260             => firstTarget > secondTarget || (firstTarget == secondTarget && firstSource >
                ↪  secondSource);
261 
262         /// <summary>
263         /// <para>
264         /// Clears the node using the specified node.
265         /// </para>
266         /// <para></para>
267         /// </summary>
268         /// <param name="node">
269         /// <para>The node.</para>
270         /// <para></para>
271         /// </param>
272         [MethodImpl(MethodImplOptions.AggressiveInlining)]
273         protected override void ClearNode(ulong node)
274         {
275             ref var link = ref Links[node];
276             link.LeftAsTarget = OUL;
277             link.RightAsTarget = OUL;
278             link.SizeAsTarget = OUL;
279         }
280     }
281 }
```

1.110 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64UnitedMemoryLinks.cs

```
1  using System;
2  using System.Runtime.CompilerServices;
3  using Platform.Memory;
4  using Platform.Singletons;
5  using Platform.Data.Doublets.Memory.United.Generic;
6 
7  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
8 
9  namespace Platform.Data.Doublets.Memory.United.Specific
10 {
11     /// <summary>
12     /// <para>Represents a low-level implementation of direct access to resizable memory, for
       ↪  organizing the storage of links with addresses represented as <see cref="ulong"
       ↪  />.</para>
13     /// <para>Представляет низкоуровневую реализация прямого доступа к памяти с переменным
       ↪  размером, для организации хранения связей с адресами представленными в виде <see
       ↪  cref="ulong"/>.</para>
14     /// </summary>
15     public unsafe class UInt64UnitedMemoryLinks : UnitedMemoryLinksBase<ulong>
16     {
17         private readonly Func<ILinksTreeMethods<ulong>> _createSourceTreeMethods;
18         private readonly Func<ILinksTreeMethods<ulong>> _createTargetTreeMethods;
19         private LinksHeader<ulong>* _header;
20         private RawLink<ulong>* _links;
21 
22         /// <summary>
23         /// <para>
24         /// Initializes a new <see cref="UInt64UnitedMemoryLinks"/> instance.
25         /// </para>
26         /// <para></para>
27         /// </summary>
28         /// <param name="address">
29         /// <para>A address.</para>
30         /// <para></para>
31         /// </param>
32         [MethodImpl(MethodImplOptions.AggressiveInlining)]
33         public UInt64UnitedMemoryLinks(string address) : this(address, DefaultLinksSizeStep) { }
34 
35         /// <summary>
36         /// Создаёт экземпляр базы данных Links в файле по указанному адресу, с указанным
           ↪  минимальным шагом расширения базы данных.
37         /// </summary>
38         /// <param name="address">Полный пусть к файлу базы данных.</param>
39         /// <param name="memoryReservationStep">Минимальный шаг расширения базы данных в
           ↪  байтах.</param>
40         [MethodImpl(MethodImplOptions.AggressiveInlining)]
41         public UInt64UnitedMemoryLinks(string address, long memoryReservationStep) : this(new
           ↪  FileMappedResizableDirectMemory(address, memoryReservationStep),
           ↪  memoryReservationStep) { }
42 
43         /// <summary>
```

```
44          /// <para>
45          /// Initializes a new <see cref="UInt64UnitedMemoryLinks"/> instance.
46          /// </para>
47          /// <para></para>
48          /// </summary>
49          /// <param name="memory">
50          /// <para>A memory.</para>
51          /// <para></para>
52          /// </param>
53          [MethodImpl(MethodImplOptions.AggressiveInlining)]
54          public UInt64UnitedMemoryLinks(IResizableDirectMemory memory) : this(memory,
            ↪ DefaultLinksSizeStep) { }
55
56          /// <summary>
57          /// <para>
58          /// Initializes a new <see cref="UInt64UnitedMemoryLinks"/> instance.
59          /// </para>
60          /// <para></para>
61          /// </summary>
62          /// <param name="memory">
63          /// <para>A memory.</para>
64          /// <para></para>
65          /// </param>
66          /// <param name="memoryReservationStep">
67          /// <para>A memory reservation step.</para>
68          /// <para></para>
69          /// </param>
70          [MethodImpl(MethodImplOptions.AggressiveInlining)]
71          public UInt64UnitedMemoryLinks(IResizableDirectMemory memory, long
            ↪ memoryReservationStep) : this(memory, memoryReservationStep,
            ↪ Default<LinksConstants<ulong>>.Instance, IndexTreeType.Default) { }
72
73          /// <summary>
74          /// <para>
75          /// Initializes a new <see cref="UInt64UnitedMemoryLinks"/> instance.
76          /// </para>
77          /// <para></para>
78          /// </summary>
79          /// <param name="memory">
80          /// <para>A memory.</para>
81          /// <para></para>
82          /// </param>
83          /// <param name="memoryReservationStep">
84          /// <para>A memory reservation step.</para>
85          /// <para></para>
86          /// </param>
87          /// <param name="constants">
88          /// <para>A constants.</para>
89          /// <para></para>
90          /// </param>
91          /// <param name="indexTreeType">
92          /// <para>A index tree type.</para>
93          /// <para></para>
94          /// </param>
95          [MethodImpl(MethodImplOptions.AggressiveInlining)]
96          public UInt64UnitedMemoryLinks(IResizableDirectMemory memory, long
            ↪ memoryReservationStep, LinksConstants<ulong> constants, IndexTreeType indexTreeType)
            ↪ : base(memory, memoryReservationStep, constants)
97          {
98              if (indexTreeType == IndexTreeType.SizedAndThreadedAVLBalancedTree)
99              {
100                 _createSourceTreeMethods = () => new
                    ↪ UInt64LinksSourcesAvlBalancedTreeMethods(Constants, _links, _header);
101                 _createTargetTreeMethods = () => new
                    ↪ UInt64LinksTargetsAvlBalancedTreeMethods(Constants, _links, _header);
102             }
103             else if (indexTreeType == IndexTreeType.SizeBalancedTree)
104             {
105                 _createSourceTreeMethods = () => new
                    ↪ UInt64LinksSourcesSizeBalancedTreeMethods(Constants, _links, _header);
106                 _createTargetTreeMethods = () => new
                    ↪ UInt64LinksTargetsSizeBalancedTreeMethods(Constants, _links, _header);
107             }
108             else
109             {
```

```
110                 _createSourceTreeMethods = () => new
                    ↪  UInt64LinksSourcesRecursionlessSizeBalancedTreeMethods(Constants, _links,
                    ↪  _header);
111                 _createTargetTreeMethods = () => new
                    ↪  UInt64LinksTargetsRecursionlessSizeBalancedTreeMethods(Constants, _links,
                    ↪  _header);
112             }
113             Init(memory, memoryReservationStep);
114         }
115
116         /// <summary>
117         /// <para>
118         /// Sets the pointers using the specified memory.
119         /// </para>
120         /// <para></para>
121         /// </summary>
122         /// <param name="memory">
123         /// <para>The memory.</para>
124         /// <para></para>
125         /// </param>
126         [MethodImpl(MethodImplOptions.AggressiveInlining)]
127         protected override void SetPointers(IResizableDirectMemory memory)
128         {
129             _header = (LinksHeader<ulong>*)memory.Pointer;
130             _links = (RawLink<ulong>*)memory.Pointer;
131             SourcesTreeMethods = _createSourceTreeMethods();
132             TargetsTreeMethods = _createTargetTreeMethods();
133             UnusedLinksListMethods = new UInt64UnusedLinksListMethods(_links, _header);
134         }
135
136         /// <summary>
137         /// <para>
138         /// Resets the pointers.
139         /// </para>
140         /// <para></para>
141         /// </summary>
142         [MethodImpl(MethodImplOptions.AggressiveInlining)]
143         protected override void ResetPointers()
144         {
145             base.ResetPointers();
146             _links = null;
147             _header = null;
148         }
149
150         /// <summary>
151         /// <para>
152         /// Gets the header reference.
153         /// </para>
154         /// <para></para>
155         /// </summary>
156         /// <returns>
157         /// <para>A ref links header of ulong</para>
158         /// <para></para>
159         /// </returns>
160         [MethodImpl(MethodImplOptions.AggressiveInlining)]
161         protected override ref LinksHeader<ulong> GetHeaderReference() => ref *_header;
162
163         /// <summary>
164         /// <para>
165         /// Gets the link reference using the specified link index.
166         /// </para>
167         /// <para></para>
168         /// </summary>
169         /// <param name="linkIndex">
170         /// <para>The link index.</para>
171         /// <para></para>
172         /// </param>
173         /// <returns>
174         /// <para>A ref raw link of ulong</para>
175         /// <para></para>
176         /// </returns>
177         [MethodImpl(MethodImplOptions.AggressiveInlining)]
178         protected override ref RawLink<ulong> GetLinkReference(ulong linkIndex) => ref
            ↪  _links[linkIndex];
179
180         /// <summary>
181         /// <para>
182         /// Determines whether this instance are equal.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool AreEqual(ulong first, ulong second) => first == second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessThan(ulong first, ulong second) => first < second;

        /// <summary>
        /// <para>
        /// Determines whether this instance less or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool LessOrEqualThan(ulong first, ulong second) => first <= second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
```

```
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterThan(ulong first, ulong second) => first > second;

        /// <summary>
        /// <para>
        /// Determines whether this instance greater or equal than.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override bool GreaterOrEqualThan(ulong first, ulong second) => first >= second;

        /// <summary>
        /// <para>
        /// Gets the zero.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetZero() => 0UL;

        /// <summary>
        /// <para>
        /// Gets the one.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong GetOne() => 1UL;

        /// <summary>
        /// <para>
        /// Converts the to int 64 using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The long</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override long ConvertToInt64(ulong value) => (long)value;

        /// <summary>
        /// <para>
        /// Converts the to address using the specified value.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        /// <returns>
```

```
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong ConvertToAddress(long value) => (ulong)value;

        /// <summary>
        /// <para>
        /// Adds the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Add(ulong first, ulong second) => first + second;

        /// <summary>
        /// <para>
        /// Subtracts the first.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="first">
        /// <para>The first.</para>
        /// <para></para>
        /// </param>
        /// <param name="second">
        /// <para>The second.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Subtract(ulong first, ulong second) => first - second;

        /// <summary>
        /// <para>
        /// Increments the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        protected override ulong Increment(ulong link) => ++link;

        /// <summary>
        /// <para>
        /// Decrements the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The ulong</para>
        /// <para></para>
```

```
417         /// </returns>
418         [MethodImpl(MethodImplOptions.AggressiveInlining)]
419         protected override ulong Decrement(ulong link) => --link;
420     }
421 }
```

1.111 ./csharp/Platform.Data.Doublets/Memory/United/Specific/UInt64UnusedLinksListMethods.cs

```
1  using System.Runtime.CompilerServices;
2  using Platform.Data.Doublets.Memory.United.Generic;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Data.Doublets.Memory.United.Specific
7  {
8      /// <summary>
9      /// <para>
10     /// Represents the int 64 unused links list methods.
11     /// </para>
12     /// <para></para>
13     /// </summary>
14     /// <seealso cref="UnusedLinksListMethods{ulong}"/>
15     public unsafe class UInt64UnusedLinksListMethods : UnusedLinksListMethods<ulong>
16     {
17         private readonly RawLink<ulong>* _links;
18         private readonly LinksHeader<ulong>* _header;
19
20         /// <summary>
21         /// <para>
22         /// Initializes a new <see cref="UInt64UnusedLinksListMethods"/> instance.
23         /// </para>
24         /// <para></para>
25         /// </summary>
26         /// <param name="links">
27         /// <para>A links.</para>
28         /// <para></para>
29         /// </param>
30         /// <param name="header">
31         /// <para>A header.</para>
32         /// <para></para>
33         /// </param>
34         [MethodImpl(MethodImplOptions.AggressiveInlining)]
35         public UInt64UnusedLinksListMethods(RawLink<ulong>* links, LinksHeader<ulong>* header)
36             : base((byte*)links, (byte*)header)
37         {
38             _links = links;
39             _header = header;
40         }
41
42         /// <summary>
43         /// <para>
44         /// Gets the link reference using the specified link.
45         /// </para>
46         /// <para></para>
47         /// </summary>
48         /// <param name="link">
49         /// <para>The link.</para>
50         /// <para></para>
51         /// </param>
52         /// <returns>
53         /// <para>A ref raw link of ulong</para>
54         /// <para></para>
55         /// </returns>
56         [MethodImpl(MethodImplOptions.AggressiveInlining)]
57         protected override ref RawLink<ulong> GetLinkReference(ulong link) => ref _links[link];
58
59         /// <summary>
60         /// <para>
61         /// Gets the header reference.
62         /// </para>
63         /// <para></para>
64         /// </summary>
65         /// <returns>
66         /// <para>A ref links header of ulong</para>
67         /// <para></para>
68         /// </returns>
69         [MethodImpl(MethodImplOptions.AggressiveInlining)]
70         protected override ref LinksHeader<ulong> GetHeaderReference() => ref *_header;
71     }
72 }
```

1.112 ./csharp/Platform.Data.Doublets/PropertyOperators/PropertiesOperator.cs

```
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Interfaces;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.PropertyOperators
{
    /// <summary>
    /// <para>
    /// Represents the properties operator.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksOperatorBase{TLink}"/>
    /// <seealso cref="IProperties{TLink, TLink, TLink}"/>
    public class PropertiesOperator<TLink> : LinksOperatorBase<TLink>, IProperties<TLink, TLink,
    ↪  TLink>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="PropertiesOperator"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public PropertiesOperator(ILinks<TLink> links) : base(links) { }

        /// <summary>
        /// <para>
        /// Gets the value using the specified object.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="@object">
        /// <para>The object.</para>
        /// <para></para>
        /// </param>
        /// <param name="property">
        /// <para>The property.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink GetValue(TLink @object, TLink property)
        {
            var links = _links;
            var objectProperty = links.SearchOrDefault(@object, property);
            if (_equalityComparer.Equals(objectProperty, default))
            {
                return default;
            }
            var constants = links.Constants;
            var any = constants.Any;
            var query = new Link<TLink>(any, objectProperty, any);
            var valueLink = links.SingleOrDefault(query);
            if (valueLink == null)
            {
                return default;
            }
            return links.GetTarget(valueLink[constants.IndexPart]);
        }

        /// <summary>
        /// <para>
        /// Sets the value using the specified object.
        /// </para>
        /// <para></para>
```

```
        /// </summary>
        /// <param name="@object">
        /// <para>The object.</para>
        /// <para></para>
        /// </param>
        /// <param name="property">
        /// <para>The property.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void SetValue(TLink @object, TLink property, TLink value)
        {
            var links = _links;
            var objectProperty = links.GetOrCreate(@object, property);
            links.DeleteMany(links.AllIndices(links.Constants.Any, objectProperty));
            links.GetOrCreate(objectProperty, value);
        }
    }
}
```

1.113 ./csharp/Platform.Data.Doublets/PropertyOperators/PropertyOperator.cs

```
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Interfaces;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.PropertyOperators
{
    /// <summary>
    /// <para>
    /// Represents the property operator.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksOperatorBase{TLink}"/>
    /// <seealso cref="IProperty{TLink, TLink}"/>
    public class PropertyOperator<TLink> : LinksOperatorBase<TLink>, IProperty<TLink, TLink>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;
        private readonly TLink _propertyMarker;
        private readonly TLink _propertyValueMarker;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="PropertyOperator"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="propertyMarker">
        /// <para>A property marker.</para>
        /// <para></para>
        /// </param>
        /// <param name="propertyValueMarker">
        /// <para>A property value marker.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public PropertyOperator(ILinks<TLink> links, TLink propertyMarker, TLink
        ↪  propertyValueMarker) : base(links)
        {
            _propertyMarker = propertyMarker;
            _propertyValueMarker = propertyValueMarker;
        }

        /// <summary>
        /// <para>
        /// Gets the link.
        /// </para>
        /// <para></para>
```

```
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink Get(TLink link)
        {
            var property = _links.SearchOrDefault(link, _propertyMarker);
            return GetValue(GetContainer(property));
        }
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink GetContainer(TLink property)
        {
            var valueContainer = default(TLink);
            if (_equalityComparer.Equals(property, default))
            {
                return valueContainer;
            }
            var links = _links;
            var constants = links.Constants;
            var countinueConstant = constants.Continue;
            var breakConstant = constants.Break;
            var anyConstant = constants.Any;
            var query = new Link<TLink>(anyConstant, property, anyConstant);
            links.Each(candidate =>
            {
                var candidateTarget = links.GetTarget(candidate);
                var valueTarget = links.GetTarget(candidateTarget);
                if (_equalityComparer.Equals(valueTarget, _propertyValueMarker))
                {
                    valueContainer = links.GetIndex(candidate);
                    return breakConstant;
                }
                return countinueConstant;
            }, query);
            return valueContainer;
        }
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink GetValue(TLink container) => _equalityComparer.Equals(container, default)
        ↪  ? default : _links.GetTarget(container);

        /// <summary>
        /// <para>
        /// Sets the link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <param name="value">
        /// <para>The value.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void Set(TLink link, TLink value)
        {
            var links = _links;
            var property = links.GetOrCreate(link, _propertyMarker);
            var container = GetContainer(property);
            if (_equalityComparer.Equals(container, default))
            {
                links.GetOrCreate(property, value);
            }
            else
            {
                links.Update(container, property, value);
            }
        }
    }
}
```

```
using System.Collections;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Collections.Stacks;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Stacks
{
    /// <summary>
    /// <para>
    /// Represents the stack.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksOperatorBase{TLink}"/>
    /// <seealso cref="IStack{TLink}"/>
    public class Stack<TLink> : LinksOperatorBase<TLink>, IStack<TLink>
    {
        private static readonly EqualityComparer<TLink> _equalityComparer =
        ↪  EqualityComparer<TLink>.Default;
        private readonly TLink _stack;

        /// <summary>
        /// <para>
        /// Gets the is empty value.
        /// </para>
        /// <para></para>
        /// </summary>
        public bool IsEmpty
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get => _equalityComparer.Equals(Peek(), _stack);
        }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="Stack"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="stack">
        /// <para>A stack.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public Stack(ILinks<TLink> links, TLink stack) : base(links) => _stack = stack;
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink GetStackMarker() => _links.GetSource(_stack);
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private TLink GetTop() => _links.GetTarget(_stack);

        /// <summary>
        /// <para>
        /// Peeks this instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The link</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink Peek() => _links.GetTarget(GetTop());

        /// <summary>
        /// <para>
        /// Pops this instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The element.</para>
        /// <para></para>
```

```
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public TLink Pop()
        {
            var element = Peek();
            if (!_equalityComparer.Equals(element, _stack))
            {
                var top = GetTop();
                var previousTop = _links.GetSource(top);
                _links.Update(_stack, GetStackMarker(), previousTop);
                _links.Delete(top);
            }
            return element;
        }

        /// <summary>
        /// <para>
        /// Pushes the element.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="element">
        /// <para>The element.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public void Push(TLink element) => _links.Update(_stack, GetStackMarker(),
        ↪  _links.GetOrCreate(GetTop(), element));
    }
}
```

1.115 ./csharp/Platform.Data.Doublets/Stacks/StackExtensions.cs

```
using System.Runtime.CompilerServices;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets.Stacks
{
    /// <summary>
    /// <para>
    /// Represents the stack extensions.
    /// </para>
    /// <para></para>
    /// </summary>
    public static class StackExtensions
    {
        /// <summary>
        /// <para>
        /// Creates the stack using the specified links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <typeparam name="TLink">
        /// <para>The link.</para>
        /// <para></para>
        /// </typeparam>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="stackMarker">
        /// <para>The stack marker.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The stack.</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static TLink CreateStack<TLink>(this ILinks<TLink> links, TLink stackMarker)
        {
            var stackPoint = links.CreatePoint();
            var stack = links.Update(stackPoint, stackMarker, stackPoint);
            return stack;
        }
    }
}
```

1.116 ./csharp/Platform.Data.Doublets/SynchronizedLinks.cs

```
using System;
using System.Collections.Generic;
using System.Runtime.CompilerServices;
using Platform.Data.Doublets;
using Platform.Delegates;
using Platform.Threading.Synchronization;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets
{
    /// <remarks>
    /// TODO: Autogeneration of synchronized wrapper (decorator).
    /// TODO: Try to unfold code of each method using IL generation for performance improvements.
    /// TODO: Or even to unfold multiple layers of implementations.
    /// </remarks>
    public class SynchronizedLinks<TLinkAddress> : ISynchronizedLinks<TLinkAddress>
    {
        /// <summary>
        /// <para>
        /// Gets the constants value.
        /// </para>
        /// <para></para>
        /// </summary>
        public LinksConstants<TLinkAddress> Constants
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get;
        }

        /// <summary>
        /// <para>
        /// Gets the sync root value.
        /// </para>
        /// <para></para>
        /// </summary>
        public ISynchronization SyncRoot
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get;
        }

        /// <summary>
        /// <para>
        /// Gets the sync value.
        /// </para>
        /// <para></para>
        /// </summary>
        public ILinks<TLinkAddress> Sync
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get;
        }

        /// <summary>
        /// <para>
        /// Gets the unsync value.
        /// </para>
        /// <para></para>
        /// </summary>
        public ILinks<TLinkAddress> Unsync
        {
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            get;
        }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="SynchronizedLinks"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public SynchronizedLinks(ILinks<TLinkAddress> links) : this(new
        ↪  ReaderWriterLockSynchronization(), links) { }
```

```
79
80          /// <summary>
81          /// <para>
82          /// Initializes a new <see cref="SynchronizedLinks"/> instance.
83          /// </para>
84          /// <para></para>
85          /// </summary>
86          /// <param name="synchronization">
87          /// <para>A synchronization.</para>
88          /// <para></para>
89          /// </param>
90          /// <param name="links">
91          /// <para>A links.</para>
92          /// <para></para>
93          /// </param>
94          [MethodImpl(MethodImplOptions.AggressiveInlining)]
95          public SynchronizedLinks(ISynchronization synchronization, ILinks<TLinkAddress> links)
96          {
97              SyncRoot = synchronization;
98              Sync = this;
99              Unsync = links;
100             Constants = links.Constants;
101         }
102
103         /// <summary>
104         /// <para>
105         /// Counts the restriction.
106         /// </para>
107         /// <para></para>
108         /// </summary>
109         /// <param name="restriction">
110         /// <para>The restriction.</para>
111         /// <para></para>
112         /// </param>
113         /// <returns>
114         /// <para>The link address</para>
115         /// <para></para>
116         /// </returns>
117         [MethodImpl(MethodImplOptions.AggressiveInlining)]
118         public TLinkAddress Count(IList<TLinkAddress>? restriction) =>
            ↪ SyncRoot.ExecuteReadOperation(restriction, Unsync.Count);
119
120         /// <summary>
121         /// <para>
122         /// Eaches the handler.
123         /// </para>
124         /// <para></para>
125         /// </summary>
126         /// <param name="handler">
127         /// <para>The handler.</para>
128         /// <para></para>
129         /// </param>
130         /// <param name="restriction">
131         /// <para>The substitution.</para>
132         /// <para></para>
133         /// </param>
134         /// <returns>
135         /// <para>The link address</para>
136         /// <para></para>
137         /// </returns>
138         [MethodImpl(MethodImplOptions.AggressiveInlining)]
139         public TLinkAddress Each(IList<TLinkAddress>? restriction, ReadHandler<TLinkAddress>?
            ↪ handler) => SyncRoot.ExecuteReadOperation(restriction, handler, Unsync.Each);
140
141         /// <summary>
142         /// <para>
143         /// Creates the substitution.
144         /// </para>
145         /// <para></para>
146         /// </summary>
147         /// <param name="substitution">
148         /// <para>The substitution.</para>
149         /// <para></para>
150         /// </param>
151         /// <returns>
152         /// <para>The link address</para>
153         /// <para></para>
154         /// </returns>
```

```
155         [MethodImpl(MethodImplOptions.AggressiveInlining)]
156         public TLinkAddress Create(IList<TLinkAddress>? substitution,
            ↪ WriteHandler<TLinkAddress>? handler) => SyncRoot.ExecuteWriteOperation(substitution,
            ↪ handler, Unsync.Create);
157
158         /// <summary>
159         /// <para>
160         /// Updates the substitution.
161         /// </para>
162         /// <para></para>
163         /// </summary>
164         /// <param name="restriction">
165         /// <para>The substitution.</para>
166         /// <para></para>
167         /// </param>
168         /// <param name="substitution">
169         /// <para>The substitution.</para>
170         /// <para></para>
171         /// </param>
172         /// <returns>
173         /// <para>The link address</para>
174         /// <para></para>
175         /// </returns>
176         [MethodImpl(MethodImplOptions.AggressiveInlining)]
177         public TLinkAddress Update(IList<TLinkAddress>? restriction, IList<TLinkAddress>?
            ↪ substitution, WriteHandler<TLinkAddress>? handler) =>
            ↪ SyncRoot.ExecuteWriteOperation(restriction, substitution, handler, Unsync.Update);
178
179         /// <summary>
180         /// <para>
181         /// Deletes the substitution.
182         /// </para>
183         /// <para></para>
184         /// </summary>
185         /// <param name="restriction">
186         /// <para>The substitution.</para>
187         /// <para></para>
188         /// </param>
189         [MethodImpl(MethodImplOptions.AggressiveInlining)]
190         public TLinkAddress Delete(IList<TLinkAddress>? restriction, WriteHandler<TLinkAddress>?
            ↪ handler) => SyncRoot.ExecuteWriteOperation(restriction, handler, Unsync.Delete);
191
192         //public T Trigger(IList<T> restriction, Func<IList<T>, IList<T>, T> matchedHandler,
            ↪ IList<T> substitution, Func<IList<T>, IList<T>, T> substitutedHandler)
193         //{
194         //    if (restriction != null && substitution != null &&
            ↪ !substitution.EqualTo(restriction))
195         //        return SyncRoot.ExecuteWriteOperation(restriction, matchedHandler,
            ↪ substitution, substitutedHandler, Unsync.Trigger);
196
197         //    return SyncRoot.ExecuteReadOperation(restriction, matchedHandler, substitution,
            ↪ substitutedHandler, Unsync.Trigger);
198         //}
199     }
200 }
```

1.117 ./csharp/Platform.Data.Doublets/UInt64LinksExtensions.cs

```
1  using System;
2  using System.Text;
3  using System.Collections.Generic;
4  using System.Runtime.CompilerServices;
5  using Platform.Singletons;
6
7  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
8
9  namespace Platform.Data.Doublets
10 {
11     /// <summary>
12     /// <para>
13     /// Represents the int 64 links extensions.
14     /// </para>
15     /// <para></para>
16     /// </summary>
17     public static class UInt64LinksExtensions
18     {
19         /// <summary>
20         /// <para>
21         /// The instance.
```

```
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly LinksConstants<ulong> Constants =
        ↪  Default<LinksConstants<ulong>>.Instance;

        /// <summary>
        /// <para>
        /// Determines whether any link is any.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="sequence">
        /// <para>The sequence.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool AnyLinkIsAny(this ILinks<ulong> links, params ulong[] sequence)
        {
            if (sequence == null)
            {
                return false;
            }
            var constants = links.Constants;
            for (var i = 0; i < sequence.Length; i++)
            {
                if (sequence[i] == constants.Any)
                {
                    return true;
                }
            }
            return false;
        }

        /// <summary>
        /// <para>
        /// Formats the structure using the specified links.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>The links.</para>
        /// <para></para>
        /// </param>
        /// <param name="linkIndex">
        /// <para>The link index.</para>
        /// <para></para>
        /// </param>
        /// <param name="isElement">
        /// <para>The is element.</para>
        /// <para></para>
        /// </param>
        /// <param name="renderIndex">
        /// <para>The render index.</para>
        /// <para></para>
        /// </param>
        /// <param name="renderDebug">
        /// <para>The render debug.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The string</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static string FormatStructure(this ILinks<ulong> links, ulong linkIndex,
        ↪  Func<Link<ulong>, bool> isElement, bool renderIndex = false, bool renderDebug =
        ↪  false)
        {
            var sb = new StringBuilder();
```

```
97              var visited = new HashSet<ulong>();
98              links.AppendStructure(sb, visited, linkIndex, isElement, (innerSb, link) =>
                ↪  innerSb.Append(link.Index), renderIndex, renderDebug);
99              return sb.ToString();
100         }
101
102         /// <summary>
103         /// <para>
104         /// Formats the structure using the specified links.
105         /// </para>
106         /// <para></para>
107         /// </summary>
108         /// <param name="links">
109         /// <para>The links.</para>
110         /// <para></para>
111         /// </param>
112         /// <param name="linkIndex">
113         /// <para>The link index.</para>
114         /// <para></para>
115         /// </param>
116         /// <param name="isElement">
117         /// <para>The is element.</para>
118         /// <para></para>
119         /// </param>
120         /// <param name="appendElement">
121         /// <para>The append element.</para>
122         /// <para></para>
123         /// </param>
124         /// <param name="renderIndex">
125         /// <para>The render index.</para>
126         /// <para></para>
127         /// </param>
128         /// <param name="renderDebug">
129         /// <para>The render debug.</para>
130         /// <para></para>
131         /// </param>
132         /// <returns>
133         /// <para>The string</para>
134         /// <para></para>
135         /// </returns>
136         [MethodImpl(MethodImplOptions.AggressiveInlining)]
137         public static string FormatStructure(this ILinks<ulong> links, ulong linkIndex,
                ↪  Func<Link<ulong>, bool> isElement, Action<StringBuilder, Link<ulong>> appendElement,
                ↪  bool renderIndex = false, bool renderDebug = false)
138         {
139             var sb = new StringBuilder();
140             var visited = new HashSet<ulong>();
141             links.AppendStructure(sb, visited, linkIndex, isElement, appendElement, renderIndex,
                    ↪  renderDebug);
142             return sb.ToString();
143         }
144
145         /// <summary>
146         /// <para>
147         /// Appends the structure using the specified links.
148         /// </para>
149         /// <para></para>
150         /// </summary>
151         /// <param name="links">
152         /// <para>The links.</para>
153         /// <para></para>
154         /// </param>
155         /// <param name="sb">
156         /// <para>The sb.</para>
157         /// <para></para>
158         /// </param>
159         /// <param name="visited">
160         /// <para>The visited.</para>
161         /// <para></para>
162         /// </param>
163         /// <param name="linkIndex">
164         /// <para>The link index.</para>
165         /// <para></para>
166         /// </param>
167         /// <param name="isElement">
168         /// <para>The is element.</para>
169         /// <para></para>
```

```
        /// </param>
        /// <param name="appendElement">
        /// <para>The append element.</para>
        /// <para></para>
        /// </param>
        /// <param name="renderIndex">
        /// <para>The render index.</para>
        /// <para></para>
        /// </param>
        /// <param name="renderDebug">
        /// <para>The render debug.</para>
        /// <para></para>
        /// </param>
        /// <exception cref="ArgumentNullException">
        /// <para></para>
        /// <para></para>
        /// </exception>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static void AppendStructure(this ILinks<ulong> links, StringBuilder sb,
        ↪  HashSet<ulong> visited, ulong linkIndex, Func<Link<ulong>, bool> isElement,
        ↪  Action<StringBuilder, Link<ulong>> appendElement, bool renderIndex = false, bool
        ↪  renderDebug = false)
        {
            if (sb == null)
            {
                throw new ArgumentNullException(nameof(sb));
            }
            if (linkIndex == Constants.Null || linkIndex == Constants.Any || linkIndex ==
            ↪  Constants.Itself)
            {
                return;
            }
            if (links.Exists(linkIndex))
            {
                if (visited.Add(linkIndex))
                {
                    sb.Append('(');
                    var link = new Link<ulong>(links.GetLink(linkIndex));
                    if (renderIndex)
                    {
                        sb.Append(link.Index);
                        sb.Append(':');
                    }
                    if (link.Source == link.Index)
                    {
                        sb.Append(link.Index);
                    }
                    else
                    {
                        var source = new Link<ulong>(links.GetLink(link.Source));
                        if (isElement(source))
                        {
                            appendElement(sb, source);
                        }
                        else
                        {
                            links.AppendStructure(sb, visited, source.Index, isElement,
                            ↪  appendElement, renderIndex);
                        }
                    }
                    sb.Append(' ');
                    if (link.Target == link.Index)
                    {
                        sb.Append(link.Index);
                    }
                    else
                    {
                        var target = new Link<ulong>(links.GetLink(link.Target));
                        if (isElement(target))
                        {
                            appendElement(sb, target);
                        }
                        else
                        {
                            links.AppendStructure(sb, visited, target.Index, isElement,
                            ↪  appendElement, renderIndex);
                        }
                    }
```

```
                    sb.Append(')');
                }
                else
                {
                    if (renderDebug)
                    {
                        sb.Append('*');
                    }
                    sb.Append(linkIndex);
                }
            }
            else
            {
                if (renderDebug)
                {
                    sb.Append('~');
                }
                sb.Append(linkIndex);
            }
        }
    }
}
```

1.118 ./csharp/Platform.Data.Doublets/UInt64LinksTransactionsLayer.cs

```
using System;
using System.Linq;
using System.Collections.Generic;
using System.IO;
using System.Runtime.CompilerServices;
using System.Threading;
using System.Threading.Tasks;
using Platform.Disposables;
using Platform.Timestamps;
using Platform.Unsafe;
using Platform.IO;
using Platform.Data.Doublets.Decorators;
using Platform.Delegates;
using Platform.Exceptions;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.Data.Doublets
{
    /// <summary>
    /// <para>
    /// Represents the int 64 links transactions layer.
    /// </para>
    /// <para></para>
    /// </summary>
    /// <seealso cref="LinksDisposableDecoratorBase{ulong}"/>
    public class UInt64LinksTransactionsLayer : LinksDisposableDecoratorBase<ulong> //-V3073
    {
        /// <remarks>
        /// Альтернативные варианты хранения трансформации (элемента транзакции):
        ///
        /// private enum TransitionType
        /// {
        ///     Creation,
        ///     UpdateOf,
        ///     UpdateTo,
        ///     Deletion
        /// }
        ///
        /// private struct Transition
        /// {
        ///     public ulong TransactionId;
        ///     public UniqueTimestamp Timestamp;
        ///     public TransactionItemType Type;
        ///     public Link Source;
        ///     public Link Linker;
        ///     public Link Target;
        /// }
        ///
        /// Или
        ///
        /// public struct TransitionHeader
        /// {
        ///     public ulong TransactionIdCombined;
        ///     public ulong TimestampCombined;
```

```
        ///
        ///     public ulong TransactionId
        ///     {
        ///         get
        ///         {
        ///             return (ulong) mask &amp;amp; TransactionIdCombined;
        ///         }
        ///     }
        ///
        ///     public UniqueTimestamp Timestamp
        ///     {
        ///         get
        ///         {
        ///             return (UniqueTimestamp)mask &amp;amp; TransactionIdCombined;
        ///         }
        ///     }
        ///
        ///     public TransactionItemType Type
        ///     {
        ///         get
        ///         {
        ///             // Использовать по одному биту из TransactionId и Timestamp,
        ///             // для значения в 2 бита, которое представляет тип операции
        ///             throw new NotImplementedException();
        ///         }
        ///     }
        /// }
        ///
        /// private struct Transition
        /// {
        ///     public TransitionHeader Header;
        ///     public Link Source;
        ///     public Link Linker;
        ///     public Link Target;
        /// }
        ///
        /// </remarks>
        public struct Transition : IEquatable<Transition>
        {
            /// <summary>
            /// <para>
            /// The size.
            /// </para>
            /// <para></para>
            /// </summary>
            public static readonly long Size = Structure<Transition>.Size;

            /// <summary>
            /// <para>
            /// The transaction id.
            /// </para>
            /// <para></para>
            /// </summary>
            public readonly ulong TransactionId;
            /// <summary>
            /// <para>
            /// The before.
            /// </para>
            /// <para></para>
            /// </summary>
            public readonly Link<ulong> Before;
            /// <summary>
            /// <para>
            /// The after.
            /// </para>
            /// <para></para>
            /// </summary>
            public readonly Link<ulong> After;
            /// <summary>
            /// <para>
            /// The timestamp.
            /// </para>
            /// <para></para>
            /// </summary>
            public readonly Timestamp Timestamp;

            /// <summary>
            /// <para>
```

```
        /// Initializes a new <see cref="Transition"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="uniqueTimestampFactory">
        /// <para>A unique timestamp factory.</para>
        /// <para></para>
        /// </param>
        /// <param name="transactionId">
        /// <para>A transaction id.</para>
        /// <para></para>
        /// </param>
        /// <param name="before">
        /// <para>A before.</para>
        /// <para></para>
        /// </param>
        /// <param name="after">
        /// <para>A after.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public Transition(UniqueTimestampFactory uniqueTimestampFactory, ulong
        ↪  transactionId, Link<ulong> before, Link<ulong> after)
        {
            TransactionId = transactionId;
            Before = before;
            After = after;
            Timestamp = uniqueTimestampFactory.Create();
        }

        public Transition(UniqueTimestampFactory uniqueTimestampFactory, ulong
        ↪  transactionId, IList<ulong> before, IList<ulong> after) :
        ↪  this(uniqueTimestampFactory, transactionId, new Link<ulong>(before), new
        ↪  Link<ulong>(after)) { }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="Transition"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="uniqueTimestampFactory">
        /// <para>A unique timestamp factory.</para>
        /// <para></para>
        /// </param>
        /// <param name="transactionId">
        /// <para>A transaction id.</para>
        /// <para></para>
        /// </param>
        /// <param name="before">
        /// <para>A before.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public Transition(UniqueTimestampFactory uniqueTimestampFactory, ulong
        ↪  transactionId, Link<ulong> before) : this(uniqueTimestampFactory, transactionId,
        ↪  before, default) { }

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="Transition"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="uniqueTimestampFactory">
        /// <para>A unique timestamp factory.</para>
        /// <para></para>
        /// </param>
        /// <param name="transactionId">
        /// <para>A transaction id.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public Transition(UniqueTimestampFactory uniqueTimestampFactory, ulong
        ↪  transactionId) : this(uniqueTimestampFactory, transactionId, default, default) {
        ↪  }

        /// <summary>
```

```
        /// <para>
        /// Returns the string.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The string</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override string ToString() => $"{Timestamp} {TransactionId}: {Before} =>
        ↪  {After}";

        /// <summary>
        /// <para>
        /// Determines whether this instance equals.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="obj">
        /// <para>The obj.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override bool Equals(object obj) => obj is Transition transition ?
        ↪  Equals(transition) : false;

        /// <summary>
        /// <para>
        /// Gets the hash code.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The int</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override int GetHashCode() => (TransactionId, Before, After,
        ↪  Timestamp).GetHashCode();

        /// <summary>
        /// <para>
        /// Determines whether this instance equals.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="other">
        /// <para>The other.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The bool</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public bool Equals(Transition other) => TransactionId == other.TransactionId &&
        ↪  Before == other.Before && After == other.After && Timestamp == other.Timestamp;

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool operator ==(Transition left, Transition right) =>
        ↪  left.Equals(right);

        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public static bool operator !=(Transition left, Transition right) => !(left ==
        ↪  right);
    }

    /// <remarks>
    /// Другие варианты реализации транзакций (атомарности):
    ///     1. Разделение хранения значения связи ((Source Target) или (Source Linker
    ↪  Target)) и индексов.
    ///     2. Хранение трансформаций/операций в отдельном хранилище Links, но дополнительно
    ↪  потребуется решить вопрос
```

```
274         ///        со ссылками на внешние идентификаторы, или как-то иначе решить вопрос с
            ↪  пересечениями идентификаторов.
275         ///
276         /// Где хранить промежуточный список транзакций?
277         ///
278         /// В оперативной памяти:
279         ///  Минусы:
280         ///     1. Может усложнить систему, если она будет функционировать самостоятельно,
281         ///     так как нужно отдельно выделять память под список трансформаций.
282         ///     2. Выделенной оперативной памяти может не хватить, в том случае,
283         ///     если транзакция использует слишком много трансформаций.
284         ///         -> Можно использовать жёсткий диск для слишком длинных транзакций.
285         ///         -> Максимальный размер списка трансформаций можно ограничить / задать
            ↪  константой.
286         ///     3. При подтверждении транзакции (Commit) все трансформации записываются разом
            ↪  создавая задержку.
287         ///
288         /// На жёстком диске:
289         ///  Минусы:
290         ///     1. Длительный отклик, на запись каждой трансформации.
291         ///     2. Лог транзакций дополнительно наполняется отменёнными транзакциями.
292         ///         -> Это может решаться упаковкой/исключением дублирующих операций.
293         ///         -> Также это может решаться тем, что короткие транзакции вообще
294         ///            не будут записываться в случае отката.
295         ///     3. Перед тем как выполнять отмену операций транзакции нужно дождаться пока все
            ↪  операции (трансформации)
296         ///        будут записаны в лог.
297         ///
298         /// </remarks>
299         public class Transaction : DisposableBase
300         {
301             private readonly Queue<Transition> _transitions;
302             private readonly UInt64LinksTransactionsLayer _layer;
303             /// <summary>
304             /// <para>
305             /// Gets or sets the is committed value.
306             /// </para>
307             /// <para></para>
308             /// </summary>
309             public bool IsCommitted { get; private set; }
310             /// <summary>
311             /// <para>
312             /// Gets or sets the is reverted value.
313             /// </para>
314             /// <para></para>
315             /// </summary>
316             public bool IsReverted { get; private set; }
317
318             /// <summary>
319             /// <para>
320             /// Initializes a new <see cref="Transaction"/> instance.
321             /// </para>
322             /// <para></para>
323             /// </summary>
324             /// <param name="layer">
325             /// <para>A layer.</para>
326             /// <para></para>
327             /// </param>
328             /// <exception cref="NotSupportedException">
329             /// <para>Nested transactions not supported.</para>
330             /// <para></para>
331             /// </exception>
332             [MethodImpl(MethodImplOptions.AggressiveInlining)]
333             public Transaction(UInt64LinksTransactionsLayer layer)
334             {
335                 _layer = layer;
336                 if (_layer._currentTransactionId != 0)
337                 {
338                     throw new NotSupportedException("Nested transactions not supported.");
339                 }
340                 IsCommitted = false;
341                 IsReverted = false;
342                 _transitions = new Queue<Transition>();
343                 SetCurrentTransaction(layer, this);
344             }
345
346             /// <summary>
347             /// <para>
```

```
            /// Commits this instance.
            /// </para>
            /// <para></para>
            /// </summary>
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            public void Commit()
            {
                EnsureTransactionAllowsWriteOperations(this);
                while (_transitions.Count > 0)
                {
                    var transition = _transitions.Dequeue();
                    _layer._transitions.Enqueue(transition);
                }
                _layer._lastCommitedTransactionId = _layer._currentTransactionId;
                IsCommitted = true;
            }
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            private void Revert()
            {
                EnsureTransactionAllowsWriteOperations(this);
                var transitionsToRevert = new Transition[_transitions.Count];
                _transitions.CopyTo(transitionsToRevert, 0);
                for (var i = transitionsToRevert.Length - 1; i >= 0; i--)
                {
                    _layer.RevertTransition(transitionsToRevert[i]);
                }
                IsReverted = true;
            }

            /// <summary>
            /// <para>
            /// Sets the current transaction using the specified layer.
            /// </para>
            /// <para></para>
            /// </summary>
            /// <param name="layer">
            /// <para>The layer.</para>
            /// <para></para>
            /// </param>
            /// <param name="transaction">
            /// <para>The transaction.</para>
            /// <para></para>
            /// </param>
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            public static void SetCurrentTransaction(UInt64LinksTransactionsLayer layer,
            ↪  Transaction transaction)
            {
                layer._currentTransactionId = layer._lastCommitedTransactionId + 1;
                layer._currentTransactionTransitions = transaction._transitions;
                layer._currentTransaction = transaction;
            }

            /// <summary>
            /// <para>
            /// Ensures the transaction allows write operations using the specified transaction.
            /// </para>
            /// <para></para>
            /// </summary>
            /// <param name="transaction">
            /// <para>The transaction.</para>
            /// <para></para>
            /// </param>
            /// <exception cref="InvalidOperationException">
            /// <para>Transation is commited.</para>
            /// <para></para>
            /// </exception>
            /// <exception cref="InvalidOperationException">
            /// <para>Transation is reverted.</para>
            /// <para></para>
            /// </exception>
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            public static void EnsureTransactionAllowsWriteOperations(Transaction transaction)
            {
                if (transaction.IsReverted)
                {
                    throw new InvalidOperationException("Transation is reverted.");
                }
                if (transaction.IsCommitted)
```

```
                {
                    throw new InvalidOperationException("Transation is commited.");
                }
            }

            /// <summary>
            /// <para>
            /// Disposes the manual.
            /// </para>
            /// <para></para>
            /// </summary>
            /// <param name="manual">
            /// <para>The manual.</para>
            /// <para></para>
            /// </param>
            /// <param name="wasDisposed">
            /// <para>The was disposed.</para>
            /// <para></para>
            /// </param>
            [MethodImpl(MethodImplOptions.AggressiveInlining)]
            protected override void Dispose(bool manual, bool wasDisposed)
            {
                if (!wasDisposed && _layer != null && !_layer.Disposable.IsDisposed)
                {
                    if (!IsCommitted && !IsReverted)
                    {
                        Revert();
                    }
                    _layer.ResetCurrentTransation();
                }
            }
        }

        /// <summary>
        /// <para>
        /// The from seconds.
        /// </para>
        /// <para></para>
        /// </summary>
        public static readonly TimeSpan DefaultPushDelay = TimeSpan.FromSeconds(0.1);
        private readonly string _logAddress;
        private readonly FileStream _log;
        private readonly Queue<Transition> _transitions;
        private readonly UniqueTimestampFactory _uniqueTimestampFactory;
        private Task _transitionsPusher;
        private Transition _lastCommitedTransition;
        private ulong _currentTransactionId;
        private Queue<Transition> _currentTransactionTransitions;
        private Transaction _currentTransaction;
        private ulong _lastCommitedTransactionId;

        /// <summary>
        /// <para>
        /// Initializes a new <see cref="UInt64LinksTransactionsLayer"/> instance.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="links">
        /// <para>A links.</para>
        /// <para></para>
        /// </param>
        /// <param name="logAddress">
        /// <para>A log address.</para>
        /// <para></para>
        /// </param>
        /// <exception cref="ArgumentNullException">
        /// <para></para>
        /// <para></para>
        /// </exception>
        /// <exception cref="NotSupportedException">
        /// <para>Database is damaged, autorecovery is not supported yet.</para>
        /// <para></para>
        /// </exception>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public UInt64LinksTransactionsLayer(ILinks<ulong> links, string logAddress)
            : base(links)
        {
            if (string.IsNullOrWhiteSpace(logAddress))
            {
```

```
                throw new ArgumentNullException(nameof(logAddress));
            }
            // В первой строке файла хранится последняя закоммиченную транзакцию.
            // При запуске это используется для проверки удачного закрытия файла лога.
            // In the first line of the file the last committed transaction is stored.
            // On startup, this is used to check that the log file is successfully closed.
            var lastCommitedTransition = FileHelpers.ReadFirstOrDefault<Transition>(logAddress);
            var lastWrittenTransition = FileHelpers.ReadLastOrDefault<Transition>(logAddress);
            if (!lastCommitedTransition.Equals(lastWrittenTransition))
            {
                Dispose();
                throw new NotSupportedException("Database is damaged, autorecovery is not
                ↪  supported yet.");
            }
            if (lastCommitedTransition == default)
            {
                FileHelpers.WriteFirst(logAddress, lastCommitedTransition);
            }
            _lastCommitedTransition = lastCommitedTransition;
            // TODO: Think about a better way to calculate or store this value
            var allTransitions = FileHelpers.ReadAll<Transition>(logAddress);
            _lastCommitedTransactionId = allTransitions.Length > 0 ? allTransitions.Max(x =>
            ↪  x.TransactionId) : 0;
            _uniqueTimestampFactory = new UniqueTimestampFactory();
            _logAddress = logAddress;
            _log = FileHelpers.Append(logAddress);
            _transitions = new Queue<Transition>();
            _transitionsPusher = new Task(TransitionsPusher);
            _transitionsPusher.Start();
        }

        /// <summary>
        /// <para>
        /// Gets the link value using the specified link.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="link">
        /// <para>The link.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>A list of ulong</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public IList<ulong> GetLinkValue(ulong link) => _links.GetLink(link);

        /// <summary>
        /// <para>
        /// Creates the substitution.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The created link index.</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override ulong Create(IList<ulong> substitution, WriteHandler<ulong> handler)
        {
            return _links.Create(new Link<ulong>(), (before, after) =>
            {
                CommitTransition(new Transition(_uniqueTimestampFactory, _currentTransactionId,
                ↪  new Link<ulong>(before), new Link<ulong>(after)));
                return handler(before, after);
            });
        }

        /// <summary>
        /// <para>
        /// Updates the substitution.
        /// </para>
        /// <para></para>
```

```
        /// </summary>
        /// <param name="restriction">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <param name="substitution">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        /// <returns>
        /// <para>The link index.</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override ulong Update(IList<ulong> restriction, IList<ulong> substitution,
        ↪  WriteHandler<ulong> handler)
        {
            return _links.Update(restriction, substitution, (before, after) =>
                {
                    CommitTransition(new Transition(_uniqueTimestampFactory,
                    ↪  _currentTransactionId, new Link<ulong>(before), new Link<ulong>(after)));
                    return handler(before, after);
                }
            );
        }

        /// <summary>
        /// <para>
        /// Deletes the substitution.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="restriction">
        /// <para>The substitution.</para>
        /// <para></para>
        /// </param>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public override ulong Delete(IList<ulong> restriction, WriteHandler<ulong> handler)
        {
            var link = restriction[_constants.IndexPart];
            return _links.Delete(restriction, (before, after) =>
            {
                CommitTransition(new Transition(_uniqueTimestampFactory, _currentTransactionId,
                ↪  before, after));
                return handler(before, after);
            });
        }
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private Queue<Transition> GetCurrentTransitions() => _currentTransactionTransitions ??
        ↪  _transitions;
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private void CommitTransition(Transition transition)
        {
            if (_currentTransaction != null)
            {
                Transaction.EnsureTransactionAllowsWriteOperations(_currentTransaction);
            }
            var transitions = GetCurrentTransitions();
            transitions.Enqueue(transition);
        }
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private void RevertTransition(Transition transition)
        {
            if (transition.After.IsNull()) // Revert Deletion with Creation
            {
                _links.Create();
            }
            else if (transition.Before.IsNull()) // Revert Creation with Deletion
            {
                _links.Delete(transition.After.Index);
            }
            else // Revert Update
            {
                _links.Update(new[] { transition.After.Index, transition.Before.Source,
                ↪  transition.Before.Target });
            }
        }
```

```
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private void ResetCurrentTransation()
        {
            _currentTransactionId = 0;
            _currentTransactionTransitions = null;
            _currentTransaction = null;
        }
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private void PushTransitions()
        {
            if (_log == null || _transitions == null)
            {
                return;
            }
            for (var i = 0; i < _transitions.Count; i++)
            {
                var transition = _transitions.Dequeue();

                _log.Write(transition);
                _lastCommitedTransition = transition;
            }
        }
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private void TransitionsPusher()
        {
            while (!Disposable.IsDisposed && _transitionsPusher != null)
            {
                Thread.Sleep(DefaultPushDelay);
                PushTransitions();
            }
        }

        /// <summary>
        /// <para>
        /// Begins the transaction.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <returns>
        /// <para>The transaction</para>
        /// <para></para>
        /// </returns>
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        public Transaction BeginTransaction() => new Transaction(this);
        [MethodImpl(MethodImplOptions.AggressiveInlining)]
        private void DisposeTransitions()
        {
            try
            {
                var pusher = _transitionsPusher;
                if (pusher != null)
                {
                    _transitionsPusher = null;
                    pusher.Wait();
                }
                if (_transitions != null)
                {
                    PushTransitions();
                }
                _log.DisposeIfPossible();
                FileHelpers.WriteFirst(_logAddress, _lastCommitedTransition);
            }
            catch (Exception ex)
            {
                ex.Ignore();
            }
        }

        #region DisposalBase

        /// <summary>
        /// <para>
        /// Disposes the manual.
        /// </para>
        /// <para></para>
        /// </summary>
        /// <param name="manual">
        /// <para>The manual.</para>
        /// <para></para>
```

```
730         /// </param>
731         /// <param name="wasDisposed">
732         /// <para>The was disposed.</para>
733         /// <para></para>
734         /// </param>
735         [MethodImpl(MethodImplOptions.AggressiveInlining)]
736         protected override void Dispose(bool manual, bool wasDisposed)
737         {
738             if (!wasDisposed)
739             {
740                 DisposeTransitions();
741             }
742             base.Dispose(manual, wasDisposed);
743         }
744 
745         #endregion
746     }
747 }
```

1.119 ./csharp/Platform.Data.Doublets.Tests/GenericLinksTests.cs

```
1  using System;
2  using System.IO;
3  using Platform.Data.Doublets.Decorators;
4  using Xunit;
5  
6  using Platform.Memory;
7  
8  using Platform.Data.Doublets.Memory.United.Generic;
9  
10 namespace Platform.Data.Doublets.Tests
11 {
12     public static class GenericLinksTests
13     {
14         [Fact]
15         public static void CRUDTest()
16         {
17             Using<byte>(links => links.TestCRUDOperations());
18             Using<ushort>(links => links.TestCRUDOperations());
19             Using<uint>(links => links.TestCRUDOperations());
20             Using<ulong>(links => links.TestCRUDOperations());
21         }
22 
23         [Fact]
24         public static void RawNumbersCRUDTest()
25         {
26             Using<byte>(links => links.TestRawNumbersCRUDOperations());
27             Using<ushort>(links => links.TestRawNumbersCRUDOperations());
28             Using<uint>(links => links.TestRawNumbersCRUDOperations());
29             Using<ulong>(links => links.TestRawNumbersCRUDOperations());
30         }
31 
32         [Fact]
33         public static void MultipleRandomCreationsAndDeletionsTest()
34         {
35             Using<byte>(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().Test
               ↪ MultipleRandomCreationsAndDeletions(16)); // Cannot use more because current
               ↪ implementation of tree cuts out 5 bits from the address space.
36             Using<ushort>(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().Te
               ↪ stMultipleRandomCreationsAndDeletions(100));
37             Using<uint>(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().Test
               ↪ MultipleRandomCreationsAndDeletions(100));
38             Using<ulong>(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().Tes
               ↪ tMultipleRandomCreationsAndDeletions(100));
39         }
40         private static void Using<TLink>(Action<ILinks<TLink>> action)
41         {
42             var unitedMemoryLinks = new UnitedMemoryLinks<TLink>(new
               ↪ HeapResizableDirectMemory());
43             using (var logFile = File.Open("linksLogger.txt", FileMode.Create, FileAccess.Write))
44             {
45                 LoggingDecorator<TLink> links = new(unitedMemoryLinks, logFile);
46                 action(links);
47             }
48 
49             File.Delete("db.links");
50             using var ffiLinks = new FFI.UnitedMemoryLinks<TLink>("db.links");
51             action(ffiLinks);
52         }
```

```
    }
}
```

1.120 ./csharp/Platform.Data.Doublets.Tests/ILinksBasicTests.cs

```
using System.IO;
using Platform.Data.Doublets.Memory.United.Generic;
using Platform.Memory;
using Xunit;


namespace Platform.Data.Doublets.Tests
{
    public static class ILinksBasicTests
    {
        [Fact]
        public static void DeleteAllUsages()
        {
            var mem = new HeapResizableDirectMemory();
            var links = new UnitedMemoryLinks<uint>(mem);

            var root = links.CreatePoint();

            var a = links.CreatePoint();
            var b = links.CreatePoint();

            links.CreateAndUpdate(a, root);
            links.CreateAndUpdate(b, root);

            Assert.Equal(5U, links.Count());

            links.DeleteAllUsages(root);

            Assert.Equal(3U, links.Count());
        }

        [Fact]
        public static void FfiDeleteAllUsages()
        {
            File.Delete("db.links");
            var links = new FFI.UnitedMemoryLinks<uint>("db.links");

            var root = links.CreatePoint();

            var a = links.CreatePoint();
            var b = links.CreatePoint();

            links.CreateAndUpdate(a, root);
            links.CreateAndUpdate(b, root);

            Assert.Equal(5U, links.Count());

            links.DeleteAllUsages(root);

            Assert.Equal(3U, links.Count());
        }
    }
}
```

1.121 ./csharp/Platform.Data.Doublets.Tests/LinksConstantsTests.cs

```
using Xunit;

namespace Platform.Data.Doublets.Tests
{
    public static class LinksConstantsTests
    {
        [Fact]
        public static void ExternalReferencesTest()
        {
            LinksConstants<ulong> constants = new LinksConstants<ulong>((1, long.MaxValue),
            ↪  (long.MaxValue + 1UL, ulong.MaxValue));

            //var minimum = new Hybrid<ulong>(0, isExternal: true);
            var minimum = new Hybrid<ulong>(1, isExternal: true);
            var maximum = new Hybrid<ulong>(long.MaxValue, isExternal: true);

            Assert.True(constants.IsExternalReference(minimum));
            Assert.True(constants.IsExternalReference(maximum));
        }
    }
}
```

1.122 ./csharp/Platform.Data.Doublets.Tests/ResizableDirectMemoryLinksTests.cs

```
using System.IO;
using Xunit;
using Platform.Singletons;
using Platform.Memory;
using Platform.Data.Doublets.Memory.United.Specific;

namespace Platform.Data.Doublets.Tests
{
    public static class ResizableDirectMemoryLinksTests
    {
        private static readonly LinksConstants<ulong> _constants =
        ↪ Default<LinksConstants<ulong>>.Instance;

        [Fact]
        public static void BasicFileMappedMemoryTest()
        {
            var tempFilename = Path.GetTempFileName();
            using (var memoryAdapter = new UInt64UnitedMemoryLinks(tempFilename))
            {
                memoryAdapter.TestBasicMemoryOperations();
            }
            File.Delete(tempFilename);
        }

        [Fact]
        public static void BasicHeapMemoryTest()
        {
            using (var memory = new
            ↪ HeapResizableDirectMemory(UInt64UnitedMemoryLinks.DefaultLinksSizeStep))
            using (var memoryAdapter = new UInt64UnitedMemoryLinks(memory,
            ↪ UInt64UnitedMemoryLinks.DefaultLinksSizeStep))
            {
                memoryAdapter.TestBasicMemoryOperations();
            }
        }
        private static void TestBasicMemoryOperations(this ILinks<ulong> memoryAdapter)
        {
            var link = memoryAdapter.Create();
            memoryAdapter.Delete(link);
        }

        [Fact]
        public static void NonexistentReferencesHeapMemoryTest()
        {
            using (var memory = new
            ↪ HeapResizableDirectMemory(UInt64UnitedMemoryLinks.DefaultLinksSizeStep))
            using (var memoryAdapter = new UInt64UnitedMemoryLinks(memory,
            ↪ UInt64UnitedMemoryLinks.DefaultLinksSizeStep))
            {
                memoryAdapter.TestNonexistentReferences();
            }
        }
        private static void TestNonexistentReferences(this ILinks<ulong> memoryAdapter)
        {
            var link = memoryAdapter.Create();
            memoryAdapter.Update(link, ulong.MaxValue, ulong.MaxValue);
            var resultLink = _constants.Null;
            memoryAdapter.Each(foundLink =>
            {
                resultLink = foundLink[_constants.IndexPart];
                return _constants.Break;
            }, _constants.Any, ulong.MaxValue, ulong.MaxValue);
            Assert.True(resultLink == link);
            Assert.True(memoryAdapter.Count(ulong.MaxValue) == 0);
            memoryAdapter.Delete(link);
        }
    }
}
```

1.123 ./csharp/Platform.Data.Doublets.Tests/ScopeTests.cs

```
using Xunit;
using Platform.Scopes;
using Platform.Memory;
using Platform.Data.Doublets.Decorators;
using Platform.Reflection;
using Platform.Data.Doublets.Memory.United.Generic;
using Platform.Data.Doublets.Memory.United.Specific;

```

```
namespace Platform.Data.Doublets.Tests
{
    public static class ScopeTests
    {
        [Fact]
        public static void SingleDependencyTest()
        {
            using (var scope = new Scope())
            {
                scope.IncludeAssemblyOf<IMemory>();
                var instance = scope.Use<IDirectMemory>();
                Assert.IsType<HeapResizableDirectMemory>(instance);
            }
        }

        [Fact]
        public static void CascadeDependencyTest()
        {
            using (var scope = new Scope())
            {
                scope.Include<TemporaryFileMappedResizableDirectMemory>();
                scope.Include<UInt64UnitedMemoryLinks>();
                var instance = scope.Use<ILinks<ulong>>();
                Assert.IsType<UInt64UnitedMemoryLinks>(instance);
            }
        }

        [Fact(Skip = "Would be fixed later.")]
        public static void FullAutoResolutionTest()
        {
            using (var scope = new Scope(autoInclude: true, autoExplore: true))
            {
                var instance = scope.Use<UInt64Links>();
                Assert.IsType<UInt64Links>(instance);
            }
        }

        [Fact]
        public static void TypeParametersTest()
        {
            using (var scope = new Scope<Types<HeapResizableDirectMemory,
            ↪  UnitedMemoryLinks<ulong>>>())
            {
                var links = scope.Use<ILinks<ulong>>();
                Assert.IsType<UnitedMemoryLinks<ulong>>(links);
            }
        }
    }
}
```

1.124 ./csharp/Platform.Data.Doublets.Tests/SplitMemoryGenericLinksTests.cs

```
using System;
using Xunit;
using Platform.Memory;
using Platform.Data.Doublets.Memory.Split.Generic;
using Platform.Data.Doublets.Memory;

namespace Platform.Data.Doublets.Tests
{
    public unsafe static class SplitMemoryGenericLinksTests
    {
        [Fact]
        public static void CRUDTest()
        {
            Using<byte>(links => links.TestCRUDOperations());
            Using<ushort>(links => links.TestCRUDOperations());
            Using<uint>(links => links.TestCRUDOperations());
            Using<ulong>(links => links.TestCRUDOperations());
        }

        [Fact]
        public static void RawNumbersCRUDTest()
        {
            UsingWithExternalReferences<byte>(links => links.TestRawNumbersCRUDOperations());
            UsingWithExternalReferences<ushort>(links => links.TestRawNumbersCRUDOperations());
            UsingWithExternalReferences<uint>(links => links.TestRawNumbersCRUDOperations());
            UsingWithExternalReferences<ulong>(links => links.TestRawNumbersCRUDOperations());
        }

```

```
29          [Fact]
30          public static void MultipleRandomCreationsAndDeletionsTest()
31          {
32              Using<byte>(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().Test
                ↪  MultipleRandomCreationsAndDeletions(16)); // Cannot use more because current
                ↪  implementation of tree cuts out 5 bits from the address space.
33              Using<ushort>(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().Te
                ↪  stMultipleRandomCreationsAndDeletions(100));
34              Using<uint>(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().Test
                ↪  MultipleRandomCreationsAndDeletions(100));
35              Using<ulong>(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().Tes
                ↪  tMultipleRandomCreationsAndDeletions(100));
36          }
37          private static void Using<TLink>(Action<ILinks<TLink>> action)
38          {
39              using (var dataMemory = new HeapResizableDirectMemory())
40              using (var indexMemory = new HeapResizableDirectMemory())
41              using (var memory = new SplitMemoryLinks<TLink>(dataMemory, indexMemory))
42              {
43                  action(memory);
44              }
45          }
46          private static void UsingWithExternalReferences<TLink>(Action<ILinks<TLink>> action)
47          {
48              var contants = new LinksConstants<TLink>(enableExternalReferencesSupport: true);
49              using (var dataMemory = new HeapResizableDirectMemory())
50              using (var indexMemory = new HeapResizableDirectMemory())
51              using (var memory = new SplitMemoryLinks<TLink>(dataMemory, indexMemory,
                ↪  SplitMemoryLinks<TLink>.DefaultLinksSizeStep, contants))
52              {
53                  action(memory);
54              }
55          }
56      }
57  }
```

1.125 ./csharp/Platform.Data.Doublets.Tests/SplitMemoryUInt32LinksTests.cs

```
1   using System;
2   using Xunit;
3   using Platform.Memory;
4   using Platform.Data.Doublets.Memory.Split.Specific;
5   using TLink = System.UInt32;
6
7   namespace Platform.Data.Doublets.Tests
8   {
9       public unsafe static class SplitMemoryUInt32LinksTests
10      {
11          [Fact]
12          public static void CRUDTest()
13          {
14              Using(links => links.TestCRUDOperations());
15          }
16
17          [Fact]
18          public static void RawNumbersCRUDTest()
19          {
20              UsingWithExternalReferences(links => links.TestRawNumbersCRUDOperations());
21          }
22
23          [Fact]
24          public static void MultipleRandomCreationsAndDeletionsTest()
25          {
26              Using(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().TestMultip
                ↪  leRandomCreationsAndDeletions(500));
27          }
28          private static void Using(Action<ILinks<TLink>> action)
29          {
30              using (var dataMemory = new HeapResizableDirectMemory())
31              using (var indexMemory = new HeapResizableDirectMemory())
32              using (var memory = new UInt32SplitMemoryLinks(dataMemory, indexMemory))
33              {
34                  action(memory);
35              }
36          }
37          private static void UsingWithExternalReferences(Action<ILinks<TLink>> action)
38          {
39              var contants = new LinksConstants<TLink>(enableExternalReferencesSupport: true);
40              using (var dataMemory = new HeapResizableDirectMemory())
```

```
41              using (var indexMemory = new HeapResizableDirectMemory())
42              using (var memory = new UInt32SplitMemoryLinks(dataMemory, indexMemory,
                ↪  UInt32SplitMemoryLinks.DefaultLinksSizeStep, contants))
43              {
44                  action(memory);
45              }
46          }
47      }
48  }
```

1.126 ./csharp/Platform.Data.Doublets.Tests/SplitMemoryUInt64LinksTests.cs

```
1   using System;
2   using Xunit;
3   using Platform.Memory;
4   using Platform.Data.Doublets.Memory.Split.Specific;
5   using TLink = System.UInt64;
6
7   namespace Platform.Data.Doublets.Tests
8   {
9       public unsafe static class SplitMemoryUInt64LinksTests
10      {
11          [Fact]
12          public static void CRUDTest()
13          {
14              Using(links => links.TestCRUDOperations());
15          }
16
17          [Fact]
18          public static void RawNumbersCRUDTest()
19          {
20              UsingWithExternalReferences(links => links.TestRawNumbersCRUDOperations());
21          }
22
23          [Fact]
24          public static void MultipleRandomCreationsAndDeletionsTest()
25          {
26              Using(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().TestMultip
                ↪  leRandomCreationsAndDeletions(500));
27          }
28          private static void Using(Action<ILinks<TLink>> action)
29          {
30              using (var dataMemory = new HeapResizableDirectMemory())
31              using (var indexMemory = new HeapResizableDirectMemory())
32              using (var memory = new UInt64SplitMemoryLinks(dataMemory, indexMemory))
33              {
34                  action(memory);
35              }
36          }
37          private static void UsingWithExternalReferences(Action<ILinks<TLink>> action)
38          {
39              var contants = new LinksConstants<TLink>(enableExternalReferencesSupport: true);
40              using (var dataMemory = new HeapResizableDirectMemory())
41              using (var indexMemory = new HeapResizableDirectMemory())
42              using (var memory = new UInt64SplitMemoryLinks(dataMemory, indexMemory,
                ↪  UInt64SplitMemoryLinks.DefaultLinksSizeStep, contants))
43              {
44                  action(memory);
45              }
46          }
47      }
48  }
```

1.127 ./csharp/Platform.Data.Doublets.Tests/TestExtensions.cs

```
1   using System.Collections.Generic;
2   using Xunit;
3   using Platform.Ranges;
4   using Platform.Numbers;
5   using Platform.Random;
6   using Platform.Setters;
7   using Platform.Converters;
8
9   namespace Platform.Data.Doublets.Tests
10  {
11      public static class TestExtensions
12      {
13          public static void TestCRUDOperations<T>(this ILinks<T> links)
14          {
15              var constants = links.Constants;
16
```

```
            var equalityComparer = EqualityComparer<T>.Default;

            var zero = default(T);
            var one = Arithmetic.Increment(zero);

            // Create Link
            Assert.True(equalityComparer.Equals(links.Count(), zero));

            var setter = new Setter<T>(constants.Null);
            links.Each(constants.Any, constants.Any, setter.SetAndReturnTrue);

            Assert.True(equalityComparer.Equals(setter.Result, constants.Null));

            var linkAddress = links.Create();

            var link = new Link<T>(links.GetLink(linkAddress));

            Assert.True(link.Count == 3);
            Assert.True(equalityComparer.Equals(link.Index, linkAddress));
            Assert.True(equalityComparer.Equals(link.Source, constants.Null));
            Assert.True(equalityComparer.Equals(link.Target, constants.Null));

            Assert.True(equalityComparer.Equals(links.Count(), one));

            // Get first link
            setter = new Setter<T>(constants.Null);
            links.Each(constants.Any, constants.Any, setter.SetAndReturnFalse);

            Assert.True(equalityComparer.Equals(setter.Result, linkAddress));

            // Update link to reference itself
            links.Update(linkAddress, linkAddress, linkAddress);

            link = new Link<T>(links.GetLink(linkAddress));

            Assert.True(equalityComparer.Equals(link.Source, linkAddress));
            Assert.True(equalityComparer.Equals(link.Target, linkAddress));

            // Update link to reference null (prepare for delete)
            var updated = links.Update(linkAddress, constants.Null, constants.Null);

            Assert.True(equalityComparer.Equals(updated, linkAddress));

            link = new Link<T>(links.GetLink(linkAddress));

            Assert.True(equalityComparer.Equals(link.Source, constants.Null));
            Assert.True(equalityComparer.Equals(link.Target, constants.Null));

            // Delete link
            links.Delete(linkAddress);

            Assert.True(equalityComparer.Equals(links.Count(), zero));

            setter = new Setter<T>(constants.Null);
            links.Each(constants.Any, constants.Any, setter.SetAndReturnTrue);

            Assert.True(equalityComparer.Equals(setter.Result, constants.Null));
        }

        public static void TestRawNumbersCRUDOperations<T>(this ILinks<T> links)
        {
            // Constants
            var constants = links.Constants;
            var equalityComparer = EqualityComparer<T>.Default;

            var zero = default(T);
            var one = Arithmetic.Increment(zero);
            var two = Arithmetic.Increment(one);

            var h106E = new Hybrid<T>(106L, isExternal: true);
            var h107E = new Hybrid<T>(-char.ConvertFromUtf32(107)[0]);
            var h108E = new Hybrid<T>(-108L);

            Assert.Equal(106L, h106E.AbsoluteValue);
            Assert.Equal(107L, h107E.AbsoluteValue);
            Assert.Equal(108L, h108E.AbsoluteValue);

            // Create Link (External -> External)
            var linkAddress1 = links.Create();

```

```
            links.Update(linkAddress1, h106E, h108E);

            var link1 = new Link<T>(links.GetLink(linkAddress1));

            Assert.True(equalityComparer.Equals(link1.Source, h106E));
            Assert.True(equalityComparer.Equals(link1.Target, h108E));

            // Create Link (Internal -> External)
            var linkAddress2 = links.Create();

            links.Update(linkAddress2, linkAddress1, h108E);

            var link2 = new Link<T>(links.GetLink(linkAddress2));

            Assert.True(equalityComparer.Equals(link2.Source, linkAddress1));
            Assert.True(equalityComparer.Equals(link2.Target, h108E));

            // Create Link (Internal -> Internal)
            var linkAddress3 = links.Create();

            links.Update(linkAddress3, linkAddress1, linkAddress2);

            var link3 = new Link<T>(links.GetLink(linkAddress3));

            Assert.True(equalityComparer.Equals(link3.Source, linkAddress1));
            Assert.True(equalityComparer.Equals(link3.Target, linkAddress2));

            // Search for created link
            var setter1 = new Setter<T>(constants.Null);
            links.Each(h106E, h108E, setter1.SetAndReturnFalse);

            Assert.True(equalityComparer.Equals(setter1.Result, linkAddress1));

            // Search for nonexistent link
            var setter2 = new Setter<T>(constants.Null);
            links.Each(h106E, h107E, setter2.SetAndReturnFalse);

            Assert.True(equalityComparer.Equals(setter2.Result, constants.Null));

            // Update link to reference null (prepare for delete)
            var updated = links.Update(linkAddress3, constants.Null, constants.Null);

            Assert.True(equalityComparer.Equals(updated, linkAddress3));

            link3 = new Link<T>(links.GetLink(linkAddress3));

            Assert.True(equalityComparer.Equals(link3.Source, constants.Null));
            Assert.True(equalityComparer.Equals(link3.Target, constants.Null));

            // Delete link
            links.Delete(linkAddress3);

            Assert.True(equalityComparer.Equals(links.Count(), two));

            var setter3 = new Setter<T>(constants.Null);
            links.Each(constants.Any, constants.Any, setter3.SetAndReturnTrue);

            Assert.True(equalityComparer.Equals(setter3.Result, linkAddress2));
        }

        public static void TestMultipleCreationsAndDeletions<TLink>(this ILinks<TLink> links,
        ↪  int numberOfOperations)
        {
            for (int i = 0; i < numberOfOperations; i++)
            {
                links.Create();
            }
            for (int i = 0; i < numberOfOperations; i++)
            {
                links.Delete(links.Count());
            }
        }

        public static void TestMultipleRandomCreationsAndDeletions<TLink>(this ILinks<TLink>
        ↪  links, int maximumOperationsPerCycle)
        {
            var comparer = Comparer<TLink>.Default;
            var addressToUInt64Converter = CheckedConverter<TLink, ulong>.Default;
            var uInt64ToAddressConverter = CheckedConverter<ulong, TLink>.Default;
            for (var N = 1; N < maximumOperationsPerCycle; N++)
```

```
            {
                var random = new System.Random(N);
                var created = 0UL;
                var deleted = 0UL;
                for (var i = 0; i < N; i++)
                {
                    var linksCount = addressToUInt64Converter.Convert(links.Count());
                    var createPoint = random.NextBoolean();
                    if (linksCount >= 2 && createPoint)
                    {
                        var linksAddressRange = new Range<ulong>(1, linksCount);
                        TLink source = uInt64ToAddressConverter.Convert(random.NextUInt64(linksA
                        ↪  ddressRange));
                        TLink target = uInt64ToAddressConverter.Convert(random.NextUInt64(linksA
                        ↪  ddressRange));
                        ↪  //-V3086
                        var resultLink = links.GetOrCreate(source, target);
                        if (comparer.Compare(resultLink,
                        ↪  uInt64ToAddressConverter.Convert(linksCount)) > 0)
                        {
                            created++;
                        }
                    }
                    else
                    {
                        links.Create();
                        created++;
                    }
                }
                Assert.True(created == addressToUInt64Converter.Convert(links.Count()));
                for (var i = 0; i < N; i++)
                {
                    TLink link = uInt64ToAddressConverter.Convert((ulong)i + 1UL);
                    if (links.Exists(link))
                    {
                        links.Delete(link);
                        deleted++;
                    }
                }
                Assert.True(addressToUInt64Converter.Convert(links.Count()) == 0L);
            }
        }
    }
}
```

1.128 ./csharp/Platform.Data.Doublets.Tests/Uint64LinksExtensionsTests.cs

```
using Platform.Data.Doublets.Memory;
using Platform.Data.Doublets.Memory.United.Generic;
using Platform.Data.Numbers.Raw;
using Platform.Memory;
using Platform.Numbers;
using Xunit;
using Xunit.Abstractions;
using TLink = System.UInt64;

namespace Platform.Data.Doublets.Tests
{
    public class Uint64LinksExtensionsTests
    {
        public static ILinks<TLink> CreateLinks() => CreateLinks<TLink>(new
        ↪  Platform.IO.TemporaryFile());

        public static ILinks<TLink> CreateLinks<TLink>(string dataDBFilename)
        {
            var linksConstants = new LinksConstants<TLink>(enableExternalReferencesSupport:
            ↪  true);
            return new UnitedMemoryLinks<TLink>(new
            ↪  FileMappedResizableDirectMemory(dataDBFilename),
            ↪  UnitedMemoryLinks<TLink>.DefaultLinksSizeStep, linksConstants,
            ↪  IndexTreeType.Default);
        }
        [Fact]
        public void FormatStructureWithExternalReferenceTest()
        {
            ILinks<TLink> links = CreateLinks();
            TLink zero = default;
            var one = Arithmetic.Increment(zero);
            var markerIndex = one;
            var meaningRoot = links.GetOrCreate(markerIndex, markerIndex);
```

```
            var numberMarker = links.GetOrCreate(meaningRoot, Arithmetic.Increment(ref markerIndex));
            AddressToRawNumberConverter<TLink> addressToNumberConverter = new();
            var numberAddress = addressToNumberConverter.Convert(1);
            var numberLink = links.GetOrCreate(numberMarker, numberAddress);
            var linkNotation = links.FormatStructure(numberLink, link => link.IsFullPoint(), true);
            Assert.Equal("(3:(2:1 2) 18446744073709551615)", linkNotation);
        }
    }
}
```

1.129 ./csharp/Platform.Data.Doublets.Tests/UnitedMemoryUInt32LinksTests.cs

```
using System;
using Xunit;
using Platform.Reflection;
using Platform.Memory;
using Platform.Scopes;
using Platform.Data.Doublets.Memory.United.Specific;
using TLink = System.UInt32;

namespace Platform.Data.Doublets.Tests
{
    public unsafe static class UnitedMemoryUInt32LinksTests
    {
        [Fact]
        public static void CRUDTest()
        {
            Using(links => links.TestCRUDOperations());
        }

        [Fact]
        public static void RawNumbersCRUDTest()
        {
            Using(links => links.TestRawNumbersCRUDOperations());
        }

        [Fact]
        public static void MultipleRandomCreationsAndDeletionsTest()
        {
            Using(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().TestMultipleRandomCreationsAndDeletions(100));
        }
        private static void Using(Action<ILinks<TLink>> action)
        {
            using (var scope = new Scope<Types<HeapResizableDirectMemory, UInt32UnitedMemoryLinks>>())
            {
                action(scope.Use<ILinks<TLink>>());
            }
        }
    }
}
```

1.130 ./csharp/Platform.Data.Doublets.Tests/UnitedMemoryUInt64LinksTests.cs

```
using System;
using Xunit;
using Platform.Reflection;
using Platform.Memory;
using Platform.Scopes;
using Platform.Data.Doublets.Memory.United.Specific;
using TLink = System.UInt64;

namespace Platform.Data.Doublets.Tests
{
    public unsafe static class UnitedMemoryUInt64LinksTests
    {
        [Fact]
        public static void CRUDTest()
        {
            Using(links => links.TestCRUDOperations());
        }

        [Fact]
        public static void RawNumbersCRUDTest()
        {
            Using(links => links.TestRawNumbersCRUDOperations());
        }

```

```
25          [Fact]
26          public static void MultipleRandomCreationsAndDeletionsTest()
27          {
28              Using(links => links.DecorateWithAutomaticUniquenessAndUsagesResolution().TestMultip
                ↪ leRandomCreationsAndDeletions(100));
29          }
30          private static void Using(Action<ILinks<TLink>> action)
31          {
32              using (var scope = new Scope<Types<HeapResizableDirectMemory,
                ↪ UInt64UnitedMemoryLinks>>())
33              {
34                  action(scope.Use<ILinks<TLink>>());
35              }
36          }
37      }
38  }
```

Index